Enteric Disease Timeline Study

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The Council of State and Territorial Epidemiologists (CSTE) conducted this project with support from its cooperative agreement with the Centers for Disease Control and Prevention's National Center for Infectious Disease/Division of Bacterial and Mycotic Diseases (CDC-NCID/DBMD)-Food Safety Office.

The EDITS Project Leads were Jesse Greenblatt, State Epidemiologist, New Hampshire, and Bela Matyas, State Epidemiologist, Massachusetts. Their longstanding interest in Food Safety have made them national resources. The EDITS Core Operational Team also included Arthur Liang, Don Sharp, and Richard Skibicki, from CDC's Food Safety Office, Jennifer Lemmings, CSTE, and Craig Hedberg, PI.

The EDITS Advisory Committee included representatives of CSTE, CDC, ASTHO, NEHA, APHL, NACCHO, FDA, USDA, and AFDO.

The PI is deeply indebted to the EDITS Project Leads, Core Operational Team, and Advisory Committee for guidance and support throughout the project. In addition, this project would not have been possible without the support of the participants in the individual states:

- State Epidemiologists
- Surveillance staff of State and Local Health Departments
- PFGE Groups and Public Health Laboratories

EXECUTIVE SUMMARY

BACKROUND

The Enteric Disease Investigation Timelines Study (EDITS) was developed to assess time intervals from disease onset to reporting to CDC. It was a follow-up to National Assessment of Epidemiology Capacity in Food Safety Programs 2002 (http://www.cste.org), and was conducted under the CDC Cooperative Agreement with CSTE.

EDITS establishes baseline measures to evaluate improved performance of foodborne disease surveillance and identifies strategies for improvement

METHODS

Six states were selected and agreed to participate based on a variety of parameters including size, geographic location, FoodNet or PulseNet support, type of public health reporting system, and a measure of performance for surveillance. The measure used for this purpose was the ratio of *Salmonella* cases reported through NETTS and PHLIS.

The study included 2002 surveillance data. A sample of cases selected by state:

≤ 100 *Salmonella*
≤ 50 *E. coli* O157:H7, *Shigella, Campylobacter*
All confirmed foodborne outbreaks were included.

Timeline information was abstracted from records at State and Local Health Departments, and Public Health Laboratories.

RESULTS

Altogether, 1319 records from individual cases of *Salmonella, Shigella, E. coli* O157:H7 and *Campylobacter* infections were and 112 outbreaks from six states reviewed. Data completeness varied; the date of collection of the stool sample was available for 82% of cases, but the date of onset of symptoms was available for only 66% of cases.

All milestones were reached 1-3 days earlier for *E. coli* O157:H7 cases and isolates than for *Salmonella.* Median intervals, respectively from onset were:

3 and 4 days to stool collection
7 and 9 days to the case being reported to the health department
8 and 10 days to the isolate being submitted to the health department
12 and 14 days to the cases being interviewed
15 and 18 days to the isolate being subtyped.

States with decentralized surveillance, where cases were reported initially to Local Health Departments (LHD,) were quicker to interview cases, but states with centralized PHL laboratory surveillance were quicker to subtype the isolates. The primary difference for these timelines appears to relate to actions of the Local or State HD, following report of the case

and submission of the isolate. Differences from *Salmonella*, suggest greater sense of urgency associated with *E. coli* O157:H7, particularly from the stand point of conducting interviews by LHD.

Isolate submission requirement affected percentage of isolates submitted, but not timelines.

Of 112 confirmed foodborne disease outbreaks, 52 (46%) were caused by norovirus, 20 (18%) were caused by *Salmonella*, four (4%) were caused by *E. coli* O157:H7, three (3%) were caused by *Campylobacter*, and 20 (18%) were caused by other, non-EDITS pathogens. The distribution of outbreaks by agent varied with respect to the characteristics of the state surveillance system. For the centralized surveillance, 69% of outbreaks were norovirus and 9% were *Salmonella*. For states with decentralized surveillance, 43% were norovirus and 26% were *Salmonella*.

Median intervals from onset to outbreak complaint or recognition ranged from:
1-3 days for bacterial toxins and norovirus
8-10 days for *E. coli* O157:H7 and *Salmonella.*

For outbreaks caused by *Campylobacter*, *E. coli* O157:H7, and *Salmonella*, median intervals from onset to outbreak recognition were:
9 days for complaint and provider report
12 days for case follow-up
>21 days for PFGE subtype.
However, a small number of outbreaks were reported by providers, 2-3 days after onset and before confirmation of etiology.

Outbreak detection timelines were consistent with reporting timelines from individual cases.

DISCUSSION/CONCLUSIONS

Local Health Departments appear to provide faster response times for case interviews than do states with centralized surveillance.

Rules requiring submission of isolates increase percentage of isolates submitted, but not timeliness.

States with centralized PHL surveillance appear to provide faster PFGE subtyping, and better opportunities to link epidemiology and laboratory results.

Detection of most outbreaks caused by *E. coli* O157:H7 and *Salmonella* appears to be dependent on case surveillance.

Thus, centralization of surveillance and outbreak responses may result in more effective outbreak responses, as evidenced by higher rates of reported outbreaks.

RECOMMENDATIONS

Ensure that, at least, all *Salmonella* and *E. coli* O157:H7 are forwarded to the PHL and routinely subtyped by PFGE.

Take advantage of the widespread availability and relative speed of Local Health Departments to conduct interviews.

Use standardized, broad-based exposure questionnaires to routinely and systematically collect data for use in cluster and outbreak investigations.

Immediately forward completed questionnaires to the State HD for linkage with PFGE subtype results.

Establish centralized and standardized foodborne illness complaint systems.

Establish performance criteria for routine surveillance and outbreak investigations.

BACKGROUND

This document is a report to CSTE and the Centers for Disease Control and Prevention (CDC) of a project supported by cooperative agreement U60/CCU007277. This particular project was funded through the cooperative agreement by the National Center for Infectious Diseases, through the Food Safety Office.

The Enteric Disease Investigation Timeline Study (EDITS) represents the third in a series of efforts to evaluate the Nation's capacity and capabilities to conduct foodborne disease surveillance that were initiated in response to the National Food Safety Initiative (NFSI). In 1997 a work group of CSTE, the Association of Public Health Laboratories (APHL), CDC, federal food regulatory agencies, and representatives of state and local health departments developed a report summarizing basic epidemiology and laboratory capacity for foodborne disease surveillance and outbreak response[1].

In 2001, CSTE in conjunction with the National Association of City and County Health Officials (NACCHO) and APHL surveyed states and territories to assess foodborne illness surveillance and response capacity. This survey was designed based on the *Essential Epidemiology and Laboratory Components of a State Foodborne Disease Prevention and Control Program Report*. Results of the National Assessment of Epidemiology Capacity in Food Safety Programs 2002 (http://www.cste.org) were used by the CSTE Food Safety Standards Advisory Committee in 2002 to develop minimum performance/capacity standards for foodborne disease surveillance[2].

Because the first report comprised expert opinion and the second report represented a survey of perceived capacity and needs, CSTE convened an EDITS Steering Committee composed of representatives from CSTE, CDC, the Association of State and Territorial Health Officers (ASTHO), the National Environmental Health Association (NEHA), APHL, and NACCHO to develop a project to assess time intervals from disease onset to reporting to CDC for the surveillance of foodborne diseases and investigation of foodborne outbreaks. The EDITS project program goals were to examine potential lags in enteric disease reporting time and obstacles to reporting, both for individual cases of reportable enteric diseases and complaints of foodborne illness. EDITS also establishes baseline measures to evaluate improved performance of foodborne disease surveillance and identifies strategies for improvement.

In 2003, a request for proposals was announced, and Craig Hedberg, University of Minnesota, School of Public Health, Division of Environmental Health Sciences was chosen to serve as Principle Investigator for the project.

METHODS

The EDITS Steering Committee established the overall goals of the study and a framework for conducting the study in five states. A smaller EDITS work group developed specific methods with the intention of evaluating the impact of several parameters on enteric disease reporting.

These included:

a. Population (stratifying based on the size of the population)
b. Geographic location (stratifying based on region of the country)
c. External support for enteric disease surveillance (stratifying based on participation in FoodNet, or as PulseNet regional laboratory)
d. Demonstrated capacity for conducting enteric disease surveillance (stratifying based on some measure of reporting efficiency)
e. Public health reporting system organization (stratifying based on reporting to central state health department or individual local health departments)

Selection of states:

In order to provide an analytical framework that allowed evaluation of these multiple parameters, while preserving the limited sample size of states, selection required overlapping selection criteria among the states selected. Methods for stratifying by parameter are described below.

a. The 2000 Census population of states ranged from 480,000 (Wyoming) to 33,145,000 (California). Thus, a stratification scheme was developed with the following population ranges:

    Large states: Population > 6,000,000; includes 13 states.
    Medium states: Population 2,000,000 – 6,000,000; includes 21 states.
    Small states: Population < 2,000,000; includes 19 states.

b. Enteric disease surveillance data were aggregated by state in nine geographic regions used by CDC: New England, Mid-Atlantic, E.N. Central, W.N. Central, S. Atlantic, E.S. Central, W.S. Central, Mountain, and Pacific. These were retained for this project.

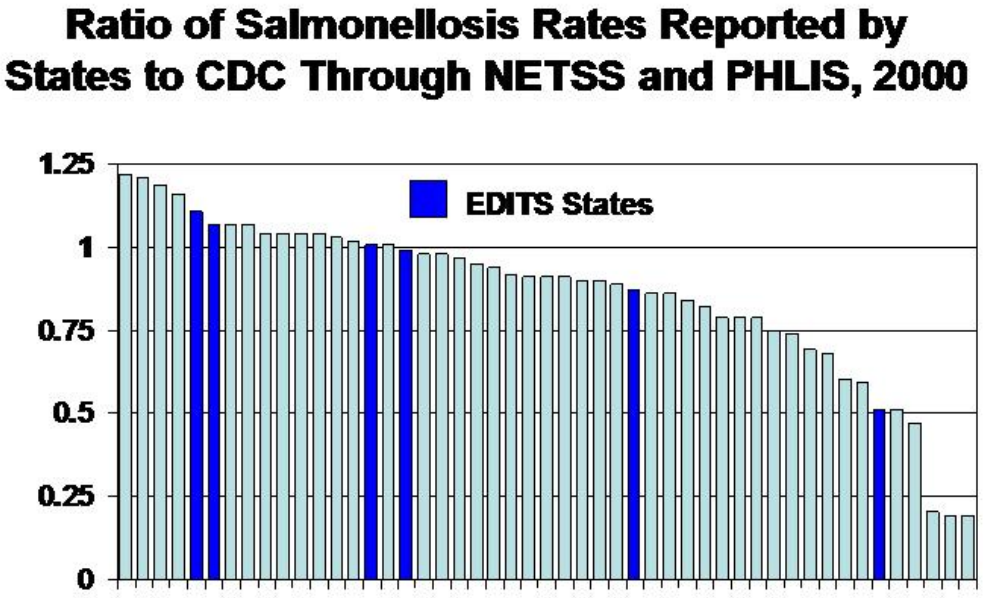
c. States participating in FoodNet or as a PulseNet regional laboratory were identified by CDC.

d. A relevant measure of surveillance capacity was derived from the results of surveillance. In this regard consideration was given to the two major surveillance activities being assessed, pathogen-specific surveillance and outbreak surveillance. In general, comparisons between states with regard to pathogen-specific surveillance can be influenced by regional differences in the underlying distribution of disease, as well as by differences in clinical diagnostic practices and availability of laboratory testing. For example, reported rates of *E.coli* O157:H7 infections would not be a useful comparison because large differences between states would be expected. Similarly, the number of confirmed foodborne outbreaks reported may be influenced by several factors.

The one agent for which meaningful comparisons between states can be made is *Salmonella*. Public health surveillance for *Salmonella* is well established across the country, and active surveillance within the FoodNet sites suggest that while serotype distributions vary, the overall rates of *Salmonella* infections do not vary greatly by state or region. In addition, estimates derived from FoodNet suggest that traditional passive surveillance for *Salmonella* is comprehensive.

Salmonella surveillance may also provide an opportunity to compare case-based reporting to the submission of isolates to the Public Health Laboratory. Since submission of isolates to the Public Health Laboratory is critical to the performance of PulseNet, the relationship between case-based reporting and isolate submissions appears to be an important index of surveillance capacity. Thus, for the purposes of stratification, the ratio of confirmed *Salmonella* cases reported through NETSS to *Salmonella* cases reported through PHLIS was created, as follows:

High: PHLIS:NETSS > 1.0
Medium: PHLIS:NETSS < 1.0, > 0.8
Low: PHLIS:NETSS <0.8



e. For states that were selected based on a distribution of characteristics for the parameters described above, reporting rules were obtained to determine whether reports were required to the state or local health departments, and how quickly the reports were required to be submitted.

Based on a review of the distribution of states based on the above parameters, seven states were selected for inclusion in the study. However, we were unable to include one state in the analysis. Thus, the six states that comprised the study are characterized in the following table.

Table 1. Characteristics of states selected for inclusion in EDITS, based on *Salmonella* surveillance for 2000, NETSS and PHLIS are rates per 100,000 population.

AREA	POPULATION	*NETSS*	*PHLIS*	*Salmonella* index	Reporting
Large State: > 6,000,000					
S. Atlantic	7,651,000	15.018	14.874	0.990	Local
Medium States: 2,000,000- 6,000,000					
E.N. Central	5,250,000	14.571	7.371	0.506	Local
W.N. Central	4,776,000	12.856	14.217	1.106	State
New England	3,282,000	12.736	13.650	1.072	State and local
Small States: <2,000,000					
Mountain	1,740,000	13.736	11.954	0.870	State or local
New England	1,201,000	12.323	12.406	1.007	State

***Salmonella* Index**
High: PHLIS/NETSS > 1.0
Medium: PHLIS/NETSS > 0.8, < 1.0
Low: PHLIS/NETSS < 0.8

FoodNet State
PulseNet Area Laboratory

The states were selected to provide variety in size, geographic location, external support for surveillance, reporting jurisdictions, and ratio of cases reported to NETSS compared to PHLIS. While relatively few of these characteristics were expected to directly relate to the timeliness of reporting, their overlapping combinations were expected to allow for some control of the factors in the evaluations. In addition to the factors shown in the table, the states have variability in how quickly and in what format case reports are to be made, and in whether isolates are required to be submitted to the Public Health Laboratory.

Selection of reportable diseases and number of reports to be evaluated:

The EDITS Study intended to characterize the timeliness of enteric foodborne disease reporting. Thus, the principle reportable bacterial pathogens, *Salmonella, Shigella, E. coli* O157:H7, *Campylobacter*, and confirmed foodborne outbreaks were included. The large number and range in numbers of cases of these pathogens reported by state made it impractical to try to evaluate timeline data for each case reported. Thus, in order to get an informative sample of cases from each state, up to 100 *Salmonella* isolates, and up to 50 isolates of *Shigella*, *E. coli* O157:H7, *Campylobacter* were selected. Data were collected for all foodborne outbreaks. Records from 2002 were selected, to ensure that records would be complete at the time of review.

Data handling:

Samples were selected by randomization or by systematically selecting every n^{th} record based on the number of cases reported and the number to be sampled. For example, if the state had recorded 600 Salmonella cases, and wanted to select a sample of 100, every 6^{th} record was chosen. Each state selected samples based on methods that were most amenable to its surveillance file storage systems.

Timeline information was abstracted from records at State and Local Health Departments and Public Health Laboratories. Record review and abstraction was conducted either by project staff under the direction of the state epidemiologist, or by state and local surveillance staff.

Data free of identifiers was compiled in a master database for analysis.

Enteric disease reporting milestones evaluated:

For individual cases of enteric disease reported, data on the following milestones was collected:

Date of onset of symptoms
Date of stool specimen collection
Date of positive stool result
Date of report to state or local health department
Date of submission of isolate to public health laboratory
Date of interview
Date of molecular subtyping by pulsed field gel electrophoresis

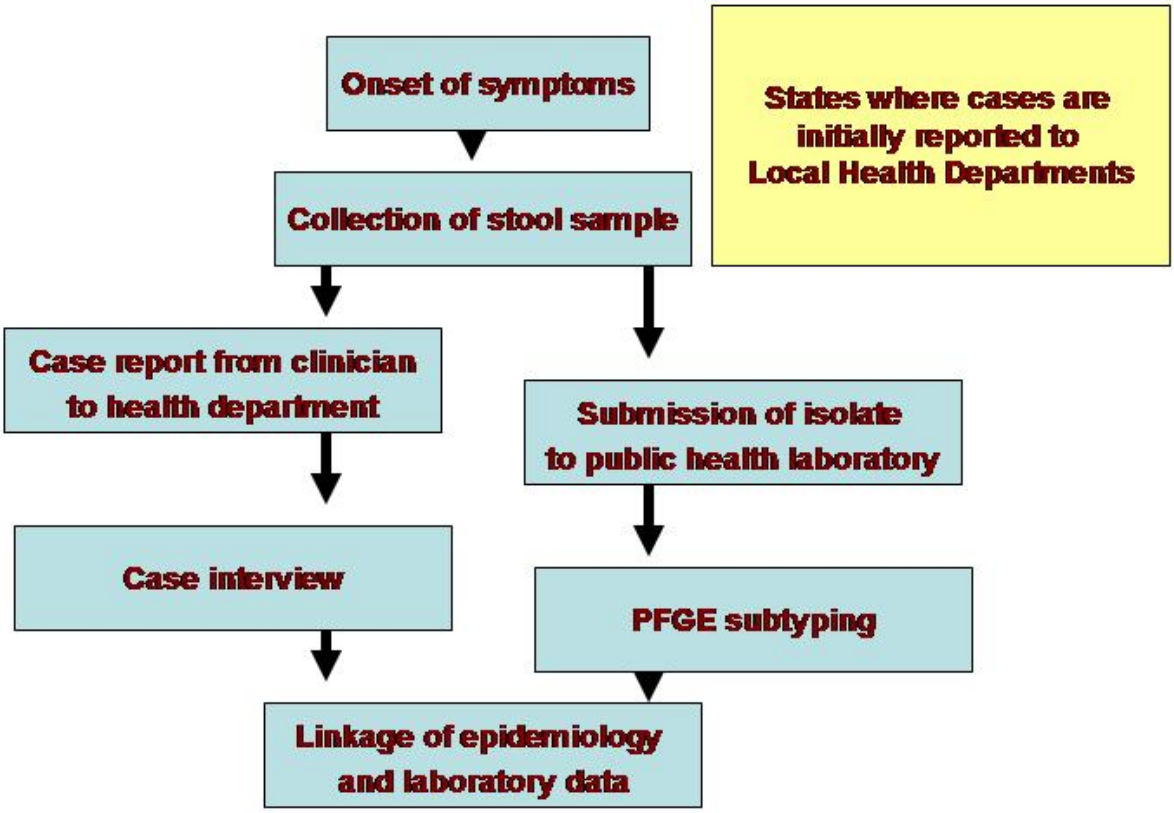
For each record, intervals between milestones were calculated from the dates available.

For outbreaks of foodborne disease, data on the following milestones was collected:

Date of event
Date of onset of symptoms of index cases
Date of stool collection
Date of foodborne illness complaint or report of outbreak related case to local or state health department
Date of initiation of outbreak investigation
Date of conclusion of outbreak investigation

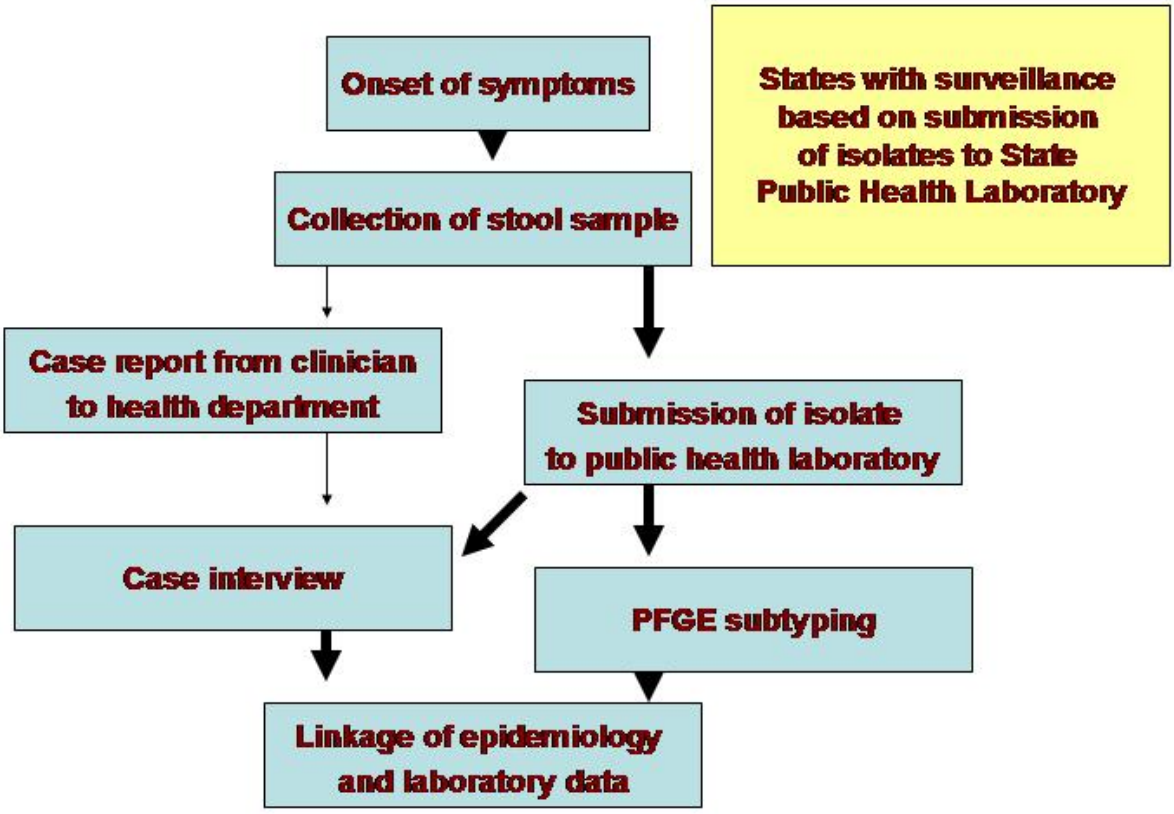
For each outbreak, intervals were calculated from the dates available.

The general flow chart of disease reporting for most states is shown in the accompanying figure:



Although most states have systems in which individual cases are reported from clinicians and clinical laboratories to local public health agencies, a small number of states have centralized reporting systems in which individual cases are reported directly to a central state surveillance office and isolates are submitted to a State Public Health Laboratory. In these latter states, the submission of the isolate to the State Public Health Laboratory frequently serves as the first report of the case. To evaluate the impact this has on reporting timelines, a comparison was

made of states with surveillance based on submission of isolates to State Public Health Laboratory with states where cases are initially reported to Local Health Departments. The flow diagram for the states with centralized surveillance is shown in the accompanying figure.



RESULTS

Pathogen-specific surveillance:

Altogether, 1319 records from individual cases of *Salmonella*, *Shigella*, *E. coli* O157:H7 and *Campylobacter* infections were reviewed. The completeness of data for specific milestones is shown in the accompanying table. Data are summarized for six key milestones that form the basis for the rest of the report. For other dates, such as date of positive culture result at the clinical laboratory, available data were not adequate to evaluate. Most local and state health departments maintain information submitted to them, but do not routinely seek to obtain additional information that was missing from the original report. Thus, the date of collection of the stool sample was available for 82% of cases, but the date of onset of symptoms was available for only 66% of cases.

EDITS: Data Quality

Date	Subjects	No. (%) Complete
Onset of symptoms	1319	873 (66%)
Collection of stool sample	1319	1088 (82%)
Case report from clinician to health department	1269	553 (44%)
Submission of isolate to public health laboratory	899	882 (98%)
PFGE subtyping	635	634 (100%)
Case interview	1319	634 (48%)

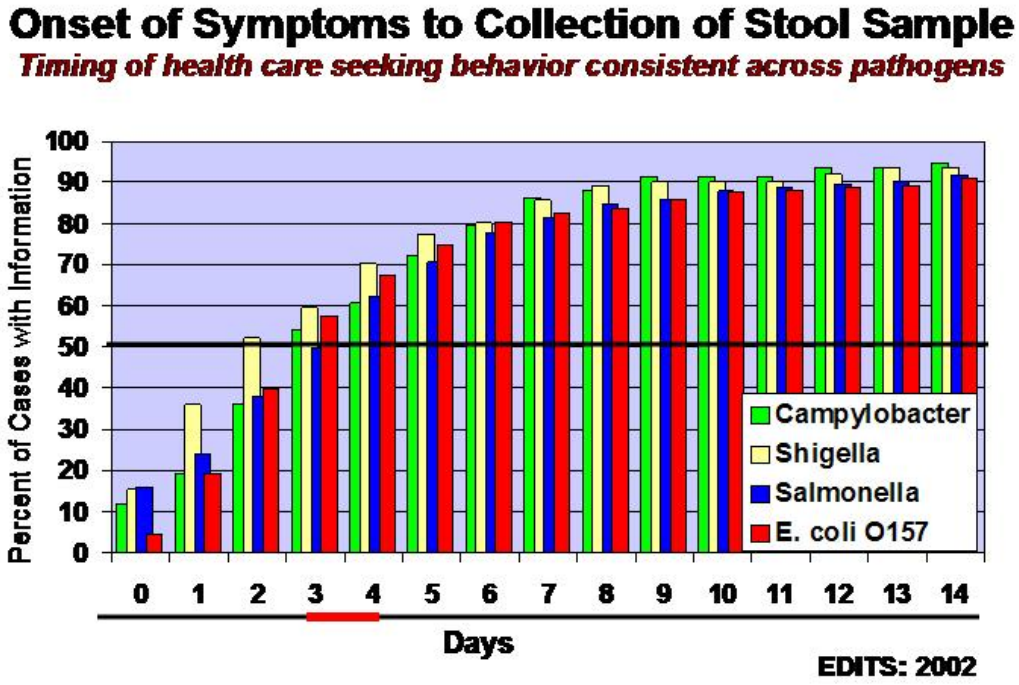
For the two foodborne disease pathogens with the greatest public health importance, and for which the most complete data were available, the timelines for these milestones from onset of symptoms are summarized in the following table. The table displays the median interval to the timeline for the aggregate data, and the range for medians by state. Thus, the variability by state was much greater for case interview and PFGE subtyping than for collection of stool sample, case report from clinician to health department, and submission of the isolate to the public health laboratory.

Median Intervals (days) and Range (by state) from Onset of Symptoms to Timeline Event

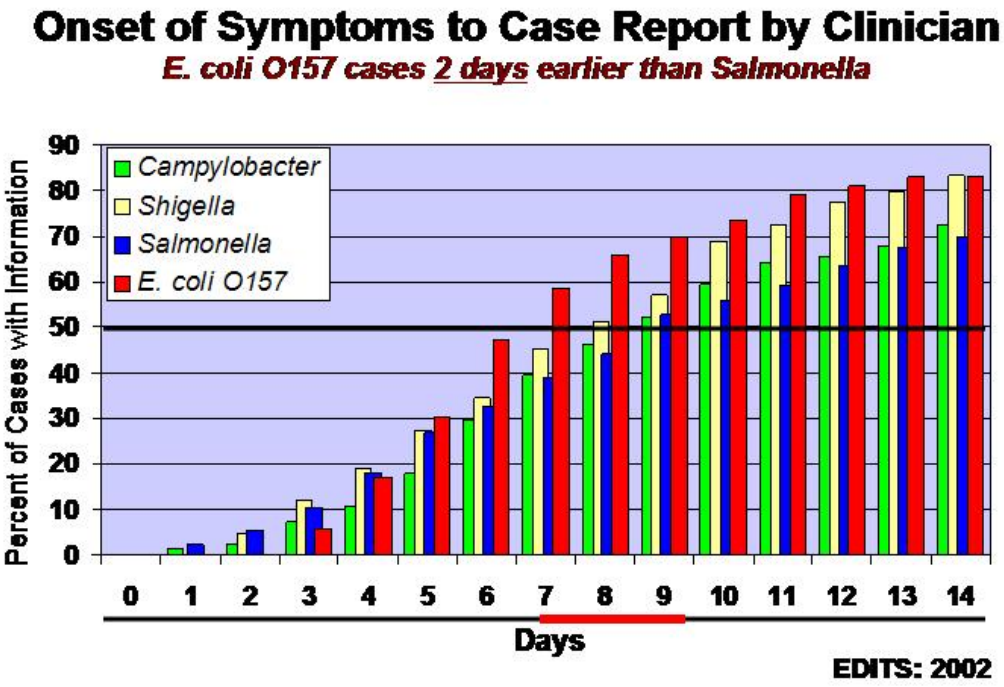
Timeline Event	*Salmonella*	*E. coli* O157
Collection of stool sample	4 (2, 4)	3 (2, 6)
Case report from clinician to health department	9 (8, 11)	7 (6, 7)
Submission of isolate to public health laboratory	10 (8, 11)	8 (5, 9)
Case interview	14 (14, 22)	12 (9, 16)
PFGE subtyping	18 (15, 28)	15 (11, 22)

For each of these, *E. coli* O157:H7 infections reached the milestones a median of 1-3 days before the *Salmonella* isolates. This suggests that clinicians and the public health system are placing a higher priority on *E. coli* O157:H7 infections than on *Salmonella* infections. Given the risk of haemolytic uremic syndrome (HUS) following *E. coli* O157:H7 infections, and the potential for person-to person transmission, such attention may be warranted.

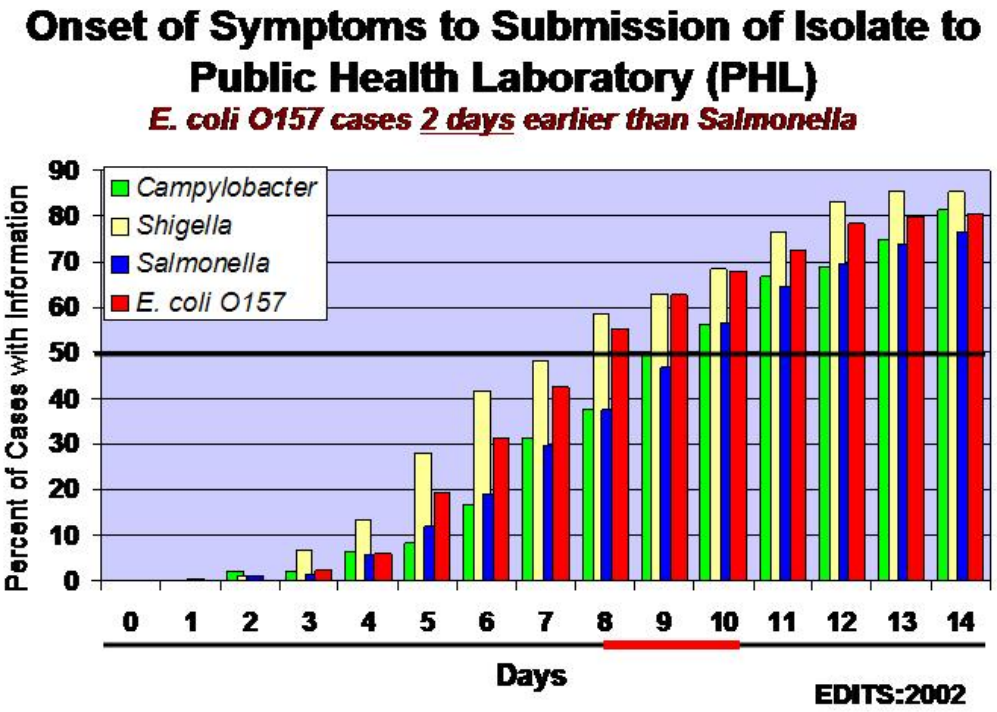
The distribution of intervals from onset of symptoms to collection of stool samples for *Salmonella*, *Shigella*, *Campylobacter* and *E. coli* O157:H7 are shown in the following figure. The medians for all of these pathogens ranged from 2-4 days, with little variability. However, noticeably fewer *E. coli* O157:H7 cases apparently sought medical attention within the first day following onset of illness.

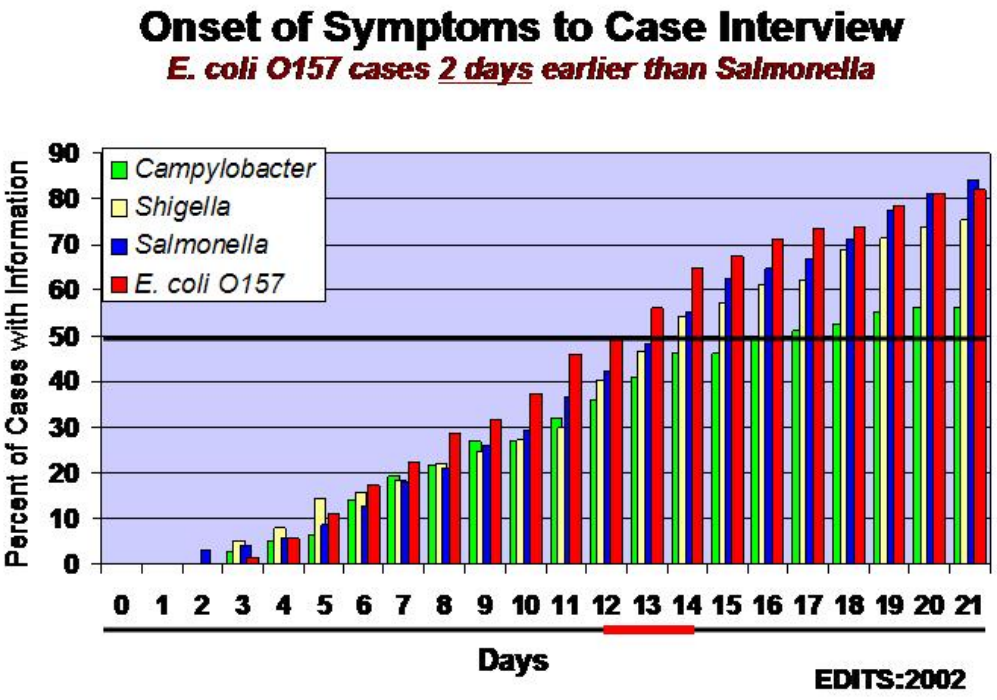


Pathogen-specific differences in reporting began to be noted in the interval from onset of symptoms to case report by the clinician to the health department, as shown in the following figure. Of note is that *E. coli* O157:H7 cases got reported a median of 2 days earlier than *Salmonella* cases.

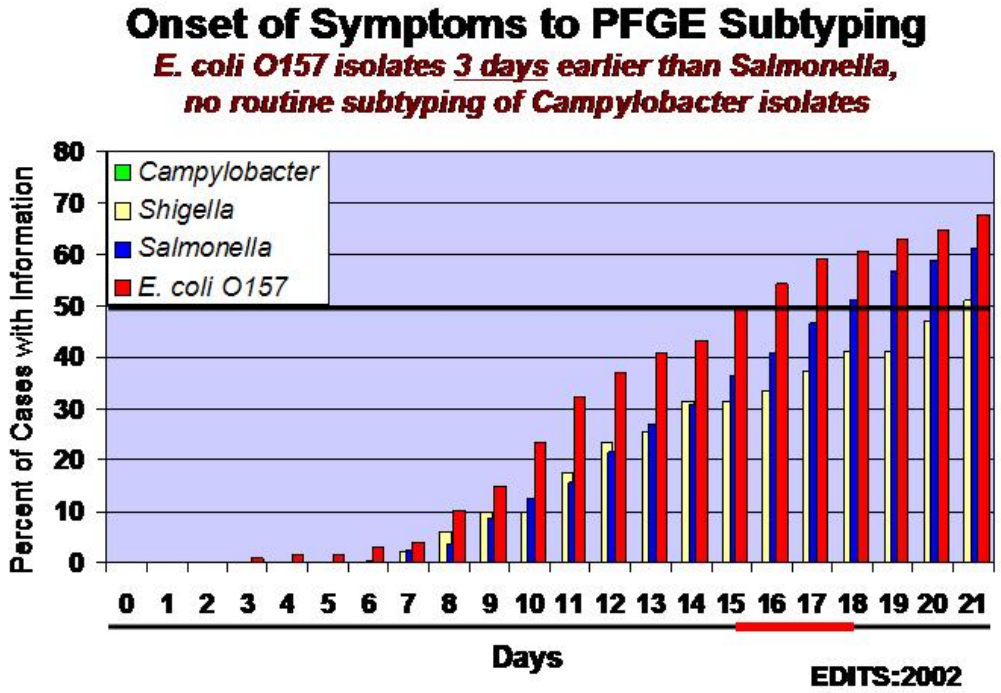


Similarly, *E.coli* O157:H7 isolates got submitted and interviewed a median of 2 days earlier than *Salmonella* isolates, as shown in the following figures.





Finally, *E. coli* O157:H7 isolates got subtyped a median of 3 days earlier than *Salmonella* isolates did. Of note, in the following figure, no routine subtyping of *Campylobacter* isolates by PFGE was performed in these states during 2002.

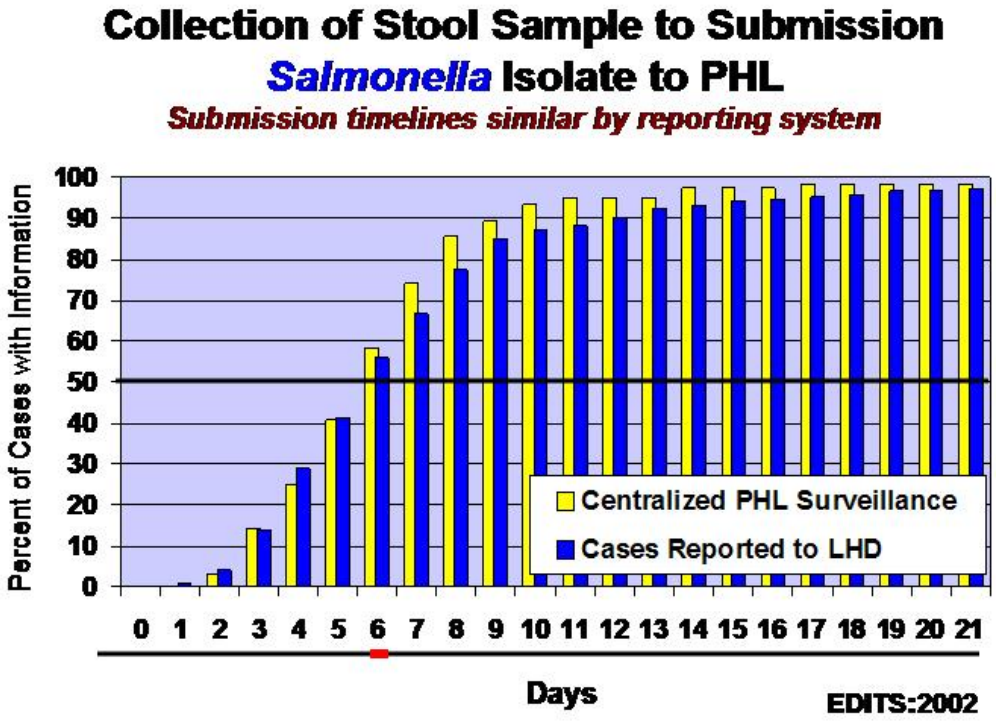


Following completion of case reports at the state level, data were forwarded to CDC via the NETTS system and PHLIS. Reports to NETTS were generated by the epidemiology surveillance offices of the state health departments and were generally sent on a weekly basis, following a routine schedule. Reports to PHLIS were submitted by the Public Health Laboratories, with the exception of FoodNet states, where PHLIS reporting was conducted by FoodNet staff. Uploading of PFGE patterns to Pulsenet was conducted by Public Health Laboratory staff. During the 2002 surveillance year, upload dates were not always documented. Although the goal was to upload patterns on a regular basis, delays in uploading were reported as a result of re-analyzing gels or because of large numbers of specimens to process during periods of peak activity. Thus, delays in reporting data to CDC can not be adequately analyzed with these data.

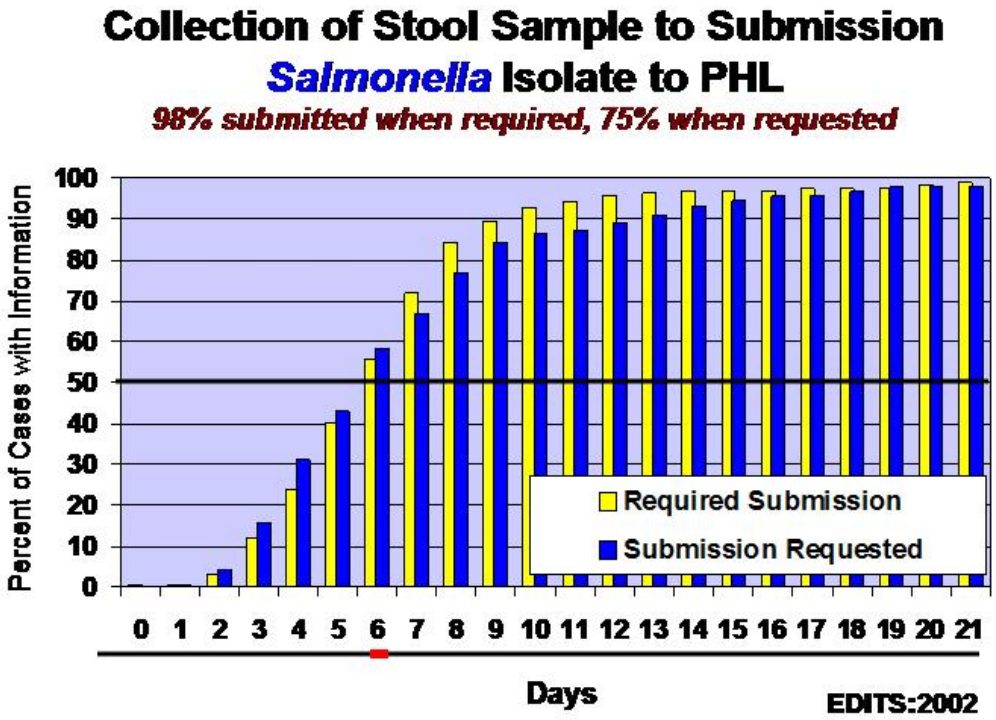
However, since the critical functions of foodborne disease surveillance happen at state and local levels, the timelines related to state and local activities are the primary ones of concern. To evaluate what impact the organization of surveillance on a state level has on the timeliness of surveillance, comparisons were made between states where cases are routinely reported to local health agencies (a decentralized system), to states with centralized disease reporting and submission of isolates to the Public Health Laboratory. In these states, the submission of the isolate to the Public Health Laboratory was usually the first notification of the illness. The following series of figures highlights apparent differences in these surveillance systems for

Salmonella. These figures are followed by a similar set of figures for *E. coli* O157:H7 surveillance.

This first figure demonstrates that there was no real difference among states with respect to how quickly stool samples are submitted to the Public Health Laboratory following collection of stool. Whether the surveillance system was centralized at the state health department, or decentralized among local health departments, it took a median of 6 days (interquartile range, 4-8 days) for a *Salmonella* isolate to be submitted to the Public Health Laboratory following collection of stool. This interval includes time it took to culture and presumptively identify the organism at the clinical laboratory, and transport it to the state Public Health Laboratory.



Furthermore, as shown in the following figure, there was no difference in the timeliness of submitting Salmonella isolates between state that required submission of the isolates and those that requested, by did not require submission. For both, it took a median of 6 days (interquartile range, 4-8 days) for a *Salmonella* isolate to be submitted to the Public Health Laboratory following collection of stool. However, a higher percentage of isolates were submitted in states where submission was required (98%) compared to states where submission of isolates was requested (75%).

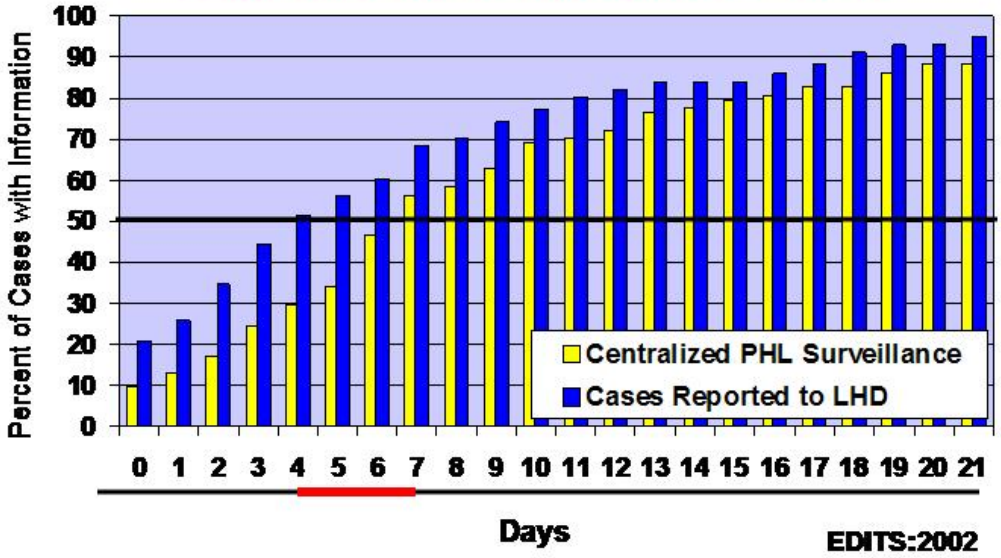


The effect of the structure of the surveillance system on enteric disease timelines can be seen in the following two figures. In states with decentralized surveillance where cases were reported to local health agencies, cases were interviewed a median 3 days earlier (4 days versus 7 days after the case was reported). However, states with centralized reporting were faster to subtype isolates by PFGE, by a median 9 days (4 days versus 13 days following submission of the isolate).

Case Report to Case Interview

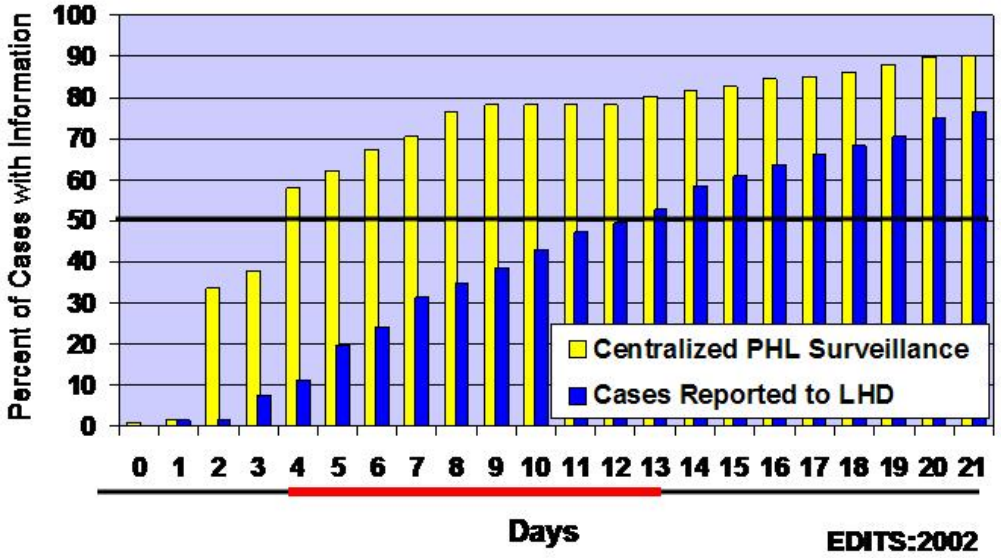
Salmonella

3 days earlier in states with reporting to Local HD

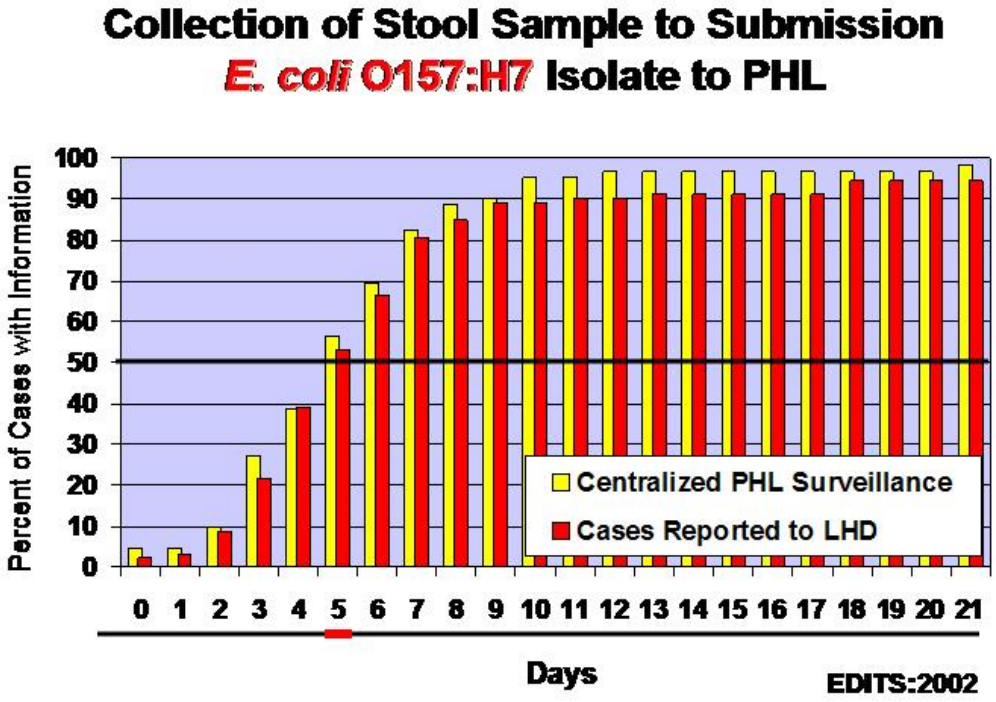


Submission *Salmonella* Isolate PHL to PFGE

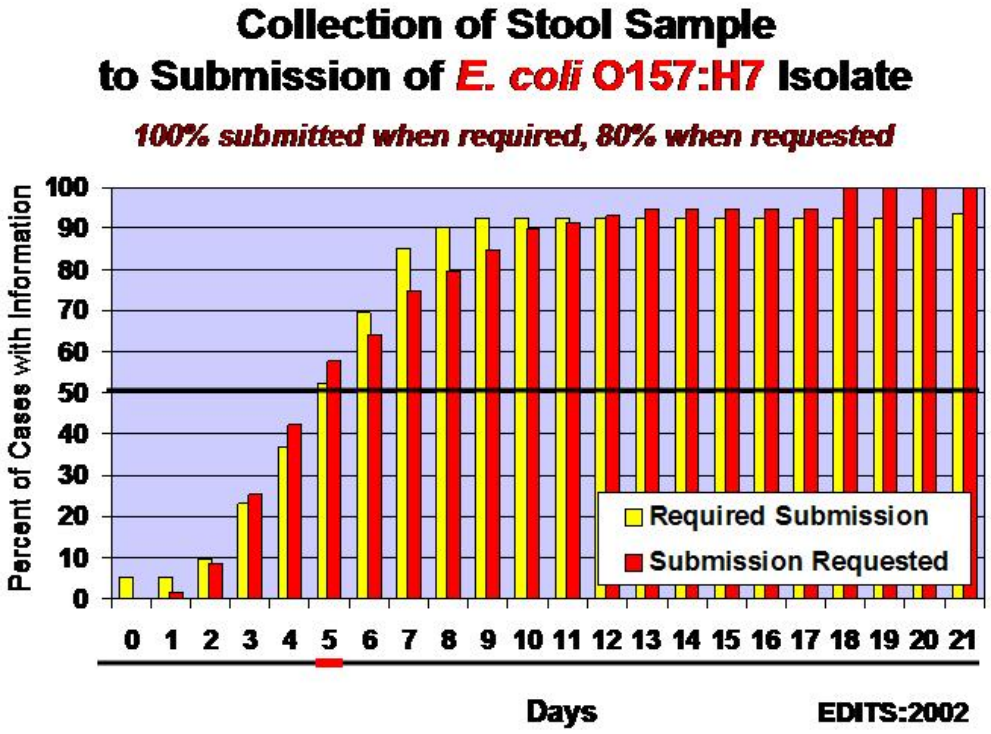
9 days earlier in states with centralized PHL surveillance



The following series of figures demonstrates the same relationships for surveillance of *E. coli* O157:H7. This first figure demonstrates that there was no real difference among states with respect to how quickly stool samples are submitted to the Public Health Laboratory following collection of stool. Whether the surveillance system was centralized at the state health department, or decentralized among local health departments, it took a median of 5 days (interquartile range, 3-7 days) for an *E. coli* O157:H7 isolate to be submitted to the Public Health Laboratory following collection of stool. This interval includes time it took to culture and presumptively identify the organism at the clinical laboratory, and transport it to the state Public Health Laboratory. As noted above, this was 1 day quicker than observed for *Salmonella*.



As shown in the following figure, there was no difference in the timeliness of submitting *E. coli* O157:H7 isolates between state that required submission of the isolates and those that requested, by did not require submission. For both, it took a median of 5 days (interquartile range, 3-7 days) for an *E. coli* O157:H7 isolate to be submitted to the Public Health Laboratory following collection of stool. However, as with *Salmonella*, a higher percentage of isolates were submitted in states where submission was required (100%) compared to states where submission of isolates was requested (80%).

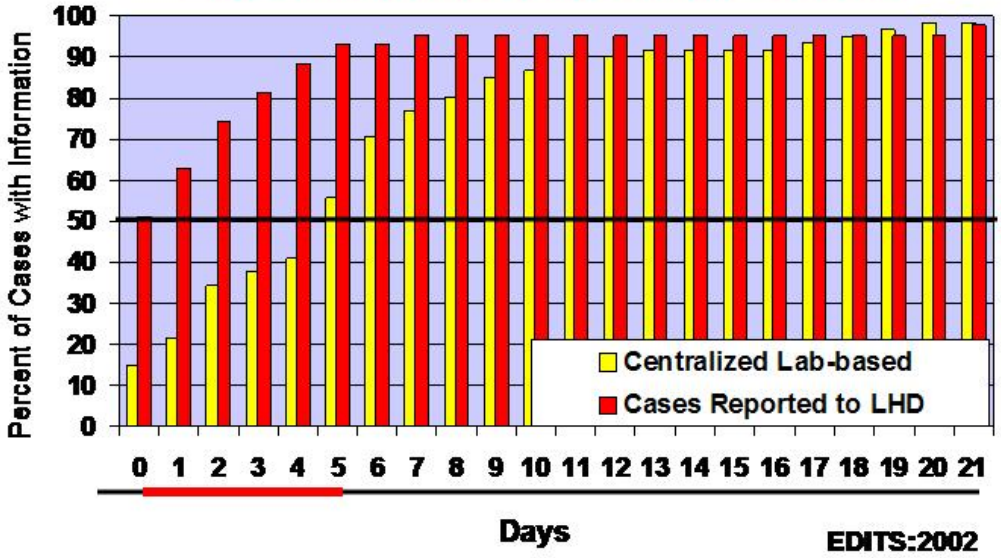


As with *Salmonella*, the effect of the structure of the surveillance system on enteric disease timelines can be seen in the following two figures. In states with decentralized surveillance where cases were reported to local health agencies, cases were interviewed a median 5 days earlier (0 days versus 7 days after the case was reported). However, states with centralized reporting were faster to subtype isolates by PFGE, by a median 3 days (4 days versus 7 days following submission of the isolate). Although the trends were the same as seen with *Salmonella*, there was a distinct shift in the intervals that suggest that *E. coli* O157H7 isolates have received a much higher priority than *Salmonella* in those states with decentralized surveillance.

Case Report to Case Interview

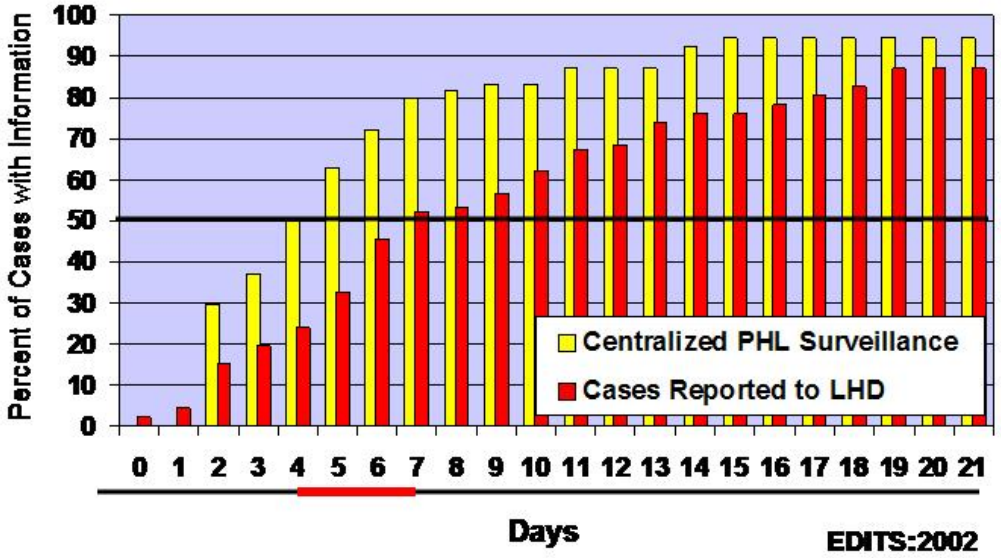
E. coli O157:H7

5 days earlier in states with reporting to Local HD



Submission *E. coli* O157:H7 Isolate PHL to PFGE

3 days earlier in states with centralized PHL surveillance



Outbreak detection and investigation:

During 2002, 112 confirmed foodborne disease outbreaks were reported in the EDITS states. The number of outbreaks by etiology and characteristics of the state surveillance system are shown in the following table. Of these, 52 (46%) were caused by norovirus, 20 (18%) were caused by *Salmonella*, four (4%) were caused by *E. coli* O157:H7, three (3%) were caused by *Campylobacter*, and 20 (18%) were caused by other, non-EDITS pathogens. The distribution of outbreaks by agent varied with respect to the characteristics of the state surveillance system. For the centralized surveillance, 69% of outbreaks were norovirus and 9% were *Salmonella*. For states with decentralized surveillance, 43% were norovirus and 26% were *Salmonella*. The proportion of outbreaks with confirmed etiology was 74% overall and did not vary markedly by type of surveillance system.

Number of Outbreaks and (%) with Confirmed Etiology Reported to EFORS from EDITS States
by State Characteristic

Agent	Central PHL Surveillance	Cases Reported to LHD
Norovirus	37 (70)	25 (76)
Other, Non-EDITS	8 (50)	12 (67)
Salmonella	5 (100)	15 (100)
E. coli O157:H7	2 (100)	2 (100)
Campylobacter	1 (100)	2 (100)
Total	54 (70)	58 (78)

On a population basis, states with centralized surveillance reported a higher rate of outbreaks; 9.0 outbreaks per million population compared to 4.4 outbreaks per million population for states with decentralized surveillance. As shown in the following table, this difference was primarily due to increased reporting of norovirus outbreaks in the states with centralized surveillance; 6.2 per million population compared to 1.9 per million population in states with decentralized surveillance.

Number of Outbreaks and Rate per 10^6 Population Reported to EFORS from EDITS States by State Characteristic

Agent	Central PHL Surveillance	Cases Reported to LHD
Norovirus	37 (6.2)	25 (1.9)
Other, Non-EDITS	8 (1.3)	12 (0.9)
Salmonella	5 (0.8)	15 (1.1)
E. coli O157:H7	2 (0.3)	2 (0.2)
Campylobacter	1 (0.2)	2 (0.2)
Total	54 (9.0)	58 (4.4)

Although the population-based rate of outbreaks for *Salmonella* and *E. coli* O157:H7 were similar across types of surveillance system, states with centralized surveillance reported a higher number of outbreaks per 1,000 reported cases of these agents. As shown in the following table, the rate of outbreaks detected per 1,000 reported cases was more than 50% greater in the states with centralized surveillance. While the differences in these rates appear small, on a national basis they could result in detection of an additional 13 outbreaks of *E. coli* O157:H7 and 100 outbreaks of *Salmonella*.

Number of Outbreaks and Rate per 10^3 Reported Cases Reported to EFORS from EDITS States
by State Characteristic

Agent	Central PHL Surveillance	Cases Reported to LHD
Salmonella	5 (6.8)	15 (4.5)
E. coli O157:H7	2 (10.1)	2 (5.7)

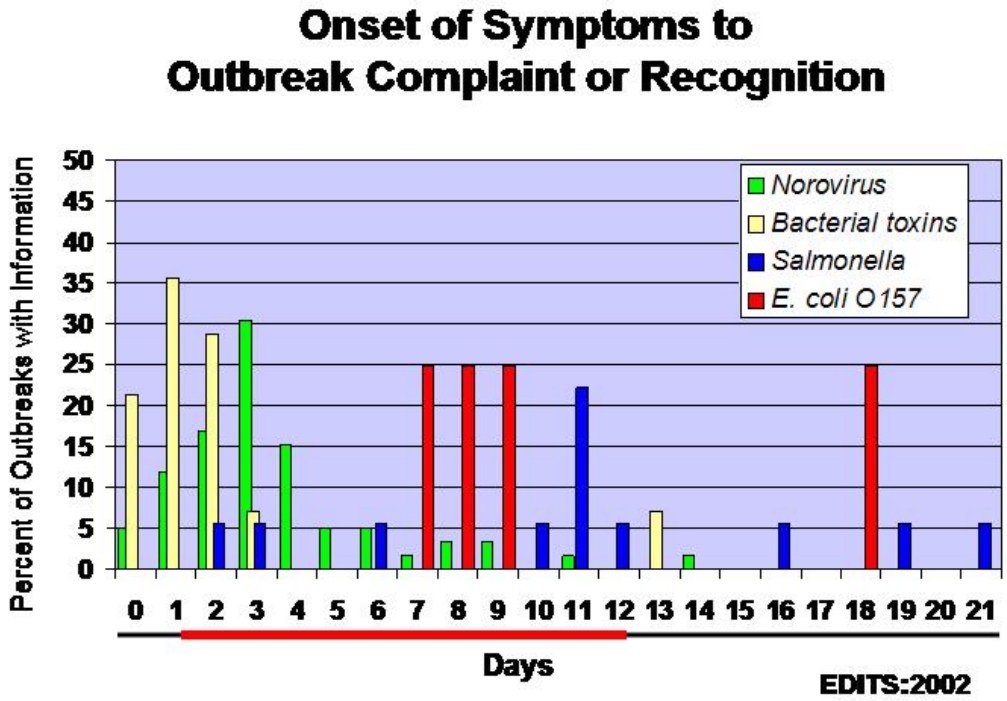
The increased detection of outbreaks in states with centralized surveillance was not due to timelier detection or initial response to the outbreak complaint. As shown in the table below, the median intervals from onset of symptoms to contacting the health department and subsequent collection of specimens and interviewing did not differ.

Median Interval and Range (days) for Response to Outbreak by State Characteristic

Interval	Centralized PHL Surveillance	Cases Reported to LHD
Onset of symptoms to contact with HD	3 (0, 23)	3 (0, 29)
Contact with HD to Interview	1 (0, 17)	0 (0, 31)
Contact with HD to specimen collection	1 (0, 7)	0 (0, 21)

The following two figures show the intervals from onset of symptoms of the outbreak to its detection by public health officials. The first figure shows the interval from onset to detection by type of agent.

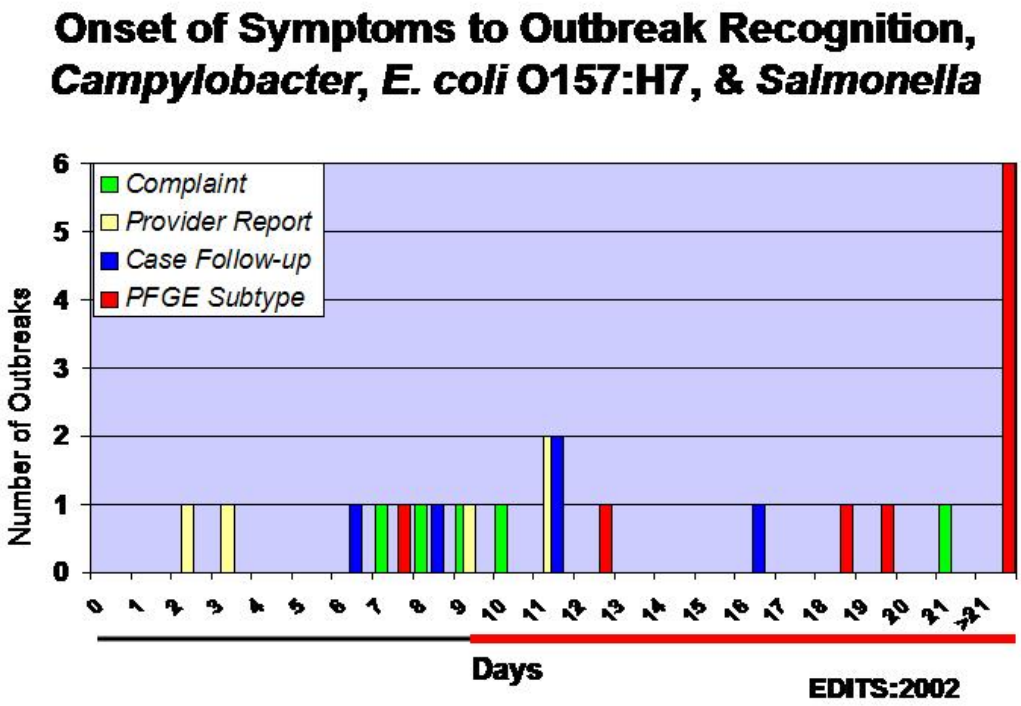
Median intervals from onset to outbreak complaint or recognition ranged from 1-3 days for bacterial toxins and norovirus to 8-10 days for *E. coli* O157:H7 and *Salmonella.* The interval from onset to detection of *E. coli* O157:H7 and *Salmonella* outbreaks, is the same as the interval from onset to clinician case report for sporadic infections with these agents.



The second figure shows intervals from onset to outbreak complaint or recognition based on how the outbreak was detected, for outbreaks caused by *Campylobacter*, *E. coli* O157:H7, and *Salmonella*. Median intervals from onset to outbreak recognition were:

9 days for complaint and provider report
12 days for case follow-up
>21 days for PFGE subtype

Of particular interest is that two of five outbreaks reported by clinicians, were reported 2-3 days following onset of illness. This is consistent with the time frame for cases to seek medical attention, and so suggests that clinicians reported the outbreaks based on clinical information and the patient's history rather than the results of stool culture. Three other outbreaks reported by clinicians were reported 9-11 days after onset of symptoms, consistent with the dates for reporting sporadic cases. This same time frame is when most consumer complaints were received, and also coincide with outbreaks detected by case follow-up. Thus, for these three bacterial pathogens for which laboratory testing is routinely conducted, it appears that most outbreaks are only detected after the results of stool culture have been obtained. Finally, six of 10 outbreaks detected by PFGE clustering were only detected more than 21 days following onset of symptoms.


Onset of Symptoms to Outbreak Recognition,
Campylobacter, E. coli O157:H7, & Salmonella
Complaint
Provider Report
Case Follow-up
PFGE Subtype
Number of Outbreaks
0
1
2
3
4
5
6
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 >21
Days
EDITS:2002

DISCUSSION/ CONCLUSIONS

This study represents a first attempt to evaluate the timeliness of foodborne disease surveillance on a national level in the United States. Although the number of states included in the evaluation was limited to six, and does not represent a randomized sample of surveillance data, there are some clear and interesting results that have implications for how surveillance for foodborne disease and outbreak investigations could be improved.

First, results demonstrate a faster response time for *E. coli* O157:H7 compared to *Salmonella*. This is a clear indication of the increased public health importance placed on *E. coli* O157:H7, and suggests that if higher priorities were placed on other foodborne diseases, the timelines could be shortened for them as well. However, this may also be a reflection of limited resources for surveillance for foodborne diseases. With increased concern over the potential for intentional contamination of foods, increasing the speed and effectiveness of foodborne disease investigations also has implications for homeland security.

Secondly, mandatory submission of isolates affected the percentage of isolates submitted, but not the timelines for submitting them. However, in all states surveyed, a relatively high proportion of isolates were submitted. There may be room to improve the efficiency of transport between clinical laboratories and the State Public Health Laboratories, but it appears that most submitting laboratories have reasonably adequate systems in place to forward isolates.

There were few state characteristics that were demonstrated to have an impact on enteric disease surveillance timelines. The study was limited in its ability to assess state size and regional area as factors. The major systematic effect on surveillance was noted for whether the state had a decentralized surveillance system with individual cases reported initially to local health departments or whether case reporting and surveillance were centralized at the state health department. The primary finding in this regard was the local health departments were quicker to interview cases, but states with centralized PHL laboratory surveillance were quicker to subtype isolates. Furthermore, the primary difference for these timelines appears to relate to actions of the Local or State HD, following report of the case and submission of the isolate.

Although the data were not reviewed in this report, participating as a FoodNet site appeared to have less impact on surveillance timelines than did the overall organization of surveillance on a state level. This is consistent with the overall objectives of FoodNet, which did not provide direct support for individual case follow-up on a routine basis.

The timelines demonstrated for reporting of cases to public health departments were consistent with the timelines for outbreak detection by health departments. Thus, detection of most outbreaks caused by *E. coli* O157:H7 and *Salmonella* appears to be dependent on case surveillance. This in turn suggests that more effective routine surveillance should result in the detection of more outbreaks. In fact, states with centralized surveillance did detect more outbreaks, even though they were not any quicker to learn of cases or to interview them. The only timeline element in which states with centralized surveillance performed better was in the speed of subtyping by PFGE. It appears that states with centralized PHL surveillance and faster PFGE subtyping provide better opportunities to link epidemiology and laboratory results. Thus,

centralization of surveillance and outbreak responses may result in more effective outbreak responses, as evidenced by higher rates of reported outbreaks.

The key issue for outbreak detection appears to be linking epidemiology and laboratory results quickly and effectively. Because states can not readily change the jurisdictional structure of their surveillance systems, improving surveillance will require creative ways to accomplish such linkages within existing systems. Thus, states with centralized surveillance may need to find a way to take advantage of the large local public health network to get interviews conducted rapidly, and states with many independent local health agencies will need to develop systems to standardize interviews and electronically transmit the epidemiologic data to a central surveillance site where it can be linked with the laboratory data.

Efforts to promote strategies for improving surveillance are clearly needed, as demonstrated by the long intervals between when illnesses occur and when information about these illnesses becomes available to public health officials. Although there have been improvements noted in each of the EDITS states since 2002, it is apparent that performance standards should be developed to create expectations of our foodborne disease surveillance system, and to evaluate the performance of the system systematically. Such a system of performance measures and evaluation will support improvements, both in timeliness and effectiveness of foodborne disease surveillance.

RECOMMENDATIONS

The following recommendations are made, based on the results of the EDITS study, to improve the timeliness and effectiveness of foodborne disease surveillance and outbreak investigations, states should:

- Ensure that, at least, all *Salmonella* and *E. coli* O157:H7 are forwarded to the PHL and routinely subtyped by PFGE
- Take advantage of the widespread availability and relative speed of Local Health Departments to conduct interviews
- Use standardized, broad-based exposure questionnaires to routinely and systematically collect data for use in cluster and outbreak investigations
- Ensure that completed questionnaires are immediately forward to the State HD for linkage with PFGE subtype results
- Establish centralized and standardized foodborne illness complaint systems
- Establish performance criteria for routine surveillance and outbreak investigations

REFERENCES

1. Centers for Disease Control and Prevention. National Center for Infectious Disease. Division of Bacterial and Mycotic Disease. Essential Epidemiology and Laboratory Components of a State Foodborne Disease Prevention and Control Program. A report from a Workgroup of CDC, CSTE, ASTPHLD, FDA, and NASPHV experts, February, 2000.
2. Council of State and Territorial Epidemiologists. National Assessment of Epidemiologic Capacity in Food Safety: Findings and Recommendations, September, 2002.