

# Food-borne Disease Outbreak Surveillance in Louisiana: A look at general trends and *Salmonella*, 1980-2006

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**Abstract: Introduction:** Food-borne illness is a major cause of personal distress, social disruption, preventable death, and avoidable economic burden in Louisiana and in the nation as a whole. *Salmonella* is responsible for the largest number of food-borne illnesses and deaths nationally and for a significant number of food-borne illnesses and the largest number of food-borne disease-related hospitalizations in Louisiana. **Methods:** This study employs a database from the Louisiana Office of Public Health to examine outbreaks of food-borne illness in Louisiana from 1980 through 2006 and compares the findings with national data. **Results:** The findings are similar in Louisiana as compared to the state, with the exception of some differences in the observed versus expected numbers of reported outbreaks. In some cases, there are too few reported outbreaks in Louisiana to determine trends; further study will be required to accomplish this.

## 1. Introduction and Literature Review

Food-borne illness is a major cause of personal distress, social disruption, preventable death, and avoidable economic burden. There are a number of society-based reasons for outbreaks of food-borne illness. There is a large variety of foods available to the population. Modern production and distribution of food have increased the potential for transmission of food-borne pathogens to large populations spread over large geographic areas. There have been changes over time in food industry practices. Dietary choices of the public have changed over time. Finally, distribution of foods has become much more global with advances in technology and transportation<sup>1</sup>.

Specific causes of outbreaks include: toxic substances produced by microorganisms, toxins naturally occurring in a food or beverage, artificial chemical compounds accidentally or intentionally added to food, and pathogenic microorganisms. Foods that are most likely to be contaminated include: foods that are stored at room temperature for several hours, foods that are cooked in large quantities and stored in a refrigerator in a large container (leads to improper cooling), meat that is inadequately cooked, and leftovers that are inadequately reheated<sup>1</sup>.

Investigation of food-borne disease outbreaks is important for a number of reasons. It is essential to rule out the contamination of a commercial product because prompt intervention may prevent thousands of further cases. Identification of an infected food handler or a specific gap in education or food handling techniques may prevent future outbreaks. Public health officials need to respond to a community problem to maintain a cooperative relationship with local health departments, private physicians, and communities. An epidemiologically- and biologically-based explanation of the outbreak may allay community fears or concerns that it was caused by something else (terrorism, toxic waste, etc.) The outbreak may provide opportunities for investigators to answer questions about the agent, host response, and epidemiologic and laboratory methods<sup>1</sup>.

*Salmonella* infection is associated most commonly with contaminated eggs, but also with poultry, fish, meat, unpasteurized milk or juice, cheese, and contaminated raw fruits and vegetables. Symptoms of *Salmonella* infection usually begin 12-74 hours (mean 18-36 hours) after inoculation and can include: abdominal cramps, diarrhea, vomiting, fever, chills, malaise, nausea, and/or headache. Recovery occurs in 4-7 days. Laboratory testing should include routine stool cultures. Treatment includes supportive care. Antibiotics are not indicated unless there is extra-intestinal spread, or the risk of extra-intestinal spread, of the infection. If indicated, antibiotics to be considered are ampicillin, gentamycin, TMP-SMX, or quinolones<sup>2</sup>.

In the United States from 1983 through 2002, there were a total of 14,218 outbreaks of food-borne illness, involving 383,479 cases and 325 deaths<sup>3,4,5,6</sup>. Figures 1 and 2 show the importance of *Salmonella* outbreaks and deaths due to *Salmonella* on a national basis. From 1983 through 2002, there were 1833 outbreaks of *Salmonella*, involving 101,963 cases and resulting in 110 deaths (see Figures 3, 4, and 5). Thus, *Salmonella* was responsible for 12.89% of food-borne outbreaks, 26.59% of cases, and 33.85% of deaths. The average number of *Salmonella* outbreaks per year was 111. The average number of cases per year was 5098.15, and the average number of deaths per year was 5.5. Reported outbreaks, cases, and deaths due to *Salmonella* have fluctuated slightly over the years, but there is no distinct trend.

However, some years are notable for unusually high or low numbers. Before 1985, reports of outbreaks of *Salmonella* enteritidis, the most common species, were collected through the National Foodborne Disease Outbreak Surveillance System. In 1985, due to a growing number of outbreaks and the need for timely follow-up, the Centers for Disease Control (CDC) began the *S. Enteritidis* Outbreak Reporting System. This encouraged reporting of outbreaks as soon as they occurred. The decrease in outbreaks after 1990 is most likely a result of the many intervention programs implemented in the 1990s, including the Egg Quality Assurance Program, while the subsequent increase is probably due to improved surveillance and reporting measures (for example, SODA, PulseNet, and eFORS)<sup>6,7</sup>

Figure 1.

Total Outbreaks per Etiologic Agent, 1983-2002

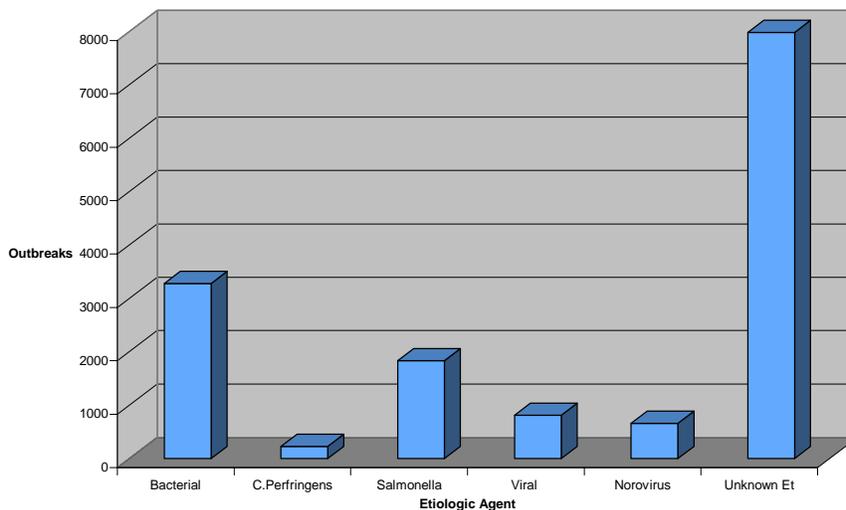


Figure 2.

Deaths per Etiologic Agent Over Time

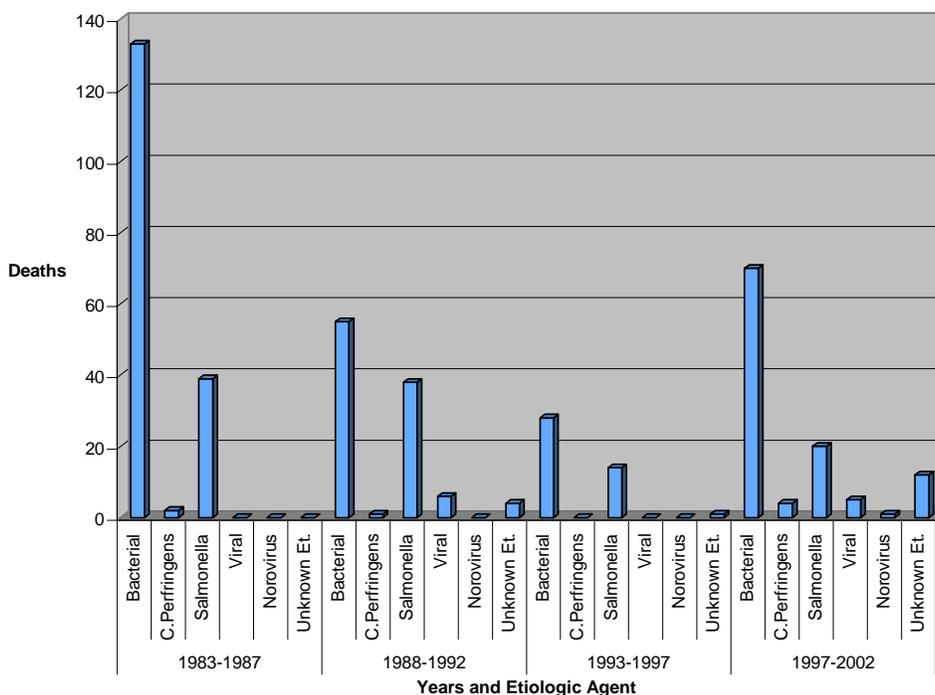


Figure 3.

Outbreaks of Salmonella Reported per Year in U.S., 1983-2002

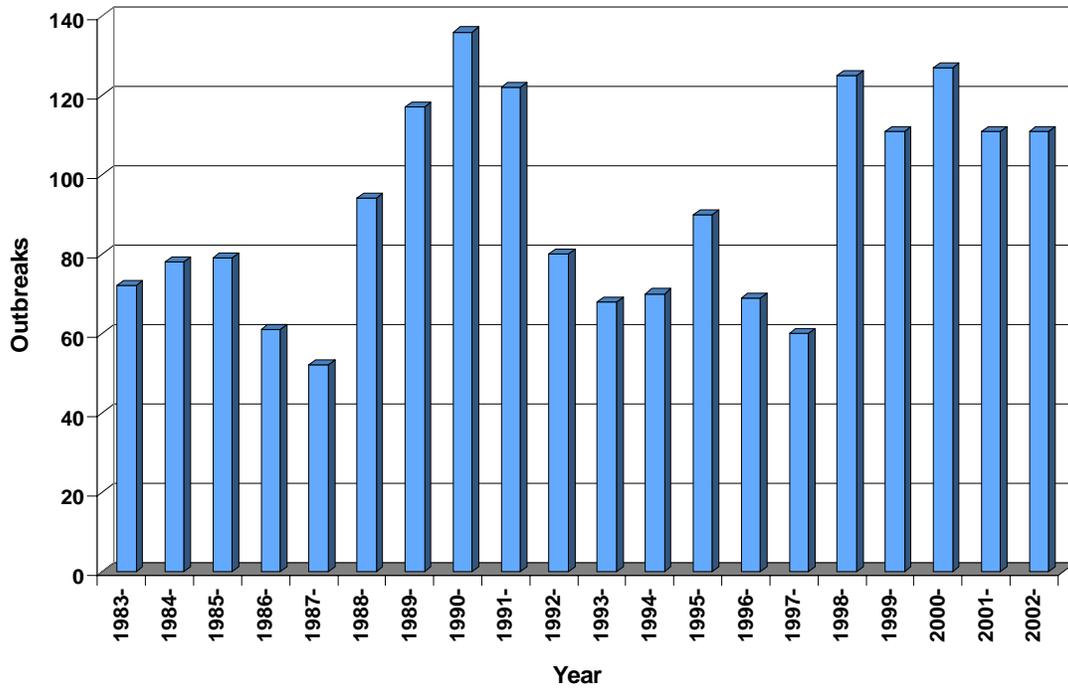


Figure 4.

Cases of Salmonella Reported per Year in U.S., 1983-2002

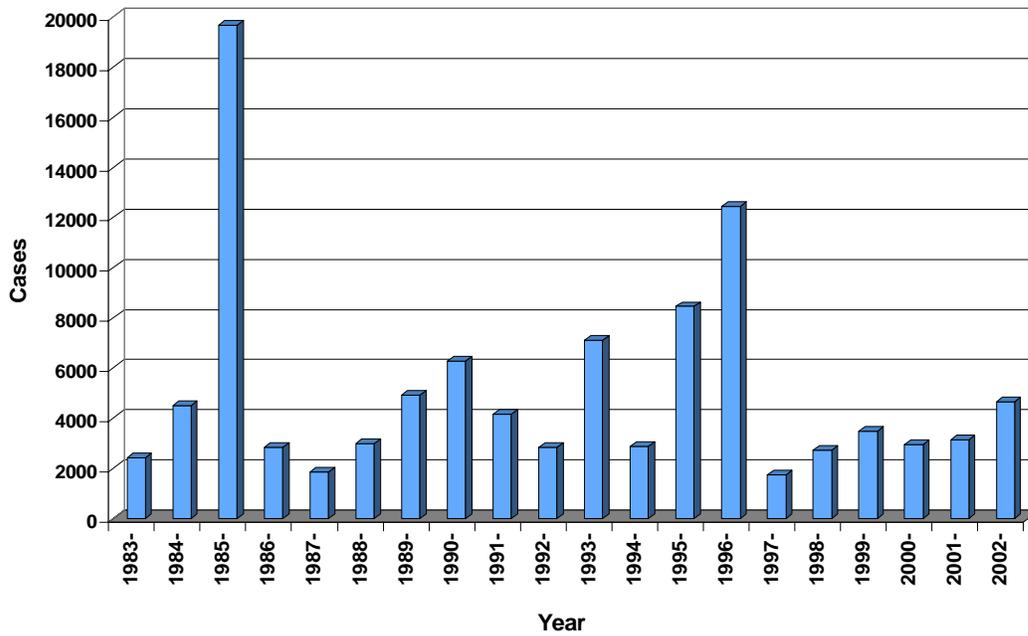
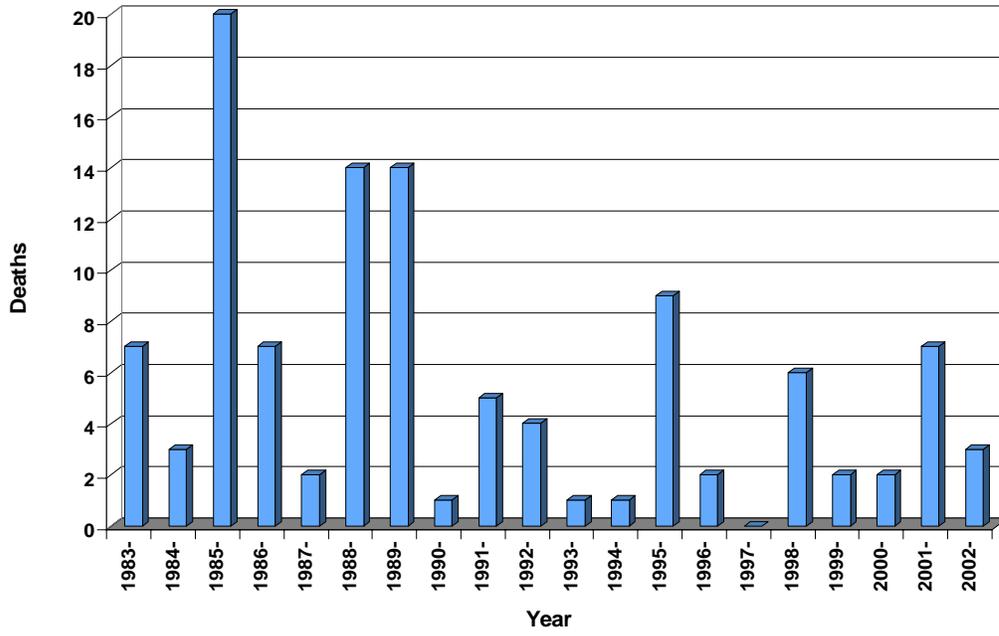


Figure 5.

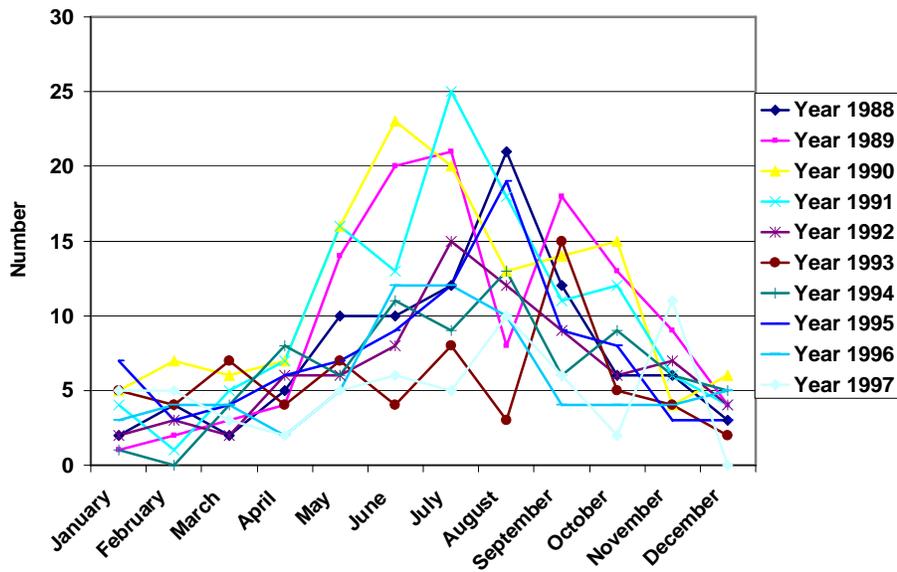
Deaths Reported Due to Salmonella in U.S., 1983-2002



*Salmonella* outbreaks in the U.S. are clearly more common in the summer months (see Figure 6)<sup>4,5</sup>; when the weather is warm, people tend to have more gatherings outside, and food is left out at temperatures that are conducive to bacterial growth. Nationally, there is a similar distribution between genders, as might be expected.

Figure 6.

## Salmonella Outbreaks per Month in U.S., 1988-1997



*Salmonella* is most frequently reported in the U.S. in children under age 5 (26% of isolates), while 10% of isolates are reported in people in the 2<sup>nd</sup>-5<sup>th</sup> decades of life. Reporting is extremely high for children because parents and physicians worry more about symptoms of any illness in a child. Children present to a physician more often than do adults when ill, and stool cultures are more frequently done for children. This results in over-sampling of the child population and thus more accurate reporting of *Salmonella* infections in children than in adults. Epidemiologists suspect that there are significantly more adults with *Salmonella* infections each year<sup>8</sup>, but most adults do not seek medical attention unless the symptoms are severe or do not resolve with a reasonable amount of time. Many of the deaths due to *Salmonella* from 1983 to 2006 have occurred in residents of nursing homes, which reflects the seriousness of this infection in elderly people, many of whom may be immunocompromised.

Outbreaks of *Salmonella* occur in a wide variety of locations throughout the country; in general, any place where food is eaten may have a *Salmonella* outbreak. Reported outbreaks have started in such places as: restaurants and delis (most common), private homes, schools, nursing home, picnic areas, tour ships, churches, commercial products, fairs, prisons, workplaces, wedding receptions, and camps<sup>9</sup>.

It should be noted that *Salmonella*, like other food-borne illnesses, is generally underreported, and reporting varies for many reasons. It is estimated that each year, about 76 million illness and 5000 deaths are due to food-borne illness; *Salmonella* is estimated to be responsible for 1.4 million illnesses per year<sup>10, 11</sup>. Whether an outbreak is reported depends on factors such as the size and severity of illness; consumer and physician awareness, interest, and motivation to report; and the resources and disease surveillance activities of the state and local public health and environmental agencies.

Factors that contribute to *Salmonella* infection and that have been recognized from 1980 to 2006 include, in order of frequency: improper holding temperatures, inadequate cooking, contaminated equipment, food from unsafe sources, and poor personal hygiene. These factors have been a problem especially in the cooking and serving of eggs, leading to education and prevention measures centered on eggs<sup>1</sup>.

The current project involves the characterization of the nature of food-borne outbreaks of disease reported in Louisiana from 1980 through 2006 using a database of information collected by the Louisiana Office of Public Health and compiled in an Access file. Specifically, outbreaks of *Salmonella* were examined because of its importance nationally as the leading cause of food-borne illness and its importance as a common cause of food-borne illness in the state of Louisiana. Research questions to be evaluated included:

1. Over the years from 1980 through 2006, how many food-borne illness outbreaks, cases, and deaths of any etiology have been reported in Louisiana? How many outbreaks, cases and deaths due to *Salmonella* have been reported in Louisiana? What was the mean for each per year? Have there been any trends in the reported number of outbreaks, cases, or deaths due to *Salmonella*?
2. Are there particular times of year when reports of *Salmonella* outbreaks are more common?
3. Are there certain parishes in which *Salmonella* is more commonly reported than would be expected?
4. Are there particular types of gatherings or locations in which *Salmonella* outbreaks are more commonly reported than would be expected?
5. How does Louisiana compare to national trends in *Salmonella*?

## 2. Methods

The database used for this study is a compilation of information about all food-borne outbreaks of disease in Louisiana from 1980 through 2006. There were a total of 182 outbreaks reported during this time. Information collected and recorded includes: etiologic agent, date, number of cases, facility type, parish, region, disease type and symptoms, hospitalizations, deaths, duration/incubation time, laboratory evaluation and results, and preventive measures implemented. The database was initially an Access file but was transferred to SPSS for easier manipulation. Certain variables were recoded: months were changed to seasons (winter = December, January, February; spring = March, April, May; summer = June, July, August; fall = September, October, November), numeric codes were created for each facility type, “enteric pathogen” and “food-borne” were regrouped into one category labeled “unknown etiology,” all subspecies of *Salmonella* were regrouped into one “*Salmonella*” category (there was no *S. typhi*), and hospitalizations and deaths were regrouped into one category labeled “morbidity/mortality.” There were some problems with the data set that will need to be corrected for future use. For example, some outbreaks occurred during the “13<sup>th</sup>” month; these outbreaks could not be used in data analysis, as there was no way to know the correct month of the outbreak.

Descriptive statistics were used initially to evaluate the data. Information examined included the number of outbreaks since 1980 overall and the number due to *Salmonella*; the number of outbreaks (total and *Salmonella*) per year for the entire state and by parish, by facility type, and by month; and the average number of cases per outbreak.

Linear regression was used to evaluate relationships within the data. Possible trends examined included the number of outbreaks (total and *Salmonella*) per year from 1980-2006, and the number of cases per outbreak per year (total and *Salmonella*).

## 3. Results

In Louisiana from 1980 through 2006, the etiologic agent was unknown for the majority of outbreaks of food-borne illness. Although *Salmonella* is known to be responsible for the majority of reported outbreaks in the nation, it is only the third leading known cause of reported outbreaks of food-borne illness in this state (see Figure 7). However, *Salmonella* was responsible for the largest number of hospitalizations due to food-borne illness in Louisiana during this time (see Figure 8). There were a total of 182 outbreaks of food-borne illness from 1980 through 2006, with a mean of 6.7 outbreaks per year and a standard deviation of 4.7. The average number of outbreaks per agent was 11.99 and the standard deviation was 7.229. *Salmonella* was responsible for 18 outbreaks during this time. Linear regression (Figure 9) shows that there was a weak ( $R^2 = 0.398$ ) upward trend in food-borne outbreaks of any etiology over the years. There were 0-2 outbreaks reported per year due to *Salmonella*. These numbers are too small to determine whether a trend exists.

Figure 7. Total Number of Outbreaks Due to Each Etiologic Agent in Louisiana, 1980-2006

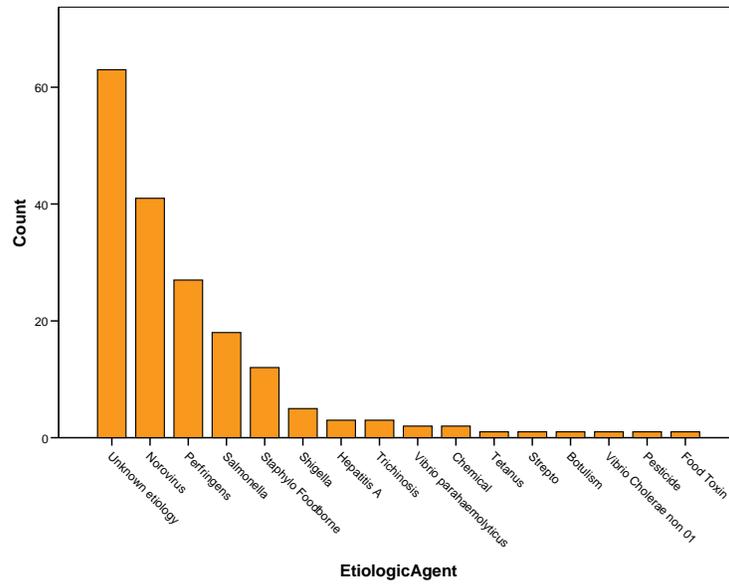


Figure 8. Total Number of Hospitalizations Due to Most Common Food-borne Illnesses in Louisiana, 1980-2006

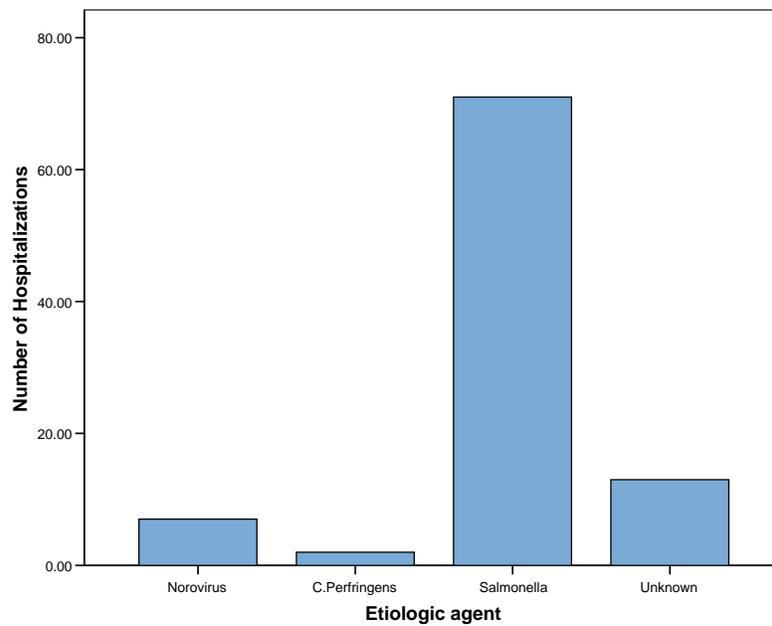
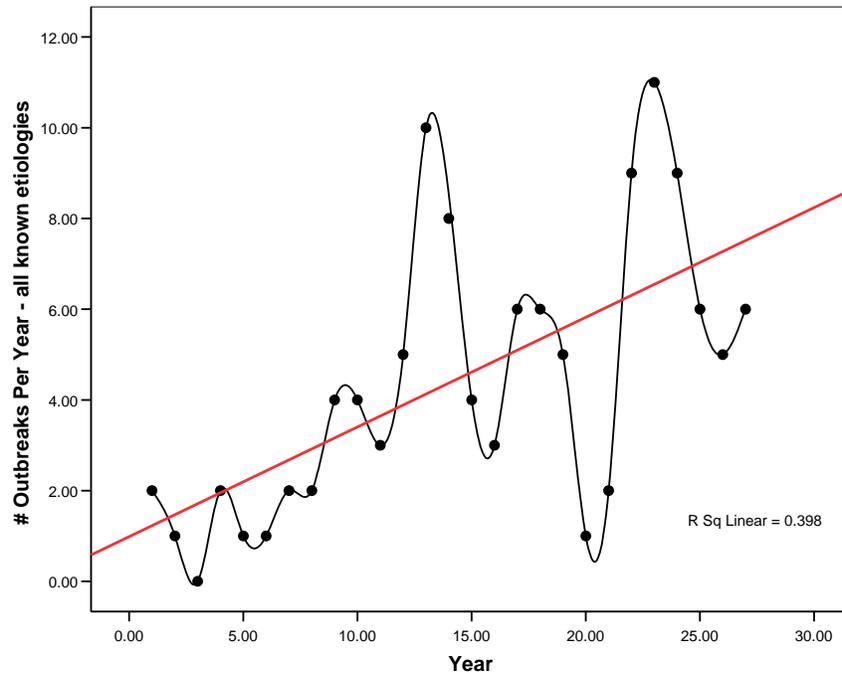


Figure 9. Total Number of Outbreaks with ALL known Etiologies over Time (1980-2006) with Superimposed Linear Regression Line



The total number of outbreaks for which the facility type was known was 174. Of these, the most common facilities in which reported outbreaks occurred were: restaurants (43), prisons (16), businesses/clubs/private functions (33), and day care or schools (33). The average number of outbreaks reported by any type of facility was 6.0632, with a standard deviation of 4.79179. The total number of *Salmonella* outbreaks for which the facility type was known was 17. Eight of the reported outbreaks occurred in restaurants, 4 in private parties/businesses/club events, 2 in schools, and one each in a church, wedding reception, and food service industry.

The average number of cases per outbreak per year, both for food-borne illnesses in general and for *Salmonella*, showed no clear trend.

Figure 10 shows that there were too few *Salmonella* outbreaks reported in Louisiana from 1980 through 2006 to determine whether there is a trend according to month that matches the national trend.

Figure 10.

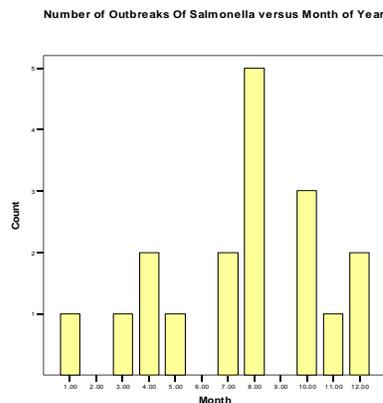


Figure 11 shows that the ratio of observed to expected reports of food-borne illness of any etiology, as well as the ratio of observed to expected reports of *Salmonella*, in the state of Louisiana was only about 0.5.

Figure 11.  
**Outbreaks of Foodborne Illness, Total and *Salmonella*, in U.S. and Louisiana, 1983-2002**

Agent	Percent of U.S. Outbreaks from Louisiana	Expected %	Observed / Expected
All Etiologies	0.88	1.67	0.53
Salmonella	0.87	1.67	0.52

Parishes with the largest number of outbreaks reported from 1980 through 2006 were: East Baton Rouge (11 outbreaks), Jefferson (14 outbreaks), and Orleans (48 outbreaks). The average number of outbreaks reported per parish was 20.94, with a standard deviation of 10.546. Parishes with the largest number of *Salmonella* outbreaks reported were: Caddo (2), East Baton Rouge (2), Orleans (5), and Richland (2). The 18 *Salmonella* outbreaks came from 10 parishes (Caddo, De Soto, East Baton Rouge, Lincoln, Orleans, Ouachita, Richland, St. Bernard, St. Landry, and Washington). Among these parishes, the average number of outbreaks reported from 1980 through 2006 was 3.

Figure 12 shows the relative contributions of the ten most populous parishes to the overall food-borne outbreak surveillance in Louisiana. Figure 13 shows relative contributions of the ten most populous parishes to the *Salmonella* outbreak surveillance in Louisiana.

Figure 12.

**Relative Contributions of the Ten Most Populous Parishes to Overall Foodborne Outbreak Surveillance in Louisiana (1980-2006)**

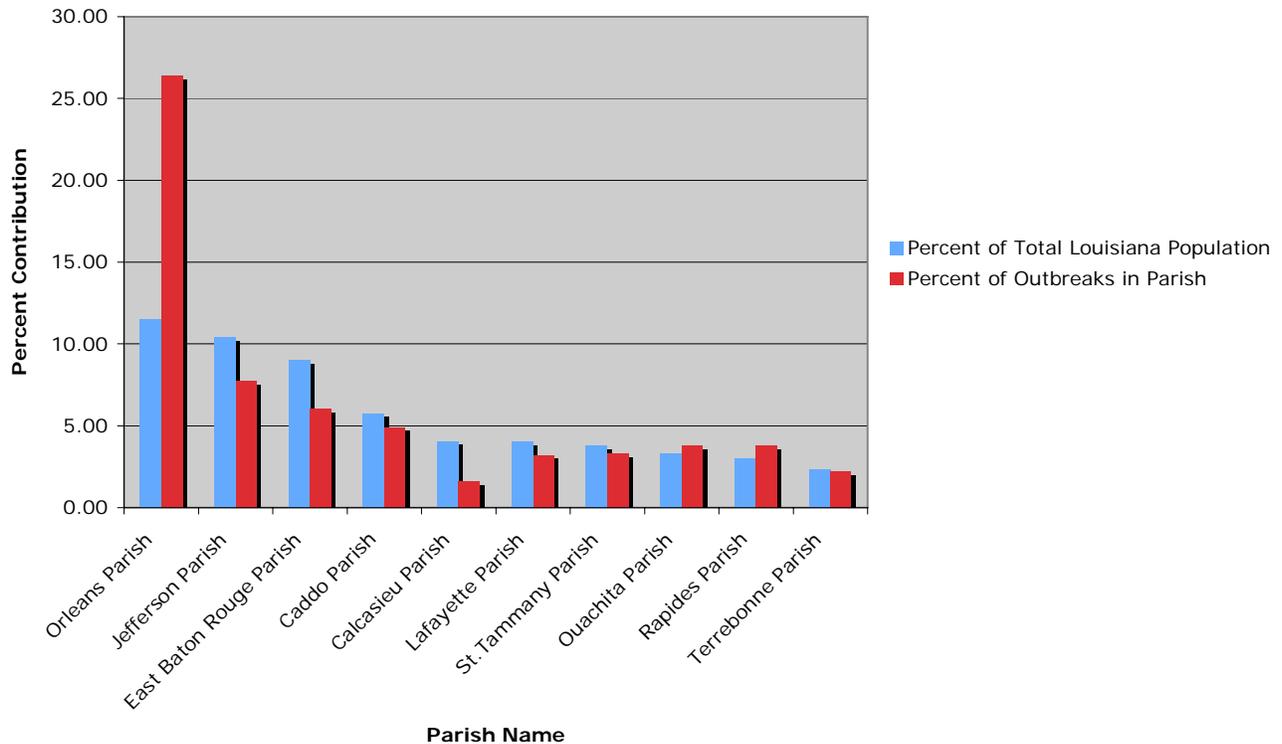
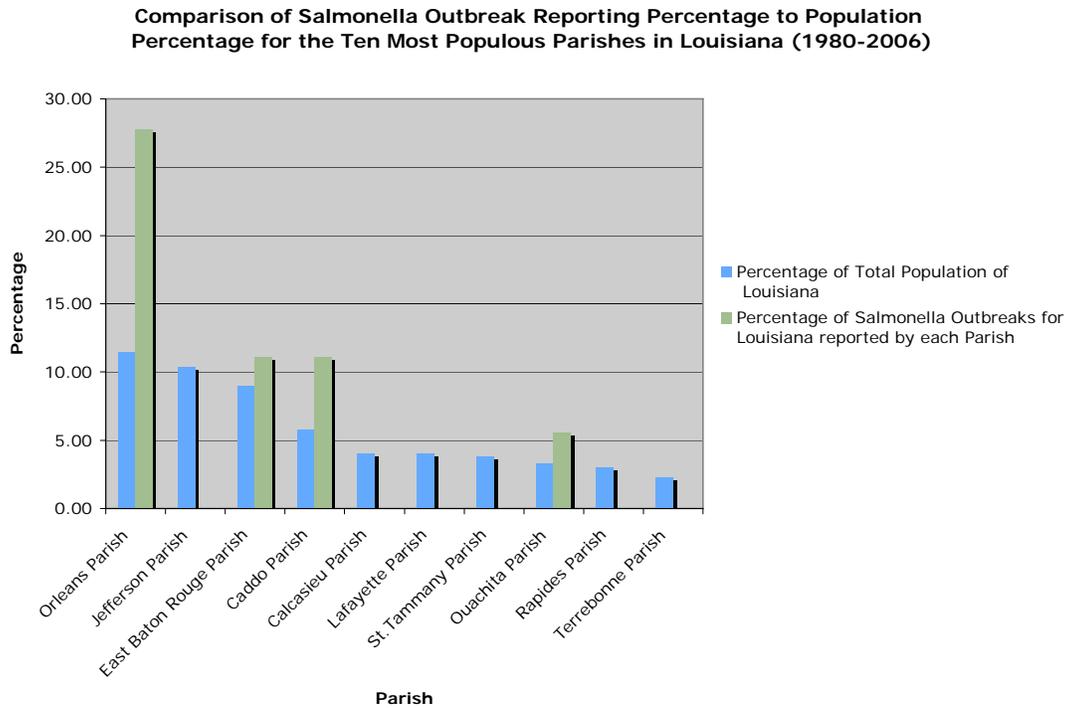


Figure 13.



Another way to look at reporting is to compare the ten parishes that reported the most food-borne outbreaks in terms of their relative percentage of the state population (see Figures 14 and 15)

Figure 14.

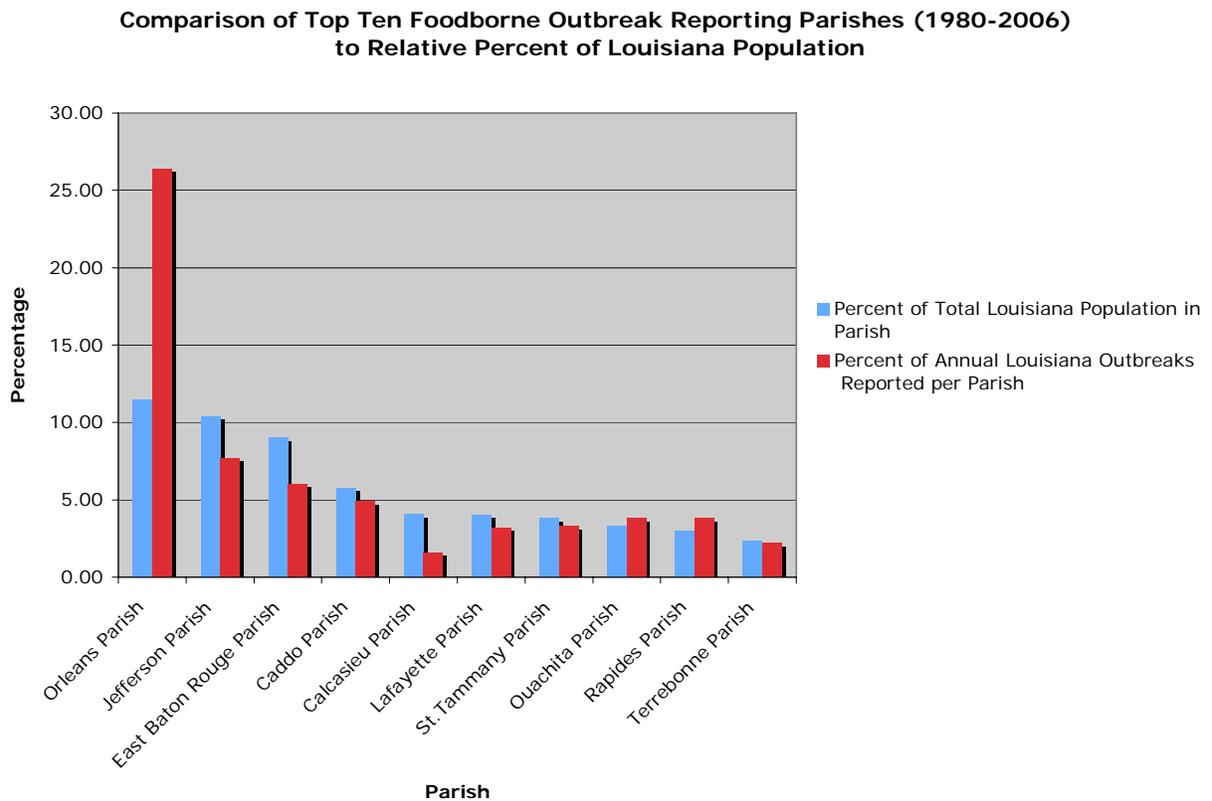
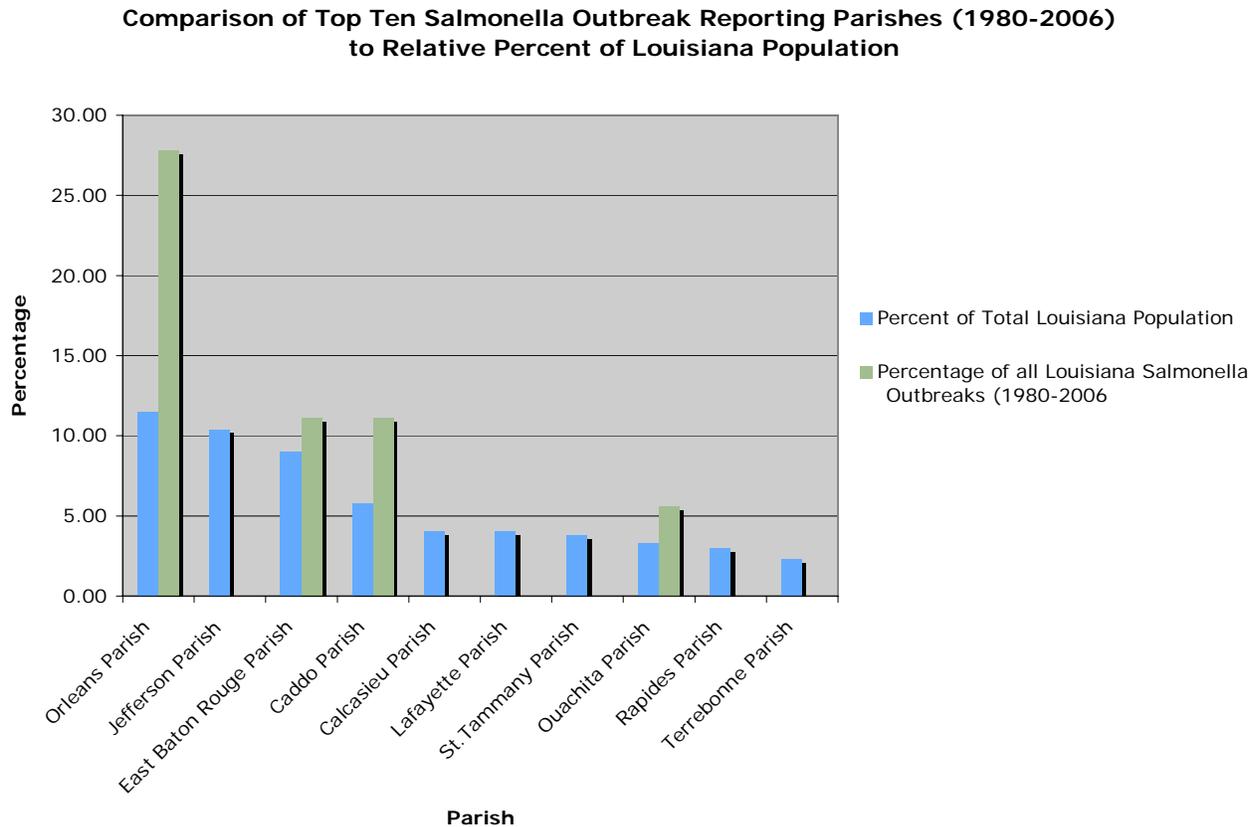


Figure 15.



#### 4. Discussion

Food-borne illnesses are clearly a major problem in Louisiana, as they are in the rest of the nation. *Salmonella* is less commonly reported in Louisiana than in the U.S., but it is responsible for the largest number of food-borne illness-related deaths both in the nation and in the state. It is possible that *Salmonella* is less common in Louisiana than in the U.S., or it may be under-reported in this state. Further investigation is required to determine this. The weak upward trend in reported outbreaks of any etiology implies either that there were increasing numbers of actual outbreaks or that surveillance and/or reporting improved. In order to evaluate this for *Salmonella*, a larger number of outbreaks would need to be reported.

Reporting varies among facilities for a number of reasons. Clearly there are many, many more restaurants than prisons in Louisiana, and, as expected, there are more food-borne outbreaks reported from restaurants than from prisons, but the difference is not enough to account for the difference between the numbers of existing facilities. Restaurants may be reluctant to report an outbreak that could hurt business, while state-run prisons are much more likely to report an outbreak in an effort to secure government aid in treating patients. Thus, it is likely that outbreaks are under-reported by restaurants and over-reported by prisons; this phenomenon surely affects other facilities and individuals as well. Also, some facilities or types of gatherings are more self-contained and easier to pinpoint than others, and reporting for some may be easier than for others.

The weak downward trend in the number of cases reported per outbreak of any etiology over the years is probably due to two outbreaks with high case numbers in early years. Further study and more data would be necessary to determine whether a real trend does exist.

Although there were not enough outbreaks of *Salmonella* reported to determine a trend, some hypotheses could be made and tested by further studies, possibly with the aid of active surveillance. The largest number of outbreaks reported in any one month was 5, in August; this suggests that, given more data, it may be determined that outbreaks are more common in the summer in Louisiana, as they are across the nation. However, there were no outbreaks reported in June or

September. It is also possible that the summer peak may not occur as clearly in Louisiana because the weather is warm year-round relative to the rest of the country. More data is necessary to make any existing trends clear.

Overall, it appears that food-borne outbreaks in general and *Salmonella* outbreaks specifically are under-reported in Louisiana. Orleans Parish stands out as the one parish that has an extremely disproportionate number of reported outbreaks, even when population is taken into consideration; it is unclear whether this is due to actual occurrence of outbreaks or to better reporting in this parish. A likely explanation is that outbreaks closer to New Orleans are more frequently investigated and fully reported; it is much easier and less expensive to send epidemiologists in training to Metairie, for example, than to Monroe.

Future directions in this area of study should include investigation of reasons for variations in reporting, as well as measures to improve the accuracy of reports of outbreaks, cases, and deaths due to food-borne illness. Measures to consider include active surveillance, as is being done in other states. Additionally, anything that makes reporting easier is helpful; computerized systems, increased manpower, etc. would be helpful in parishes where they are not already available. Education of the public and of physicians and other healthcare providers is also important; despite decades of education, often, a person has a food-borne illness and is never aware of it, and there are large numbers of people who are unaware of proper food safety techniques. More accurate reporting of food-borne outbreaks, illnesses, and deaths is important to correctly determine trends and to adjust education and prevention measures. Studies of interventions meant to improve reporting accuracy would be helpful in working towards this goal.

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