State Surveillance of Foodborne Illness

Executive Summary

In an effort to determine states' capacity to track produce-related cases of foodborne illness and gain a better understanding of how states conduct investigations of outbreaks,[1] the Produce Safety Project, an initiative of The Pew Charitable Trusts at Georgetown University, commissioned Safe Tables Our Priority (S.T.O.P.) to conduct a survey of state health departments.[2] The survey was sent to all 50 states and the District of Columbia, and 39 responded. The survey requested 2007 data on the types of questionnaires administered by state health departments to foodborne-illness victims, the time frame in which they were completed, the types of questions asked, and how states collected and stored the resulting data. These elements are key in the effective identification of the source of a foodborne illness.

Based on the survey results, state health departments:

- Are unlikely to ask about fresh produce on their initial questionnaire, even if that produce item has been associated with a past outbreak;
- Are far more likely to conduct a more thorough inquiry with an individual linked to an outbreak than with a sporadic case of foodborne illness;
- Generally use a questionnaire that combines open- and closed-ended questions, an approach that allows states to collect data in a systematic yet flexible fashion;
- Triage their response to cases of foodborne illness based on the severity of the disease; and
- Are unable to link different data sources to aid in investigation of foodborne illnesses.

While the survey did not ask states about the staffing or resources devoted to investigations of foodborne illness, the decisions of the responding states—to focus on large outbreaks of foodborne illness, to prioritize diseases that may cause serious illness or death over those that are generally milder, and to store some but not all of the available data they collect—appear to be driven by available resources and how they are prioritized and allocated to foodborne-illness surveillance issues. Funding levels for health departments vary widely from state to state: some state agencies are well funded while others only have enough to keep modest staff but no money for training, equipment, and other physical infrastructure needed for a modern, food-safety program.[3] Issues of funding and staff may become even more acute as the economy forces more budget cuts on health departments,[4] which must deal with numerous other public-health issues in addition to foodborne illness.

Background

According to the Centers for Disease Control and Prevention (CDC), foodborne pathogens cause an estimated 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States each year.[5] These illnesses can be associated with virtually any food, but the number of outbreaks caused by fresh produce is increasing. One group of researchers found that produce was associated with six percent of outbreaks of foodborne illness in the 1990s, compared to just 0.7 percent of outbreaks in the 1970s. The researchers also found that the proportion of reported foodborne illnesses caused by produce had also increased, equaling 12 percent of the cases in the 1990s but only one percent of those reported in the 1970s.[6] More recently, between 1996 and 2006 there were 72 foodborne-illness reported outbreaks in the United States associated with the consumption of fresh produce.[7] This increase parallels an increase in the amount of produce that Americans consume, and efforts on the part of the federal government to encourage Americans to eat more fruit and vegetables.[8]

These illnesses have enormous costs on multiple fronts to both consumer confidence in their food supply and the entire food industry. The U.S. Department of Agriculture (USDA) estimates that in 2007, illnesses caused by just one pathogen, *Salmonella*, cost Americans more than $2.5 billion in lost productivity, medical expenses, and premature death.[9] The food industry also experiences significant economic costs related to foodborne illness. Outbreaks undermine consumer's confidence in healthy foods such as fresh fruits and vegetables. Eating increased amounts of fruits and vegetables has important health benefits.[10] After tomatoes were linked to an outbreak of *Salmonella* Saintpaul during the summer of 2008, the tomato industry reported an estimated $200 million in losses. The outbreak was later linked, through genetic fingerprints to jalapeño and serrano peppers grown in Mexico.[11]

State and local health departments play an important role in the investigation of foodborne-illness outbreaks. They are responsible for contacting a victim once a case is confirmed by laboratory tests; recording and analyzing his or her possible exposures to the pathogen; conducting investigations of restaurants, supermarkets, retail food establishments; and performing some of the serotyping and DNA analyses that allow them to link cases of foodborne illness to one another. Together, these local and state agencies "conduct many more inspections, test many more food samples for harmful contamination, and bring many more food safety enforcement actions than the federal food safety agencies."[12] They work in collaboration with the CDC and the Food and Drug Administration (FDA) during multi-state produce related outbreaks of foodborne illness. When the CDC investigates a multi-state outbreak, it aggregates data on illnesses that have been collected by state and local agencies.

Although information on the resources available to state and local agencies is limited, there is general agreement that these agencies are chronically underfunded and understaffed, particularly "in relation to the magnitude and difficulty of the food safety problem and the importance of their contribution to the national food safety effort."[13]

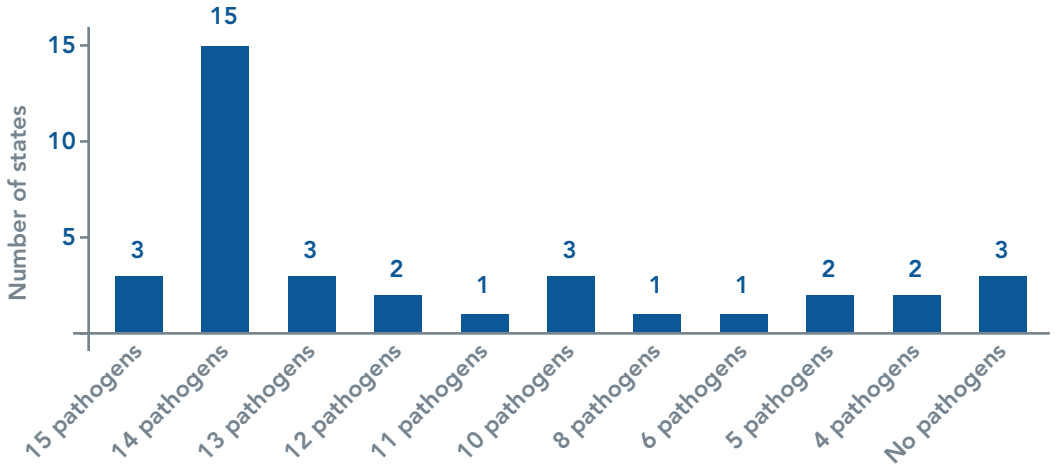
Pathogens included in foodborne-illness questionnaires

To assess their ability to detect the source of a particular pathogen, states were given a list of 15 pathogens commonly associated with foodborne illness and asked whether it was state protocol to always administer initial questionnaires that include questions about food for culture-confirmed cases of each pathogen.[14] Three-quarters (27) of the 36 states that answered this question reported that they routinely administer such questionnaires for ten or more of the listed pathogens. Six states reported that they ask questions related to fewer than ten pathogens; three states provided reasons for why they did not administer questionnaires for any of the listed pathogens.[15]

State health departments utilize questionnaires as the foundation of their epidemiological investigation. Determining the source of a pathogen and point of exposure can limit the scope of a potential outbreak. Since many foodborne pathogens can also be transmitted through other vectors, questionnaires are necessary to pinpoint common exposures: Did two or more individuals eat from the same salad bar before they became ill? Are their young children enrolled at the same daycare? Have they swum in the same pool? Have they had any contact with pets or domesticated animals?[16] During the 2006 outbreak of *E. coli* O157:H7, for example, investigators identified spinach as a potential source of infection after only six structured interviews, during which five of the respondents reported that they had eaten bagged, pre-washed spinach.[17]

FIGURE 1

Number of states asking about food items for multiple pathogens, 2007 (N=36)



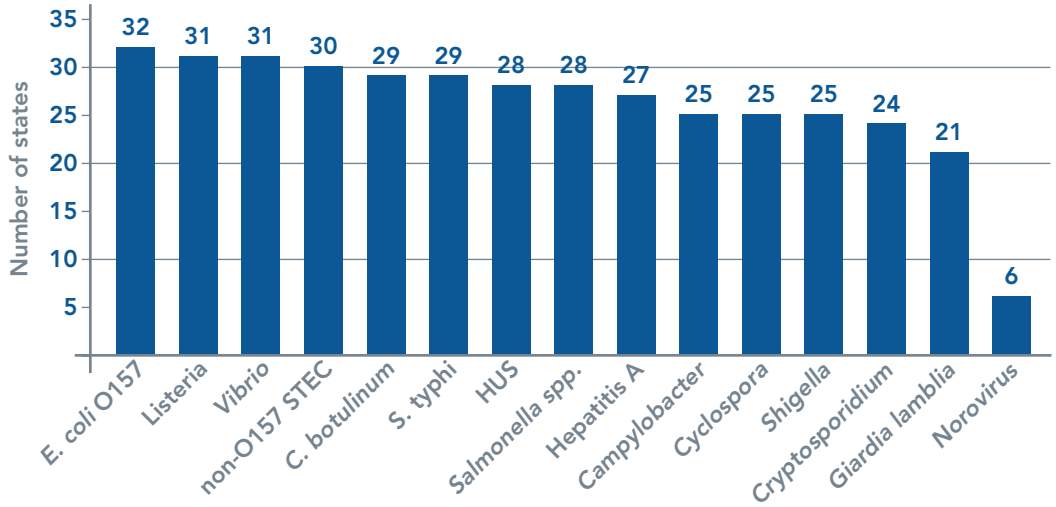
Source: PSP/S.T.O.P. Survey, Question 1.

Policy on administering questionnaires

States' policies on whether to administer a questionnaire—which represents the initial step in investigating the source of a foodborne-illness outbreak—depends on a number of factors, including the relative virulence of the pathogens being tracked and the mode of transmission. The decision-making process varies, however, both by state and by pathogen. Of the 36 states that responded to the question of whether they always administer questionnaires for a given pathogen (Figure 2),[18] 80 percent or more, respectively, administered questionnaires for cases of *E. coli* O157:H7, *Listeria monocytogenes*, *Vibrio* (including *Vibrio cholerae*), other forms of Shiga toxin-producing *E. coli* (STEC), and *Clostridium botulinum* (botulism). These pathogens can all cause life-threatening complications. Substantial proportions of the surveyed states also administered questionnaires for cases of typhoid fever, hemolytic uremic syndrome (HUS), other serotypes of *Salmonella*, and for Hepatitis A.

FIGURE 2

Number of states asking about food items by specific pathogen on initial questionnaire, 2007 (N=36)



Source: PSP/S.T.O.P. Survey, Question 1.

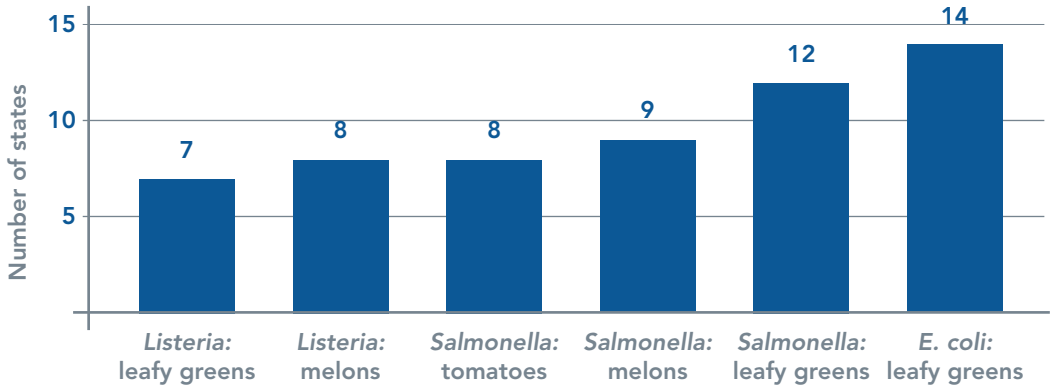
References to specific produce items in questionnaires

While most responding states (36 out of 39) reported that they administered questionnaires for at least some pathogens, only 25 provided data suggesting that they asked about specific produce items.[19] There were four large multi-state outbreaks of *Salmonella* linked to tomatoes between 2005 and 2006, three during the summer of 2004, and additional outbreaks in 2002, 1999, 1993 and 1990.[20] Despite the frequent association between tomatoes and *Salmonella*, only 8 out of 25 (32%) states that asked about specific produce items in their questionnaires in 2007 included questions about tomatoes in their initial questionnaires when investigating *Salmonella* cases, possibly indicating that they had not updated their questionnaires based on recent outbreaks.

Similarly, there were 19 outbreaks of *E. coli* O157:H7 that were linked to contaminated fresh spinach or lettuce between 1995 and 2005, causing 409 illnesses and two deaths.[21] However, only 14 of the 25 states that responded to the produce-item question included leafy greens on their initial questionnaires for *E. coli* O157:H7. There were 20 outbreaks of *Salmonella* associated with leafy greens and 16 outbreaks of *Salmonella* associated with melons between 1990 and 2005.[22] Only 12 states included leafy greens on their initial questionnaires for *Salmonella*; only 9 asked about melons for this pathogen.[23]

FIGURE 3

Number of states asking about fresh produce items on initial questionnaires for specific pathogens (N=25)



Source: PSP/S.T.O.P. Survey, Question 3.

Types of questionnaires

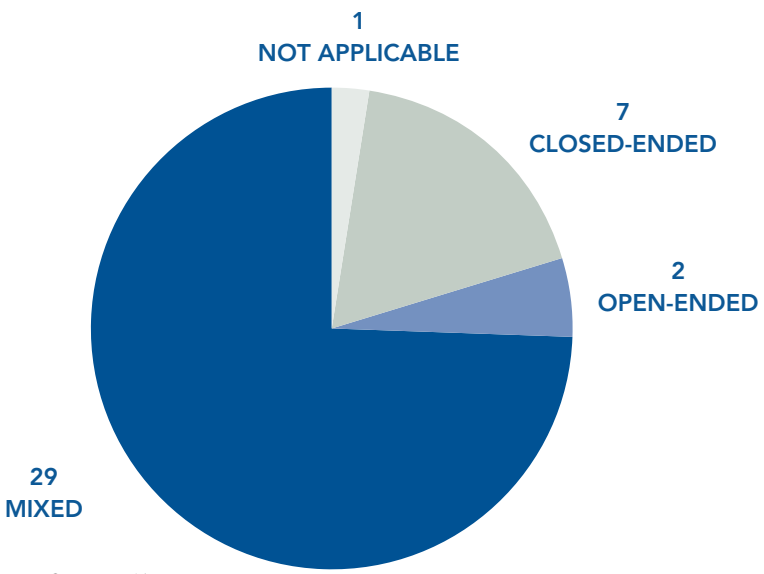
Health officials may administer a first, preliminary questionnaire to victims of foodborne illness, and return with a second, more detailed questionnaire as they gather more information. All 39 of the responding states said that they would administer a second questionnaire when an outbreak of foodborne illness was suspected.[24] States' responses differed when they were asked what they would do regarding cases that appeared sporadic—that is, not obviously part of a broader outbreak of illness. Most states (35) responded that they would not interview such cases a second time.[25] The remaining four said that they would perform a follow-up questionnaire of some sort. This finding is problematic because the majority of foodborne illness cases are never linked to a food product.[26] Cursory investigations lead to missed opportunities for identification of foodborne outbreaks and their resolution. The 2009 *Salmonella* Typhimurium outbreak from contaminated peanut products and the *E. coli* O157:H7 outbreak from cookie dough both serve as good examples of situations where follow-up was done and there was resolution; in both instances, cases that were ultimately linked to large national outbreaks at first appeared as local and sporadic.

The types of questions used on either an initial or secondary questionnaire may vary, with some questions seeking more or different kinds of information than others.

- Closed-ended questionnaires are standardized and tend to rely on yes or no questions about specific foods—e.g., "Did you eat eggs in the seven-day period before you got sick?" The advantages of closed-ended questionnaires are that they can be administered by people with less formal training, and they produce standardized sets of data that are easy to enter into a database. However, recall bias can be introduced since specific food items are listed,

FIGURE 4

Types of initial questionnaire states use for the first culture-confirmed case of a foodborne illness, 2007



Source: PSP/S.T.O.P. Survey, Question 7.

(e.g., foodborne illness victims may erroneously report that they have eaten a listed food). Conversely, closed-ended questionnaires may not include important food exposures.

- Open-ended questionnaires are, by their nature, more comprehensive than closed-ended questionnaires, but also less interpretable. Instead of asking individuals whether they have eaten a specific food, investigators ask questions such as: "What did you eat for breakfast yesterday?" This type of data collection is more difficult to analyze, since the number of food items and food brands that result from an unfocused open-ended interview are numerous and unlimited.
- A "mixed" questionnaire encompasses both closed-ended questions that are structured, and open ended questions that may provide additional information. An example of this type of question may be "Did you consume ground beef, such as a hamburger, in the last week? (Yes or No) If yes, please list any restaurants where you ate this food item."

Of the 39 responding states, 29 (74%) described their initial questionnaires as "mixed"—combining open- and closed-ended questions.[27] Seven states said they use a closed-ended questionnaire when they first interviewed victims of foodborne illness; of the remaining states, two used purely open-ended questionnaires for the first round of questions. When administering a second questionnaire during an outbreak of foodborne illness, states were somewhat more likely to use a mixed questionnaire; 34 reported that they would do so, compared to three that opted for a closed-ended questionnaire and one that chose an open-ended questionnaire.[28]

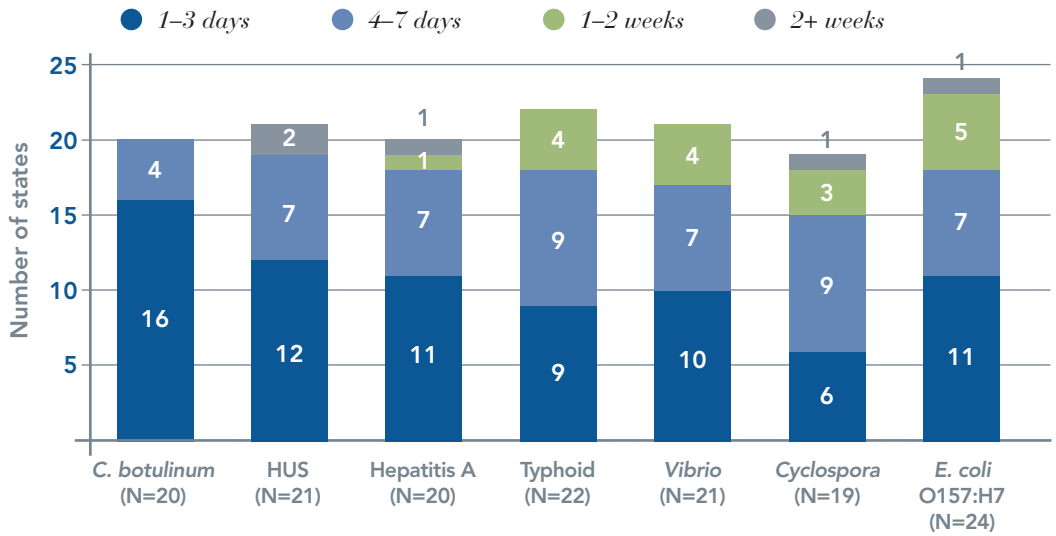
Time period for completing questionnaires

The time it takes states to complete questionnaires once a case of foodborne illness has been confirmed appears to vary by the severity of the disease. Based on survey results, states are not only more likely to administer questionnaires for more severe foodborne illnesses, but they are also more likely to complete those questionnaires within a shorter time frame. Of the 20 states that estimated a time frame for questionnaires administered for cases of botulism,[29] 16 states (80%) reported that questionnaires were completed in one to three days.[30] The other four states (20%) reported that they completed questionnaires in four to seven days. Six states responded that they were unable to estimate the amount of time required to complete an initial questionnaire for a culture-confirmed case of botulism.[31]

Responding states appear to treat other life-threatening illnesses—such as HUS, Hepatitis A, typhoid fever, and *Vibrio*-related infections—with a similar level of urgency, with the majority of states reporting that questionnaires for those pathogens are completed within seven days or less. By contrast, states take longer to complete questionnaires for other pathogens, some of which may cause serious illness.

FIGURE 5

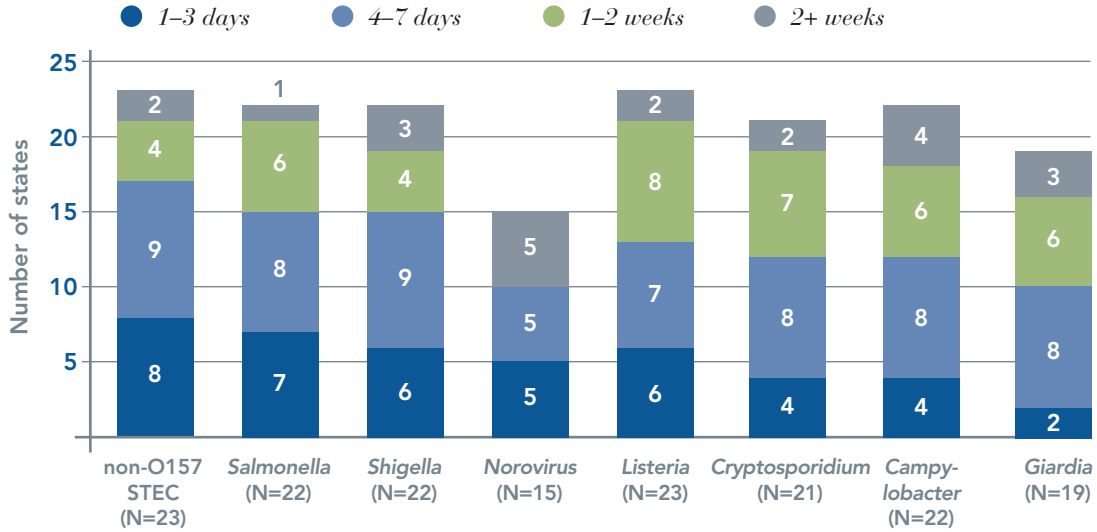
Average amount of time from receipt of a culture-confirmed case to completion of initial questionnaire



Source: PSP/S.T.O.P. Survey, Question 4. An additional 6 states responded that they did not track the time needed to complete an initial questionnaire, or data was unavailable because questionnaires were administered by local agencies.

FIGURE 6

Average amount of time from receipt of a culture-confirmed case to completion of initial questionnaire



Source: PSP/S.T.O.P. Survey, Question 4. An additional 6 states responded that they did not track the time needed to complete an initial questionnaire, or data was unavailable because questionnaires were administered by local agencies.

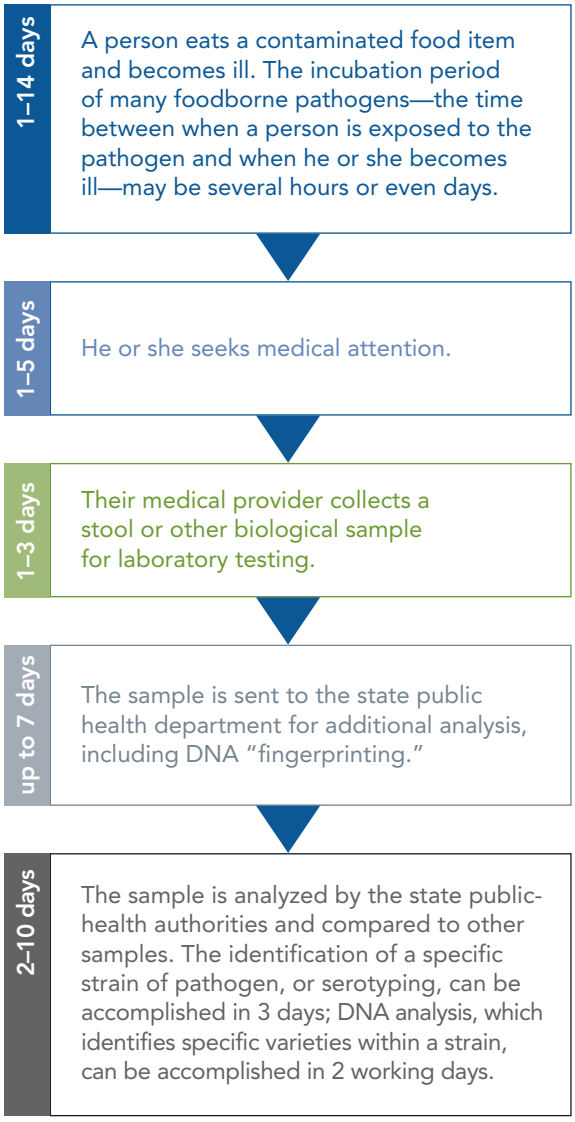
Delays in administering questionnaires pose serious barriers to epidemiological investigations. Some delays are unavoidable in any investigation of foodborne illness. For example, before a state or local health department can even begin investigating a culture-confirmed case of a foodborne pathogen, the following steps must occur:

These built-in delays make a prompt investigation all the more important. Individuals may have difficulty remembering what they ate a few days ago, and that difficulty increases as time passes.[32] Timely administration of a properly designed questionnaire increases the probability that a respondent will accurately report his or her recent food-consumption history along with other pertinent information about the nature of his/her illness. Investigators may ask individuals if they have grocery or restaurant receipts that can help them reconstruct their recent meals and snacks; but again, this documentation is more likely to be available when a questionnaire is administered sooner, rather than later.

The memory of individuals questioned is a problem in all foodborne-illness investigations. The problem of detection is particularly acute for cases linked to fresh produce because contaminated produce is perishable and usually not available to test by the time the person falls ill. Investigators must not only identify the strain and DNA fingerprint of the pathogen from the sample submitted by a victim but they must also match that strain and fingerprint to a specific food that the victim has consumed. Once a match is made and a source of foodborne illness has been identified, authorities can take necessary steps to try and limit additional cases.

As with other aspects of a foodborne-illness investigation, confirming that a specific contaminated food item is the cause of an outbreak takes time. It took nearly ten weeks to confirm that peanut products were responsible for the 2008 multi-state outbreak of *Salmonella* Typhimurium.[33] Investigators were aided through epidemiology and the fact that peanut butter has a long shelf life, which meant that samples were available for testing weeks after they had first been eaten.[34] By contrast, in investigations of outbreaks linked to fresh produce, identifying the suspect food is far more challenging; because the product is perishable, it is often long gone from the victim's refrigerator and memory, making confirmation of the source dependent solely on the epidemiological study, often times without laboratory confirmation.

Timeline for Investigating Foodborne Illness



Source: "Salmonella Outbreak Investigations: Timeline for Reporting Cases," Centers for Disease Control and Prevention, http://www.cdc.gov/Salmonella/reportingtimeline.html, accessed 1 July 2009.

Rates of completion of initial questionnaires

The rate of completion of the initial food questionnaires—how many questionnaires are begun versus how many questionnaires are completed—can be a useful measure of how thoroughly state public health departments investigate cases of foodborne disease. Such rates also allow for comparisons across pathogens. The importance of completing the initial questionnaire increases with the severity of the health risks posed by a particular pathogen: if the first few cases of a deadly pathogen are missed because the state did not follow up on questioning the victim, then an outbreak has the potential to spread.

As shown in Figure 7, follow-up rate for questionnaires varies by pathogen. Cases of *C. botulinum*, *Cyclospora*, Hepatitis A, HUS, and *E. coli* O157:H7 all have very high completion rates; in particular, all responding states reported that they completed 100 percent of the questionnaires they administered for cases of *C. botulinum* and *Cyclospora*. Hepatitis A also had a similarly high average completion rate of 99 percent. On average, states that responded to this question completed more than 95 percent of the questionnaires they administered for HUS, typhoid fever, and illnesses caused by both *E. coli* O157:H7 and other Shiga toxin-producing *E. coli*. This suggests, not surprisingly, that states are more likely to complete questionnaires for those diseases that are serious or even life-threatening.

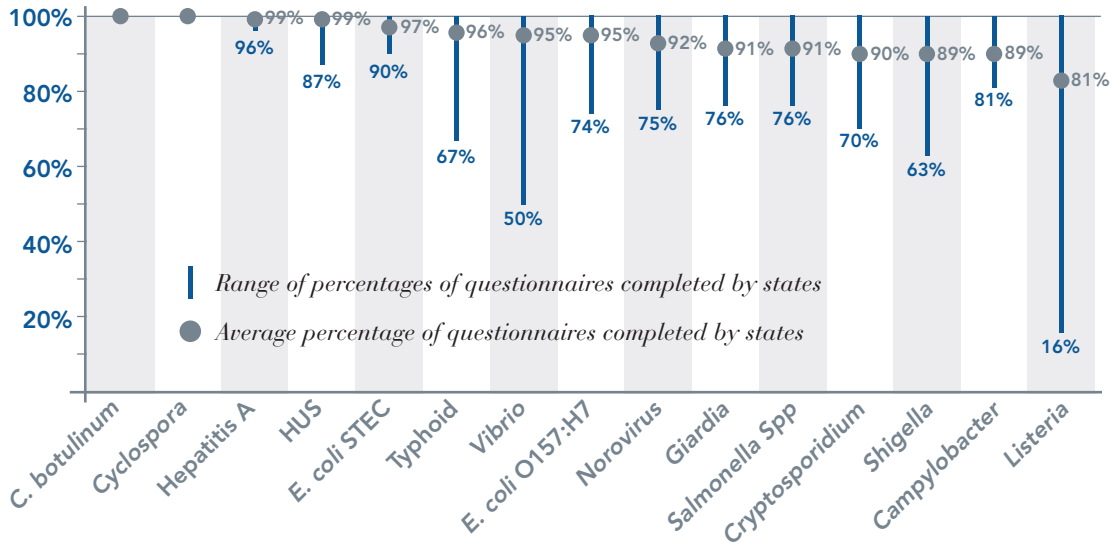
Diseases that may cause less serious symptoms appear to receive less intensive follow-up efforts from state health departments. On average, approximately ten percent of questionnaires attempted by responding states for cases of illness caused by *Salmonella*, *Giardia*, *Shigella*, and *Campylobacter* were not completed.[35]

Of the 39 states that responded to the survey, only 16 (41%) completed this question.

Many states responded that they do not keep track of this information; others said it was too time consuming to report. States' submission of data on questionnaires administered and completed also varied by pathogen.

FIGURE 7

Range and average of questionnaires completed by states by individual pathogens



Source: PSP/S.T.O.P. Survey, Question 1.

Type of Data Collected

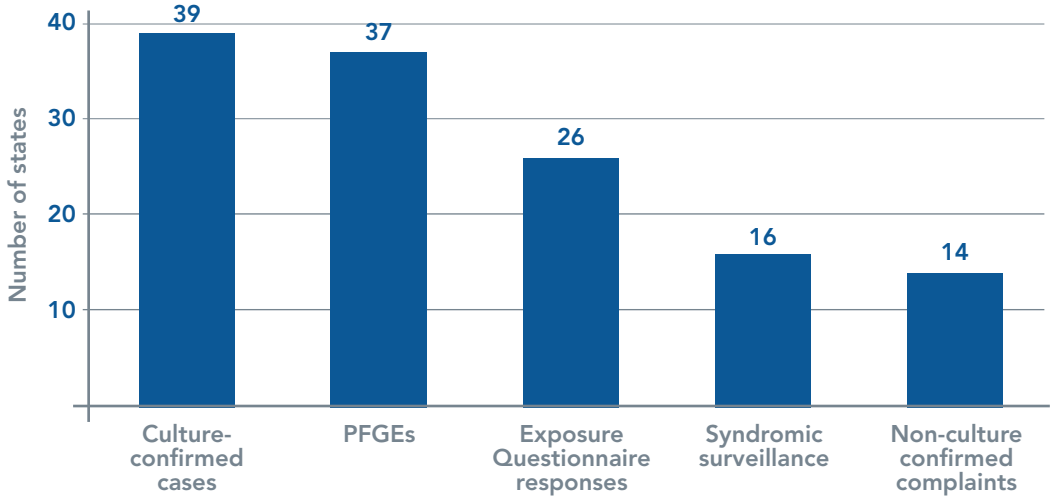
In the PSP/S.T.O.P. survey, states were also asked whether they collected any of the following types of data:[36]

- Culture-confirmed cases: documentation on cases of foodborne illness that have been confirmed by laboratory testing.
- Exposure questionnaire responses: a form administered by the state or local health department that records a history of food eaten and other possible exposures to the pathogen in question.
- PFGE isolates: Pulsed field gel electrophoresis (PFGE) is a method of DNA fingerprinting that allows researchers to differentiate between strains of the same bacteria. PFGE technology forms the basis of the PulseNet program, operated by the CDC, which links federal agencies and state and local health departments to a database of PFGE results or isolates, allowing agencies to compare their results to those of laboratories across the country.[37]
- Foodborne-illness syndromic surveillance: first utilized after the 2001 anthrax scare, syndromic surveillance uses automated systems to look for increases in markers of illness within a population. In the case of foodborne illness, syndromic surveillance might include analysis of the number of calls to poison-control centers or nurse helplines, sales of over-the-counter drugs or emergency room visits for diarrheal illness.
- Numbers of non culture-confirmed complaints: data on cases of illness that were not linked to any specific pathogen, but that are otherwise characteristic of foodborne illness. These complaints are not actively collected; instead, they are submitted by affected consumers or treating physicians to the health department.

Of the 39 states that responded to the survey, all reported that they maintained electronic records of culture-confirmed cases of foodborne illness. Nearly all of the responding states (37) reported that they collected PFGE isolates; approximately two-thirds kept exposure-questionnaire responses. States were least likely to report that they maintained records of non culture-confirmed complaints or syndromic surveillance.

FIGURE 8

Number of states collecting electronic records of types of investigation data (N=39)



Source: PSP/S.T.O.P. Survey, Question 10.

Data collected from questionnaires

The type of questionnaire used by states has implications for the use of the resulting data. The usefulness of information collected through a questionnaire is limited unless it is integrated with other sources of information—questionnaires from other cases, laboratory test results, and reports from inspections of restaurants, food manufacturing or packaging facilities, among others. Ideally, data from multiple sources should be compiled into a single system that allows investigators to analyze it quickly and efficiently. Nearly 60 percent of responding states (23 out of 39), however, indicated that the data they collected and stored could not be easily linked together.[38]

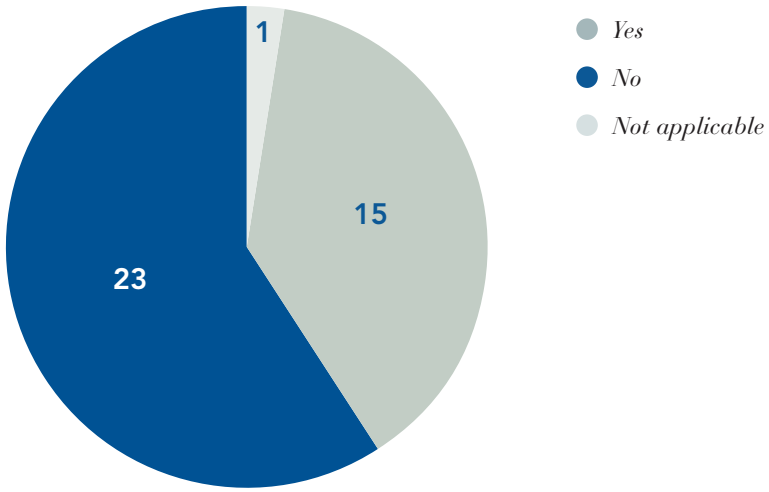
This finding is problematic. A good food-safety information network would include information that would not only be "generated and used appropriately within organizations" but would also flow "among organizations to enhance the overall safety of the food safety system."[39] The following barriers to such a system have been identified:[40]

- Agencies may lack a mandate or the resources for data collection.
- Information gathering may not be coordinated.
- Agencies may be reluctant to share data.
- Data may differ across agencies or jurisdictions.
- Data may be stored in different formats.
- Information may be collected by non-standardized instruments

While it is unknown which, if any, of these barriers prevents the states that responded to the survey from linking their data for analysis, it is likely that a more coordinated system of data collection and storage would aid states' investigations of foodborne illness.

FIGURE 9

States able to electronically link their investigative data for analysis (N=39)



Source: PSP/S.T.O.P. Survey, Question 10.

Conclusion

The policies governing how cases of foodborne illness are investigated vary enormously across jurisdictions. The disparities in how state health departments respond to cases of foodborne illness are neither surprising nor desirable. The variation in approaches in foodborne illness investigations can cause delays in public-health response, leading to additional illnesses and unnecessary financial burdens. It also may undermine consumer confidence in the safety of the food supply and in the adequacy of food safety protections.

While more funding would likely help state and federal agencies prevent and detect outbreaks of foodborne illness, broader organizational efforts are also needed to create a truly integrated food-safety network. Increased funding will not, in and of itself, encourage agencies to coordinate and standardize the ways they collect, test, store, and share data. These changes could be accomplished, however, through strengthening of applicable legal authorities and strong federal leadership, in particular from the Secretary of Health and Human Services.[41]

Acknowledgements

The Produce Safety Project would like to thank Jen Thompson, former Research Associate at the Georgetown Health Policy Institute, for her extensive analysis and work on this report.

PSP would also like to thank the following for their review of this report.

Paul Bancroft Allwood, PhD, MPH, RS, Assistant Director of Environmental Health and Safety, Assistant Professor of Environmental Health Sciences, University of Minnesota

Douglas L. Archer, BA, MS, Professor and Past Chair, Food Science and Human Nutrition Department, Institute of Food and Agricultural Sciences, University of Florida

S.T.O.P. would like to sincerely thank Eric Juzenas, JD, MPH, whose wealth of knowledge in public health and experience in addressing food issues to Congress contributed to his very helpful editing of this report.

S.T.O.P. would also like to acknowledge our friends at the Centers for Disease Control & Prevention, for their encouragement of our survey work and for providing an anonymous reviewer whose expertise and incisive comments tremendously strengthened this report.

The opinions expressed in this report are those of the authors and do not necessarily reflect those of the reviewers or of The Pew Charitable Trusts.

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APPENDIX A: Methodology

Surveys were sent to representatives of health departments in all 50 states and the District of Columbia. Thirty-nine of 51 health departments responded (76%). The survey, commissioned by the Produce Safety Project, was administered by S.T.O.P. The surveys were mailed and e-mailed to the state epidemiologist charged with foodborne-illness surveillance. The survey, a cover letter and a self-addressed return, postage paid envelope was enclosed. Officials could complete a hard copy of the survey and submit it by fax or mail or complete a web-based version. States completing the online survey were required to provide answers for some key questions in order to complete the survey; states that completed a hard copy could leave some questions blank. Consequently, while 39 states responded to the survey, the number of states that provided answers for each individual question (n) varies.

States were also asked to submit, via e-mail or mail, their initial food-intake or exposure questionnaire. S.T.O.P followed up with the non responding states by phone, additional emails and postal mailing. Twenty-five states responded to the questionnaire by fax or mail and 14 used the online questionnaire.

Out of the twelve states that did not respond, seven states gave reasons for not participating, including lack of resources, and direct orders to abstain. Five states did not respond and provided no explanation. States indicated they did not respond to particular questions or sections of the survey for various reasons, including the data we asked for is not routinely collected or maintained.

APPENDIX B: Survey

S.T.O.P. Survey of 2007 Foodborne Illness Cases

Name:_____ Phone:_____

State:_____ Email:_____

Pathogen	Is it your state's protocol to always administer an initial questionnaire (which includes food items) for all culture-confirmed cases of the following pathogens? (Check for yes)	For culture-confirmed cases in Calendar Year 2007; how many initial questionnaires (which include food items) were attempted and completed?		On the initial questionnaire (which includes food items) for all culture-confirmed cases, what fresh produce items are included for each listed pathogen? (Check all that apply)						What is the average amount of time from receipt of a culture-confirmed case by your state/local health department to the completion of your initial questionnaire (which includes food items)? (Check one)				If your state's MMWR data is not complete (or not reported to CDC) for each of the following pathogens, please indicate the number of culture-confirmed cases in your state for Calendar Year 2007.	How many isolates (or PFGE patterns) of this pathogen were submitted to PulseNet in Calendar Year 2007?
		Attempted	Completed	Leafy greens	Melons	Berries	Tomato	Green onions	Other produce	1 – 3 days	4 – 7 days	1 – 2 weeks	2 + weeks		
Campylobacter jejuni	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
Clostridium botulinum	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		n/a
Cryptosporidium	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		n/a
Cyclospora	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		n/a
E.coli O157:H7	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
E.coli Non-O157 STEC	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
• HUS	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		n/a
Giardia lamblia	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		n/a
Hepatitis A	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		n/a
Listeria monocytogenes	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
Noroviruses	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		n/a
Salmonella spp.	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
Salmonella typhi	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
Shigella	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
Vibrio (incl. *cholerae*)	❍			❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		

Please See Reverse Side To Complete Survey

S.T.O.P. Survey of 2007 Foodborne Illness Cases

1.) In general, what type of exposure questionnaire (containing food items) would you initially use in your state to investigate the first culture-confirmed case of a foodborne illness?

- ❍ Closed-ended questionnaire (e.g. food frequency or common exposures)
- ❍ Open-ended (e.g. a multi-day food history or diet recall)
- ❍ Mixed (e.g. closed-ended questionnaire with some open-ended responses)

2.) If the culture-confirmed case (from first question above) ***is not part*** of an obvious cluster, would a secondary, or more comprehensive, questionnaire typically be administered?

- ❍ No ❍ Yes (If so, what type of questionnaire?)
  - ❍ Closed-ended
  - ❍ Open-ended
  - ❍ Mixed

3.) If the culture-confirmed case (from first question above) ***is part*** of an obvious cluster/outbreak, would a secondary, or more comprehensive, questionnaire typically be administered?

- ❍ No ❍ Yes (If so, what type of questionnaire?)
  - ❍ Closed-ended
  - ❍ Open-ended
  - ❍ Mixed

4.) a.) Do you collect and maintain electronically information on the following? (Check all that apply)

- ❍ PFGE's
- ❍ Culture-confirmed cases
- ❍ Foodborne illness syndromic surveillance
- ❍ Exposure questionnaire responses (containing food items)
- ❍ Numbers of non culture-confirmed complaints

b.) Is the above information able to be easily linked for purposes of analysis?

- ❍ Yes ❍ No

Please send copies of your most frequently used questionnaires by email to survey@safeeating.org and indicate if they are initial or secondary questionnaires. If available online please submit URL below:

_____

APPENDIX C:

Number of states reporting that initial questionnaires ask about speciic produce items

NUMBER OF STATES ASKING ABOUT:	Campylobacter	C. botulinum	Cryptosporidium	Cyclospora	E. coli O157:H7	non-O157 STEC	HUS	Giardia	Hepatitis A	Listeria	Noroviruses	Salmonella spp.	S. typhi	Shigella	Vibrio
Leafy greens	8	3	4	13	14	13	9	5	5	7	2	12	7	7	3
Melons	2	1	2	2	9	8	6	1	5	8	1	9	4	2	1
Berries	2	2	2	12	7	6	4	2	5	4	1	8	5	3	2
Tomato	2	3	1	2	8	7	5	2	4	4	0	8	5	2	1
Green onions	2	2	2	3	9	8	5	2	4	2	1	8	4	2	1
Other produce	9	6	8	13	18	15	12	8	5	10	3	16	8	9	5

Missing response for entire question, n=14

Notes

[1] An outbreak is defined as two or more cases of the same illness from the same source, Council to Improve Foodborne Outbreak Response (CIFOR) http://www.cste.org/dnn/LinkClick.aspx?fileticket=pw6t9Ixi0yc%3d&tabid=36&mid=390 Page, 192.

[2] See Appendix A for methodology.

[3] Taylor, MR and SD David, *Stronger Partnerships for Safer Food: An Agenda for Strengthening State and Local Roles in the Nation's Food Safety System*. Robert Wood Johnson Foundation, 2009. p 29.

[4] Rita Beamish and Frank Bass, "Flu scare reveals strapped local agencies," Associated Press, 26 May 2009. http://www.washingtonpost.com/wp-dyn/content/article/2009/05/26/AR2009052601880.html?hpid=sec-health.

[5] Mead, PS, L Slutsker, V Dietz et al, "Food Related Illness and Death in the United States." *Emerging Infectious Diseases* 5(5) September 1999: 607-625.

[6] Sivapalasingam, S, CR Friedman, L Cohen and RV Tauxe. "Fresh produce: A growing cause of outbreaks of foodborne illness in the United States, 1973-1997." *Journal of Food Protection* 67(10) October 2004: 2342-2353; Johnson, LM, LA Jaykus, D Moll, J Anciso, B Mora and CL Moe, "A field study of the microbiological quality of fresh produce of domestic and Mexican origin." *International Journal of Food Microbiology*. 112(2006): 83-95.

[7] FDA *Guide to Minimize Microbial Food Safety Hazards of Fresh-cut Fruits and Vegetables* (unpublished FDA data).

[8] One of the goals of the Healthy People 2010 program, a project of the U.S. Department of Health and Human Services, is to increase the percentage of Americans who eat at least 3 servings of vegetables and 2 servings of fruit each day. "Fruit and Vegetable Consumption Among Adults, 2005," *Mortality and Morbidity Weekly* 56(10) March 16, 2007: 213-217.

[9] USDA Economic Research Service, "Foodborne Illness Cost Calculator," http://www.ers.usda.gov/data/foodborneillness/" Accessed May 14, 2009.

[10] U.S. Department of Health and Human Services, U.S. Department of Agriculture, *Dietary Guidelines for Americans 2005* www.healthierus.gov/dietaryguidelines.

[11] Maki, DG, "Coming to Grips with Foodborne Infection—Peanut Butter, Peppers, and Nationwide Salmonella Outbreaks." *New England Journal of Medicine* 360(10) 5 March 2009: 949-953.

[12] Taylor and David.

[13] Taylor and David, 29.

[14] PSP/S.T.O.P. survey, Question 1. (See Appendix B)

[15] One state's initial case questionnaire does not include any food items, while another state did not have this protocol in place, and the third state reported it did not have this protocol in place in 2007.

[16] CIFOR guidelines, page 193; Tennessee Department of Health STEC survey, page 3.

[17] A structured interview is similar in purpose to a questionnaire; both rely on a pre-determined series of questions designed to gather information in a systematic fashion. CIFOR guidelines, 61.

[18] PSP/S.T.O.P. survey, Question 1. (See Appendix B)

[19] PSP/S.T.O.P. survey, Question 3. (See Appendix B)

[20] "Multistate outbreaks of *Salmonella* infections associated with raw tomatoes eaten in restaurants—United States, 2005-2006", *MMWR* 56(35) September 7, 2007: 909-911; "Outbreaks of *Salmonella* infections associated with eating Roma tomatoes," *MMWR* 54(13) April 8 2005: 325-328; Greene, SK, ER Daly, EA Talbot et al, "Recurrent multistate outbreak of Salmonella Newport associated with tomatoes from contaminated fields, 2005," *Epidemiology and Infection* 136(2) February 2008: 157-165; Cummings, K, E Barrett, JC Mohle-Boetani et al, "A multistate outbreak of Salmonella enterica serotype Baildon associated with domestic raw tomatoes," *Emerging Infectious Diseases* 7(6): Nov-Dec 2001: 1046-1048; Hedberg, CW, FJ Angulo, KE White et al, "Outbreaks of salmonellosis associated with eating uncooked tomatoes: implications for public health. The Investigation Team." *Epidemiology and Infection* 122(3) June 1999: 385-393.

[21] HHS, FDA, CFSAN, Office of Plant and Dairy Foods. "Letter to California Firms that Grow, Pack, Process, or Ship Fresh and Fresh-cut Lettuce," 2005. http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/FruitsVegetablesJuices/GuidanceComplianceRegulatoryInformation/ucm118911.htm.

[22] Smith DeWaal, C and F Bhuiya. "Table 1," *Outbreaks by the Numbers: Fruits and Vegetables 1990-2005*. Center for Science in The Public Interest, no date.

[23] See Appendix C for additional information on how many states collected data on specific produce items by pathogen.

[24] PSP/S.T.O.P. survey, Question 9. (See Appendix B)

[25] PSP/S.T.O.P. survey, Question 8. (See Appendix B)

[26] Mead, P.M., Slutsker, L., et al. Food-Related Illness and Death in the United States. *Emerging Infectious Diseases* Vol. 5, No. 5, Sept.-Oct. 1999.

[27] PSP/S.T.O.P. survey, Question 7. (See Appendix B)

[28] One state did not specify the type of questionnaire they would use. PSP/S.T.O.P.survey, Question 9.

[29] Botulism is caused by the toxins produced by *Clostridium botulinum* bacteria; symptoms include double or blurred vision, drooping eyelids, slurred speech, and progressive muscle paralysis from the head down. While the morbidity rate of botulism has dropped from 50 percent to approximately 8 percent, victims still require weeks of intensive medical care and rehabilitation, and may experience breathing problems and fatigue for months or years. Botulism is generally associated with home-canned foods, but has also been linked with tomatoes, chili peppers, and potatoes. "Botulism," National Center for Preparedness, Detection, and Control of Infectious Diseases, CDC, http://www.cdc.gov/ncidod/aip/research/bot.html.

[30] PSP/S.T.O.P. survey, Question 4. (See Appendix B)

[31] Some states reported that they did not track this data or that the amount of time it took local or county agencies to complete questionnaires was unknown.

[32] Novotny, JA, WV Rumpler, JT Judd et al, "Diet interviews of subject pairs: How different persons recall eating the same foods." *Journal of the American Dietetic Association* 101(2001): 1189-1193. For other research on this topic, see Mann, JM, "A prospective study of response error in food history questionnaires: implications for foodborne outbreak investigation." *American Journal of Public Health* 71(12) December 1981: 1362-1366.

[33] The first group of infections was identified by the CDC's PulseNet program on November 10, 2008. Questionnaires were collected from approximately 90 affected individuals between November 25th, 2008, and January 2nd, 2009. Investigators in Minnesota identified the strain of *Salmonella* responsible for the outbreak in an opened jar of peanut butter on January 12th; this finding was inconclusive, however, as the peanut butter could have been contaminated with *Salmonella* after it was opened. Subsequent testing in Connecticut found the same strain of *Salmonella* in an unopened jar of peanut butter on January 16th, allowing researchers to pinpoint the source of the contamination to the peanut supplier. CDC, "Timeline of Infections: Multistate Outbreak of *Salmonella Infections Associated with Peanut Butter and Peanut Butter-Containing Products—United States, 2008-2009*," March 2, 2009. http://www.cdc.gov/salmonella/typhimurium/salmonellaOutbreak_timeline.pdf Accessed May 21, 2009.

[34] Ironically, the long shelf life of peanut products that aided investigators may also prolong the outbreak; A large number of products were pulled from store shelves and food service facilities, but tainted products almost certainly remained in the homes of private individuals. While the number of cases has declined since the outbreak's peak, investigators expect that future cases of salmonelosis from peanut products will occur. CDC, "Investigation Update: Outbreak of *Salmonella* Typhimurium Infections 2008-2009." http://www.cdc.gov/salmonella/typhimurium/update.html, Accessed May 25, 2009.

[35] The difference here is statistically significant, showing that more severe disease processes are more thoroughly followed up on. The result for completion of questionnaires for *Listeria monocytogenes*, a sometimes deadly pathogen, are somewhat misleading as one state had a very small number of cases and an even smaller number of completed questionnaires, skewing the average number of completed questionnaires downward for this pathogen. The statistical significance however holds true, even when this skewed data from Listeria is discarded from analysis.

[36] PSP/S.T.O.P. survey, Question 10. (See Appendix B)

[37] For more information, see http://www.cdc.gov/pulsenet.

[38] PSP/S.T.O.P. survey, Question 10. (See Appendix B)

[39] Taylor and Batz 2.

[40] Taylor and Batz 4.

[41] Taylor and David 29, 32-33, 35-36.