FoodCORE (Foodborne Diseases Centers for Outbreak Response Enhancement): Improving Foodborne Disease Outbreak Response Capacity in State and Local Health Departments, Year One Summary Report

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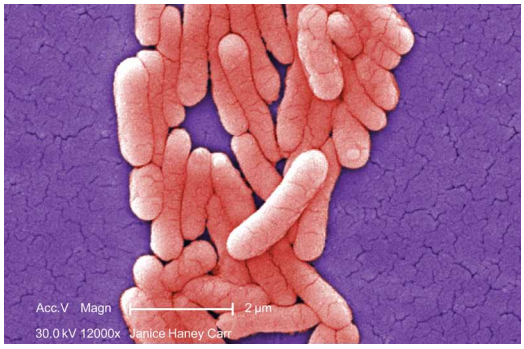
Executive Summary

Each year foodborne diseases cause illness in approximately 1 in 6 Americans, resulting in 128,000 hospitalizations and 3,000 deaths. Decreasing resources impact the ability of public health officials to identify, respond to, and control foodborne disease outbreaks. The Foodborne Diseases Centers for Outbreak Response Enhancement (FoodCORE) program was established to address gaps in foodborne disease outbreak response by improving laboratory, epidemiologic, and environmental health capacity.

FoodCORE addresses gaps in foodborne disease response through improved capacity to improve timeliness and completeness of outbreak response activities. FoodCORE promotes the evaluation and application of model practices to improve detection, investigation, and control of foodborne disease outbreaks. Successes are documented using performance metrics based on the Council for Improving Foodborne Outbreak Response Guidelines. FoodCORE centers regularly convene, provide quarterly reports, and collaborate with other foodborne diseases programs to discuss, document, and share model practices.

The FoodCORE centers during Year One (October 2010–September 2011) included: New York City, North Carolina, Ohio, South Carolina, Tennessee, Utah, and Wisconsin. Centers improved completeness and timeliness for laboratory and epidemiologic activities. On average, over 95% of *Salmonella*, Shiga toxin-producing *Escherichia coli*, and *Listeria* (SSL) isolates were subtyped. Epidemiology staff followed up with nearly 90% of all reported SSL cases. FoodCORE centers routinely engage environmental health and/or regulatory partners, and are active participants in national outbreak surveillance.

During Year One, FoodCORE centers improved timeliness and completeness of their foodborne disease outbreak response programs and used a newly developed set of performance metrics to document progress. Leveraging laboratory, epidemiology, and environmental health capacity, centers successfully applied model practices to build capacity for routine and surge capacity needs, making faster, more complete investigations possible. Enhanced outbreak response can identify sources of infection faster, limit additional illnesses, and help prevent future foodborne disease outbreaks.



Colorized scanning electron micrograph (SEM) of clustered Gram-negative *Salmonella* Typhimurium bacteria.

Introduction

Each year, foodborne diseases cause illness in 1 in 6 Americans resulting in 128,000 hospitalizations and 3,000 deaths (1). If a larger number of people than expected appear to have the same illness in a given time period and area, it is a cluster. When an investigation shows that ill persons in a cluster have something in common to explain their illness, the group of illnesses is an outbreak (2). Approximately 1,000 outbreaks are reported annually through the National Outbreak Reporting System (3). In 2012, the Centers for Disease Control and Prevention (CDC) investigated more than 200 multistate clusters and outbreaks. State and local public health officials investigated many more local or regional clusters and outbreaks. These investigations are important for solving outbreaks and preventing additional illnesses, and are critical to reducing the burden of foodborne disease. Fast and effective investigations are necessary to identify and remove contaminated food from the market to prevent additional illnesses, as well as to identify new routes of contamination and gaps in the food safety system to prevent similar outbreaks in the future. Many health departments need additional resources to conduct comprehensive foodborne disease surveillance as well as rapid and coordinated detection and investigation of foodborne disease outbreaks (4).

In 2009, to improve state and local responses to foodborne disease outbreaks, CDC funded a pilot program in three sites with support from the U.S. Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS) and the Association of Public Health Laboratories (APHL). Following successes of the yearlong pilot, the FoodCORE (Foodborne Diseases Centers for Outbreak Response Enhancement) program was expanded in 2010. FoodCORE aims to improve state and local foodborne disease outbreak response and investigations by building capacity; developing collaborative surveillance and response programs; conducting rapid, coordinated, standardized investigations; and developing and implementing measurable performance indicators.

This report describes the implementation and early successes of FoodCORE during the first year following the pilot.

Methods

FoodCORE is a collaborative effort to build capacity across three areas to develop complete foodborne disease response programs: laboratory, epidemiology, and environmental health. Funded centers implement individual work plans specific to their public health structure to meet the FoodCORE goals of improving foodborne outbreak response activities.

During October 1, 2010 to September 30, 2011 (Year One, Y1), seven centers participated in FoodCORE: New York City, North Carolina, Ohio, South Carolina, Tennessee, Utah, and Wisconsin. During Y1, centers implemented their work plans, developed and applied FoodCORE performance metrics, collaborated with other food safety programs, conducted trainings, and contributed to the development and testing of new tools and technologies. Enhancing capacity at the centers was supported through the CDC's Epidemiology and Laboratory Capacity Grant; the average award was approximately $314,000 (range: $65,000–$512,000).

In total, FoodCORE funding supported more than 40 positions in the centers, including over 15 student interviewer positions. For laboratory activities, five centers received funding to support staff, equipment, reagents, and software. Six centers provided a courier service to improve the completeness and timeliness of sample and specimen submissions to public health laboratories (PHL). Six centers began working towards the implementation of molecular serotyping. All seven centers received funding to expand epidemiologic capacity, including support for staff, equipment, and software. Four centers trained student interviewers to assist with epidemiologic interviewing and investigation; in one center, student positions also supported laboratory activities. For environmental health capacity, two centers received funding to support environmental health/food protection staff.

Metrics are used to evaluate progress towards goals, identify gaps, and document successes. FoodCORE metrics, available at http://www.cdc.gov/foodcore/ssl-metrics.html, are based on chapter 8 of the Council to Improve Foodborne Outbreak Response (CIFOR) Guidelines (5) and are reported separately by pathogen (6). Metrics data are reported for the burden, timeliness, and completeness of foodborne disease activities from outbreak surveillance and detection through investigation, response, control, and implementation of prevention measures (See Appendix A). Over time, metrics data quantitatively demonstrate changes in completeness and timeliness.

Analyses on data collected during Y1 were conducted using SAS 9.3. Data were reported for the first two quarters combined (Q1 and Q2), the final quarter (Q4), and cumulative data for the entire Y1 period. To evaluate changes during the first year of the expanded program, data from Q1 and Q2 were used as a comparative baseline for Q4.

Results

The results of Y1 activities include a description of the disease burden and structure of the centers, as well as summary metrics data for isolate-, case-, and cluster-based metrics (See Appendix A).

Disease burden and structure

FoodCORE centers have different population characteristics, disease burdens, and organizational structures (See Table 1). During Y1, centers covered a total population of approximately 47 million people, with a range from 2.8 to 11.5 million people, per center. Based on data for nationally notifiable diseases, the range of reported cases per center was <5 to 45 cases of listeriosis; approximately 25 to over 200 cases of Shiga toxin-producing *Escherichia coli* (STEC); and 350 to over 2300 cases of salmonellosis (7). Centers cover both highly urbanized and rural populations. Five centers have a decentralized organization, meaning local health departments (LHDs), including county, city, rural, or regional departments, independently provide public health services (8). Two centers have a centralized structure, which provides all local public health services (8).

The public health authorities responsible for conducting initial interviews with *Salmonella*, STEC, and *Listeria* (SSL) cases vary by center (See Table 1). In New York City, a team of student interviewers assists staff to complete interviews. In South Carolina, state staff located in regional offices conduct interviews. The five decentralized centers have different interviewing models. In North Carolina, LHD staff are responsible for interviewing SSL cases and centralized, state-based staff re-interview cases who are identified as part of a cluster or outbreak. In the other centers, LHD staff retain authority to interview SSL cases, but centralized staff are available to assist with interviews. In Wisconsin, LHDs can request assistance for any case(s); central staff also proactively contact LHDs who have not been able to complete an interview within seven days of report to offer interviewing assistance. In Ohio, Tennessee, and Utah, some LHDs have partnered with centralized staff so state-based interviewers automatically attempt interviews with all SSL cases in the LHD jurisdiction. Other LHDs

conduct their own routine interviews and utilize central staff for surge capacity, additional coverage, and for cases they might not be able to reach otherwise.

Centers successfully implemented their work plans and used metrics to document improved laboratory, epidemiologic, and environmental health completeness and timeliness.

Isolate-based metrics

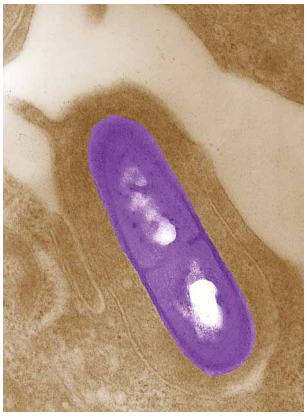
In Y1, the FoodCORE laboratories received over 9,000 SSL isolates and isolate-yielding specimens. This included SSL isolates (e.g., human, food, environmental) submitted to public health laboratories (PHLs) as well as isolates recovered from specimens submitted to PHLs. Primary isolates and isolate-yielding specimens are the subset of all received specimens limited to the first or representative SSL isolate or sample for each case or testing unit. The laboratories received a total of 8,264 *Salmonella*, 916 STEC, and 89 *Listeria* submissions; 7,677 (93%) of *Salmonella*, 787 (86%) of STEC, and 83 (93%) of *Listeria* were primary isolates.

During baseline, the average proportion of *Salmonella* isolates with serotyping was 99% (range 95–100%) and for STEC it was 86% (range 46–100%). During Q4, these proportions improved to 100% (range 99–100%) for *Salmonella* and 94% (range 76–100%) for STEC. The time it took to complete subtyping, or turn-around time (TAT), was measured in days, from receipt or recovery of an isolate to subtyping results. The median TAT for serotyping decreased as follows: for *Salmonella*, from 6 days (range 4–14 days) during baseline to 4 days (range 3–9 days) during Q4; for STEC, from 5 days (range 4–8 days) during baseline to 4.5 days (range 2–14 days) during Q4 (See Table 2).

The proportion of isolates with pulse-field gel electrophoresis (PFGE) subtyping, and the associated TAT, also improved during Y1. The average proportion of isolates with PFGE data increased as follows: for *Salmonella* from 82% (range 28–100%) during baseline to 94% (range 56–100%) in Q4; for STEC, from 93% (range 67–100%) during baseline in to 98% (range 92–100%) in Q4; and for *Listeria*, from 82% (range 26–100%) during baseline to 100% for all centers in Q4 (See Figure 1). The median TAT for PFGE subtyping during baseline was 6 days (range 4-40 days) for *Salmonella*, 4 days (range 3–8 days) for STEC, and 4 days (range 2–16 days) for *Listeria*. The median and range for TAT for *Salmonella* PFGE showed improvement in Q4 to 5 days (range 2–18 days). For STEC and *Listeria*, the median TAT remained the same at 4 days, but there was improvement in the range of TATs for PFGE: 2–9 days for STEC and 1–12 days for *Listeria* (See Table 2).

Case-based and cluster-based metrics

In Y1, epidemiology programs were notified of 7,951 SSL cases: 7,039 cases of *Salmonella* infection, 820 cases of STEC infection, and 92 cases of *Listeria* infection. FoodCORE resources supported additional staff for epidemiologic interview and investigation, resulting in an increased proportion of cases with an attempted interview from the baseline quarters through Q4. For *Salmonella*, the average proportion of cases with an attempted interview increased from 88% (range 53–100%) to 94% (range 78–100%). The average proportion of STEC cases with an attempted interview increased from 90% (range 60–100%) during baseline, to 97% (range 89–100%) in Q4. For *Listeria*, the average proportion of cases with an attempted interview remained at 100% during baseline and in Q4 (See Figure 2).



Electron micrograph of a *Listeria* bacterium in tissue.

In addition to attempting an interview for the majority of reported cases, the timeliness of interviews also improved. The average TAT from notification to first attempted interview decreased as follows: for *Salmonella* from 1.3 days (range 0–3) during baseline to 0.6 days (range 0–2) in Q4; for STEC, from 2.7 days (range 1–5) to 0.6 days (range 0–1); and for *Listeria*, from 7 days (range 3–11) to 0.7 days (range 0–1) (See Table 2).

Combining data from the laboratory and epidemiologic interviews and investigations, centers identified 510 clusters during Y1. Cluster investigations conducted within the centers were characterized by improved collaboration and communication across program areas. Centers participated in numerous multistate cluster investigations and provided critical contributions to investigative efforts. Centers conducted routine interviews among cluster-associated cases for 472 (93%) of the identified clusters, including 100% of the STEC and *Listeria* clusters. Centers were able to determine a suspect vehicle associated with illness for 89 (17%) and a confirmed vehicle for 30 (7%) *Salmonella* clusters, 10 (18%) STEC clusters, and 3 (60%) *Listeria* clusters. Environmental health or regulatory partners were contacted in nearly half of all cluster investigations. The cluster investigations led to 78 public health actions including public messaging such as website updates or press releases, or regulatory actions.

Discussion

This report provides the first description of implementing the FoodCORE program. FoodCORE centers improved timeliness and completeness of their foodborne disease outbreak response programs and used a newly developed set of performance metrics to document progress.

During Y1, centers successfully implemented their individual work plans to build capacity in the three areas: laboratory, epidemiology, and environmental health. Metrics are an essential tool for FoodCORE in evaluating the impact and effectiveness of activities, documenting successes, identifying gaps, and quantifying the scope of work and resources necessary to have a complete foodborne disease response program.

Improving laboratory capacity

With FoodCORE funding the laboratories were able to increase and maintain the proportion of isolates subtyped by serotyping and PFGE while improving TAT to complete subtyping. The substantial progress made with the proportion of isolates with subtyping data is most evident by comparing the low end of the ranges between the baseline quarters and Q4 (See Figure 1). For example, in Q4 each center serotyped between 76-100% of all STEC isolates, an increase from the lowest value of 46% serotyped during the baseline quarters. For *Salmonella*, the lowest proportion of isolates with PFGE data improved from only 28% during baseline to 56% in Q4. The lowest proportion of isolates with PFGE data for STEC improved from 67% during baseline to over 90% in Q4. For *Listeria*, the proportion of isolates with PFGE data improved dramatically from a low of only 26% during baseline to 100% for every center during Q4.

There were also improvements in the median TAT for serotyping and PFGE from baseline to Q4. For *Salmonella*, the median TAT for serotyping was reduced from 6 days to 4 days. The median TAT for *Salmonella* PFGE subtyping was also reduced by one day, but even more notable was the reduction in the top end of the range from 40 to 18 days. The median TAT for STEC serotyping was reduced by 0.5 days. The longest reported TAT for *Listeria* decreased from 16 to 12 days.

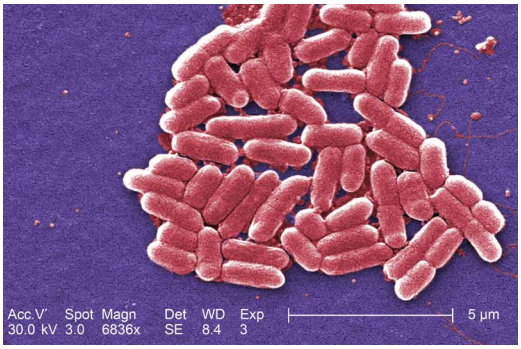
Increased serotyping and PFGE subtyping are vital components to complete laboratory surveillance and outbreak detection. Complete and timely subtyping allows for more rapid detection of clusters and outbreaks. Early detection creates the opportunity to respond to and control outbreaks during an earlier stage, thereby limiting additional illness. Additionally, sampling and subtyping of food and environmental specimens can help determine the source of an outbreak and contributing factors, both of which are critical to response and control activities and informing prevention efforts.

Improving epidemiology capacity

The increase in the proportion of cases with an attempted interview quantifies the improved completeness of epidemiologic investigations within the centers. These improvements are most evident by comparing the low end of the ranges between the baseline quarters and Q4 (See Figure 2).

The lowest proportion of cases with an attempted interview improved as follows: for *Salmonella*, from 53% during baseline to 78% in Q4; for STEC, from 60% during baseline to nearly 90% in Q4. For *Listeria*, the proportion of cases with an attempted interview was maintained at 100% for all centers. Not only were centers attempting to interview a high proportion of reported cases, these interviews were happening more quickly. The median TAT for attempted SSL interviews decreased to one day, or less.

Improving the proportion of cases with an interview provides more complete epidemiologic data for routine surveillance as well as cluster and outbreak investigations. Case interviews provide crucial data for developing hypotheses about the vehicle of infection. Conducting interviews rapidly is critical in obtaining the most useful information from cases about their food consumption histories and other exposures. Reducing TAT from notification of a case to attempted interview helps ensure the best possible response and recall from cases. Routine case interviews can also identify high-risk cases who could spread their infections to others (e.g., food handlers, day care workers or attendees, healthcare workers). During interviews, cases can receive information about risky exposures and how to protect themselves and others.



Colorized scanning electron micrograph of Gram-negative *Escherichia coli* bacteria O157:H7.

Improving cross-cutting activities

Leveraging laboratory, epidemiology, and environmental health capacity, the centers have successfully used FoodCORE resources in various outbreak investigations and to strengthen routine foodborne activities. FoodCORE centers have built capacity for routine and surge capacity needs, making faster, more complete investigations possible. Among the 510 clusters identified during Y1, some clusters consisted of only two or three cases. Even including these small clusters, centers were still able to identify a suspect vehicle for almost 20% of these investigations, and a confirmed vehicle for nearly 10%. Identifying suspect and confirmed vehicles associated with illness helps mitigate ongoing outbreaks and informs prevention and education efforts to prevent similar outbreaks from recurring.

Using FoodCORE resources, the centers have solved and controlled outbreaks that would not have been otherwise, and the availability of data and records has resulted in more rapid recall actions.

Improving partnerships and collaborations

Centers conducted local and regional trainings for laboratory, epidemiologic, and environmental health investigations, building partnerships and improving communication across programmatic areas. These trainings further engage partners from local level public health officials to student interviewers, and contribute to the development of the public health workforce. The centers with student teams have developed training and evaluation tools for use with establishing and maintaining highly effective and well-trained student interviewers.

Many of the centers collaborate with universities and academia as part of their work plans. Additionally, FoodCORE works closely with other federal and state programs, including PulseNet, Environmental Health Specialists Network, FoodNet, CaliciNet, NoroSTAT, and the Integrated Food Safety Centers of Excellence, which are centrally coordinated by CDC. FoodCORE also works with APHL, USDA-FSIS, CIFOR, and the U.S. Food and Drug Administration's Rapid Response Teams.

The centers are contributing to the development and testing of new tools and technologies, centers pilot tested data sharing and visualization platforms with CDC and continue to develop and hone methods for cluster detection, data management, and routine data analyses and submission procedures.

Limitations

This report is subject to at least two main limitations. Only one year of metrics data were available. The performance metrics were developed during the pilot project and finalized and implemented during Y1; therefore, there are no consistent pre-program data from all the centers. Data were not reported separately for all four quarters of Y1. These factors limited analyses of trends, but additional analyses will become feasible in the future with continued reporting.

Conclusions

During Y1, FoodCORE centers improved timeliness and completeness of their foodborne disease outbreak response programs and used a newly developed set of performance metrics to document progress. FoodCORE is establishing model practices for the detection, investigation, response, and control of foodborne diseases. FoodCORE works collaboratively to identify and implement public health practices that can help shorten the time it takes to identify a source of infection and pinpoint how and why contamination occurred, in order to limit additional illnesses and help prevent future outbreaks.

The FoodCORE metrics are a critical component of the program, as they are useful for individual centers and overall programmatic evaluation. FoodCORE is developing performance metrics beyond the SSL metrics that have been implemented, including metrics for activities for norovirus as well as other and unknown etiologies.

Additional time and resources are needed to hone and test the model practices that are being developed and implemented by the centers. Initial start-up time and costs to build sufficient capacity for laboratory, epidemiology, and environmental health programs are critical. Continued resources and support are essential to maintaining the progress made during Y1 of activities.

Expanded implementation of FoodCORE model practices and metrics would allow other localities to build capacity using methodologies that have been shown to be effective. Applying the lessons learned by centers across multiple jurisdictions would further enhance the evaluation and effectiveness of foodborne disease outbreak response and prevention.

Leveraging laboratory, epidemiology, and environmental health capacity, centers successfully applied model practices to build capacity for routine and surge capacity needs, making faster, more complete investigations possible.

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Table 1. FoodCORE Center organizational structure, disease burden, and center-specific work plan details, Y1.

Center	Structure	2010 Reported SSL[1] cases[2]	Year joined FoodCORE	LAB		EPI		Environmental Health (EH)
				Implementing Molecular serotyping	Courier Service	Centralized Interviewing for SSL cases	Initial Interview Responsibility	
New York City	Centralized	1309 *Salmonella* 79 STEC 45 *Listeria*	2009	Yes	Yes	Student Team	Centralized interviewing for SSL	Collaborations with EHS-Net[4] and NYC Office of Environmental Investigations
North Carolina	Decentralized	2345 *Salmonella* 97 STEC 22 *Listeria*	2010	Yes	Yes	No	LHDs[3] interview for SSL; Centralized follow-up interviews for cluster-associated cases	Collaboration with FDA Rapid Response Team (RRT)
Ohio	Decentralized	1311 *Salmonella* 137 STEC 29 *Listeria*	2010	Yes	Yes	No	LHDs interview for SSL; Some LHDs participate in routine centralized interviewing for their SSL cases	Collaborations with Department of Agriculture and LHD Sanitarians and EH Specialists
South Carolina	Centralized	1715 *Salmonella* 24 STEC 13 *Listeria*	2010	No	Yes	Regional Staff	Regional interviewers (state staff) interview SSL in 4 regions, coverage of all state regions as seasonal burden allows	Foodborne epidemiologists in Division of Acute Disease Epi and EH; Work closely together; EH staff directly supported
Tennessee	Decentralized	1100 *Salmonella* 120 STEC 14 *Listeria*	2010	Yes	Yes	Student Team	LHDs interview SSL cases with centralized assistance; Some LHDs participate in routine centralized interviewing for SSL cases	Collaborations with EHS-Net and General and EH Section
Utah	Decentralized	350 *Salmonella* 94 STEC 3 *Listeria*	2009	Yes	Yes	Student Team	LHDs interview SSL cases with centralized assistance	Collaborations with Department of Agriculture and Food, Environmental Epidemiology, and LHD Sanitarians
Wisconsin	Decentralized	854 *Salmonella* 221 STEC 18 *Listeria*	2009	Yes	Yes	Student Team	LHDs interview SSL cases with centralized assistance	EH staff directly supported

[1]SSL = *Salmonella*, STEC, and *Listeria*

[2]Data from Morbidity and Mortality Weekly Report, Summary of Notifiable Diseases – 2010 (7)

[3]LHD = Local health department

[4]EHS-Net = Environmental Health Specialists Network

Table 2. Median and range for turn-around times for serotyping, PFGE subtyping, and attempting an interview, Y1.

TAT*	*Salmonella*		STEC		*Listeria*	
	Baseline	Final Quarter	Baseline	Final Quarter	Baseline	Final Quarter
Serotype	6 (4–14)	4 (3–9)	5 (4–8)	4.5 (2–14)	--	--
PFGE	6 (4–40)	5 (2–18)	4 (3–8)	4 (2–9)	4 (2–16)	4 (1–12)
Interview	1 (0–3)	0 (0–2)	2 (1–5)	1 (0–1)	7 (3–11)	1 (0–1)

*Turn-around time; median (range) in days

Figure 1. Average and range of the proportion of *Salmonella*, Shiga toxin-producing *Escherichia coli* (STEC), and *Listeria* isolates with PFGE subtyping data available for baseline and the final quarter of Y1.

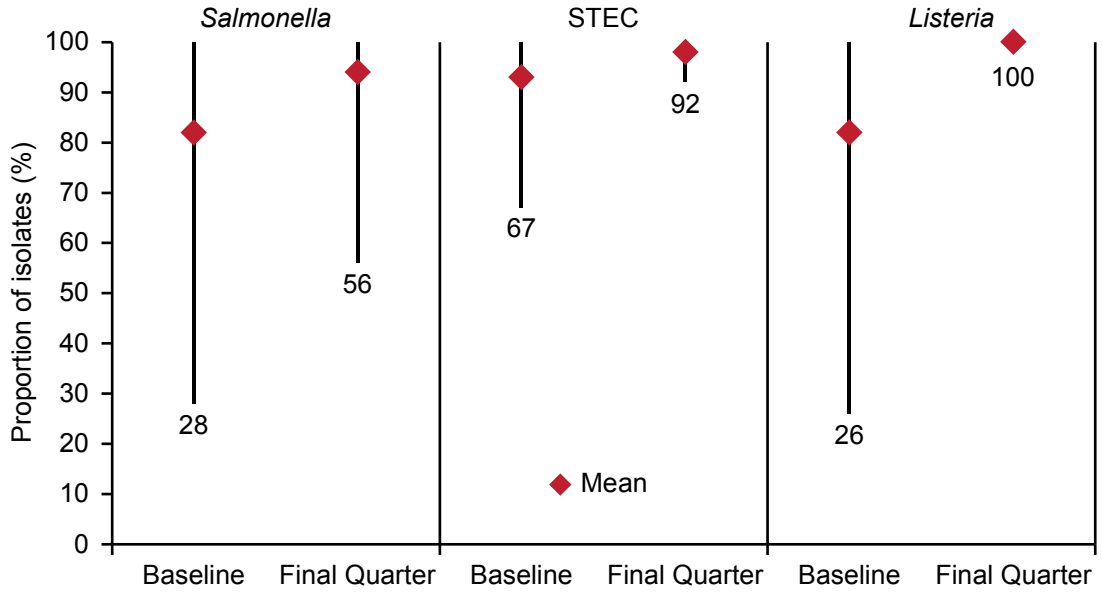
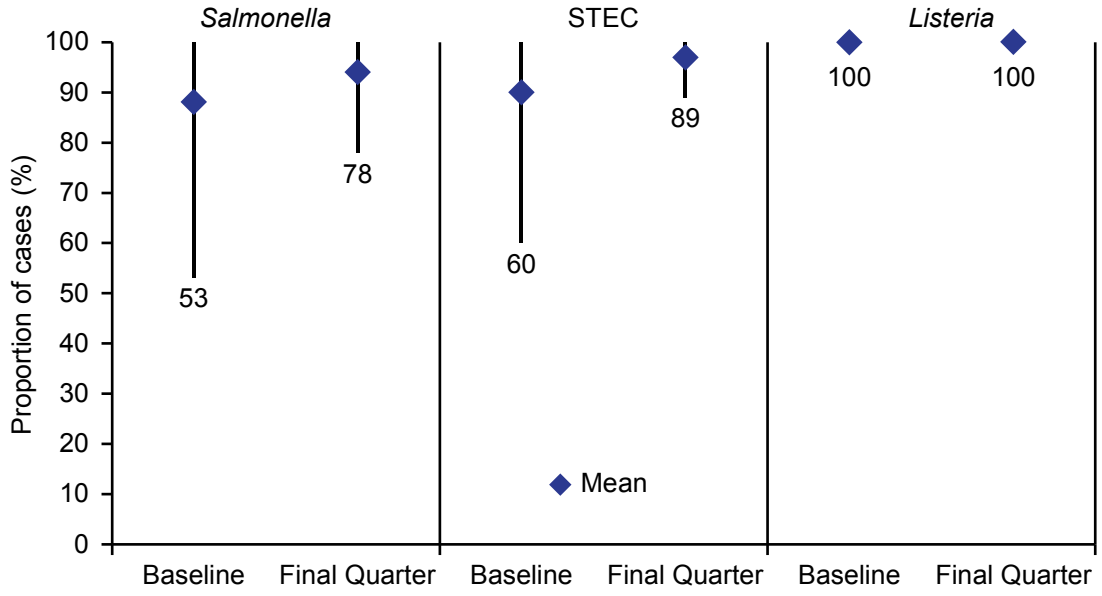


Figure 2. Average and range of the proportion of *Salmonella*, Shiga toxin-producing *Escherichia coli* (STEC), and *Listeria* cases with an attempted interview for baseline and the final quarter of Y1.



Appendix A. FoodCORE Year One (Y1) Cumulative Metrics Data (Report Period: October 1, 2010 to September 30, 2011).

Performance Metrics: (See http://www.cdc.gov/foodcore/ssl-metrics.html for current language and definitions)	***Salmonella* Measures**	**STEC Measures**	***Listeria* Measures**
	Mean (Range)	**Mean (Range)**	**Mean (Range)**
1a. Total number of isolates and isolate-yielding specimens	1181 (394–2066)	131 (15–284)	13 (5–28)
1b. Number of primary isolates/isolate-yielding specimens	1097 (366–1804)	112 (15–272)	12 (5–26)
2a. Total number of STEC clinical specimens or samples received at PHL		238 (73–693)	
2b. Number; Percent isolate-yielding STEC specimens or samples		No cumulative data available[1]	
3. Median days from isolation /isolate-yielding specimen collection to receipt at PHL	7 days (5–10 days)	5 days (3–8) days	7 days (4–10 days)
4. Median days from receipt of isolate-yielding specimens at PHL to recovery of isolate	2 days (1–3 days)	3 days (1–5) days	3 days (1–4 days)
5. Percent of primary isolates with serotype information	99% (93–100%)	88% (66–100%)	
6. Median days from isolate receipt (or recovery) at PHL to serotype result	6 days (3–8 days)	11 days (1–42) days	
7. Percent of primary isolates with PFGE information	92% (52–100%)	98% (90–100%)	100% (100–100%)
8. Median days from isolate receipt (or recovery) at PHL to PFGE upload to PulseNet	7 days (2–20 days)	5 days (2–9) days	4 days (2–10 days)
9. Number of laboratory confirmed cases reported to epidemiology staff	1006 (285–1818)	117 (11–271)	13 (5–27)
10a. Percent of cases with attempted interview	93% (71–100%)	97% (89–100%)	97% (83–100%)
10b. Median days from case report to interview attempt	0.6 days (0–2 days)	1 days (0–2) days	1 days (0–2) days
10c. Percent of cases with complete demographic data	87% (71–100%)	87% (64–100%)	91% (80–100%)
10d. Percent of cases with exposure history	72% (36–89%)	77 % (64–86%)	84% (67–100%)
10d-i. Percent of SSL cases with full shotgun or case exposure completed	No cumulative data available[1]	No cumulative data available[1]	No cumulative data available[1]
10e. Percent of cases with serotype information	95% (88–100%)	73% (52–100%)	
10f. Percent of cases with PFGE information	85% (42–100%)	87% (55–100%)	92% (80–100%)
10f-i. Percent of cases with PFGE with complete epi data	58% (34–82%)	66% (37–90%)	59% (0–79%)
10g. Reasons for not interviewing cases			
i. Lost to Follow-up: Number; Percent	38 (4–85); 7% (2–15%)	2 (0–5); 6% (0–13%)	0.5 (0–1); 11% (0–33%)
ii. Refused: Number; Percent	16 (0–24); 8% (0–13%)	2 (0–6); 5% (0–16%)	0 (0–0); 0% (0–0%)
iii. Time lag too long: Number(Percent)	No cumulative data available[1]	5 (0–14); 9% (0–25%)	0.3 (0–1); 3% (0–11%)
iv. Other: Number; Percent	136 (117–172); 54% (7–86%)	11 (0–26); 23% (0–68%)	1 (0–2); 44% (0–100%)

Performance Metrics: (See http://www.cdc.gov/foodcore/ssl-metrics.html for current language and definitions)	***Salmonella* Measures**	**STEC Measures**	***Listeria* Measures**
	Mean (Range)	**Mean (Range)**	**Mean (Range)**
11. Number of clusters	64 (16–99)	8 (0–30)	0.7 (0–2)
11a. Median and range of cluster size(primary cases only)	No cumulative data available[1]	No cumulative data available[1]	No cumulative data available[1]
12. Number; Percent of clusters with cases in multiple states	35 (13–72); 50% (15–73%)	3 (0–9); 34% (0–100%)	1 (0–2); 67% (0–100%)
13a. Number; Percent of clusters with routine interview of cases	69 (34–98); 96% (86–100%)	9 (2–30); 100% (100–100%)	2 (1–2); 100% (100–100%)
13b. Number; Percent of clusters with supplemental/targeted interviewing of cases	17 (3–45); 27% (11–64%)	5 (0–12); 48% (0–100%)	No cumulative data available[1]
13c. Number; Percent of clusters where an analytic epidemiologic study conducted (>10 Salmonella or STEC cases, >5 Listeria cases)	9 (0–44); 33% (0–100%)	0.5 (0–2); 25% (0–100%)	0.7 (0–2); 33% (0–100%)
13d. Median duration (in days) of epidemiologic investigation, from cluster notification to end of investigation/close-out	26 days (18–30)	No cumulative data available[1]	No cumulative data available[1]
14. Number; Percent of clusters with suspect vehicle/source identified	11 (3–44); 16% (4–45%)	2 (0–5); 36% (0–100%)	0.7 (0–2); 33% (0–100%)
15. Number; Percent of clusters with confirmed vehicle/source identified	4 (1–9); 6% (1–13%)	2 (0–5); 27% (0–100%)	1 (0–2); 67% (0–100%)
16a. Number; Percent of clusters with identified vehicle/source with control measure	12 (0–44); 29% (0–63%)	3 (0–7); 63% (0–100%)	No cumulative data available[1]
16b. Number; Percent of clusters with identified vehicle/source with public health action	9 (0–44); 22% (0–50%)	2 (1–4); 54% (33–100%)	1 (0–2); 67% (0–100%)
17. Number; Percent of clusters linked to a restaurant/food establishment with EHA	2 (0–4); 15% (0–80%)	0.7 (0–3); 20% (0–100%)	0 (0–0); 0% (0–0%)
18. Number; Percent of clusters with food/ environmental sample collected for testing	2 (0–7); 3% (0–9%)	2 (0–5); 9% (0–36%)	0 (0–0); 0% (0–0%)
19. Number; Percent of clusters where EH, Ag, regulatory, or food safety program staff contacted	23 (0–86); 35% (0–100%)	11 (0–50); 36% (0–100%)	1 (0–2); 67% (0–100%)
20. Number; Percent of outbreaks with NORS form completed	12 (1–48); 37% (3–94%)	4 (1–9); 55% (24–100%)	No cumulative data available[1]
20a. Number; Percent of outbreaks with supplemental form completed	No cumulative data available[1]	No cumulative data available[1]	No cumulative data available[1]

[1]Cumulative data for this metric were not reported from 3 or more centers