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Vital Signs: Multistate Foodborne Outbreaks — United States, 2010–2014

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Abstract

Introduction: Millions of U.S. residents become ill from foodborne pathogens each year. Most foodborne outbreaks occur among small groups of persons in a localized area. However, because many foods are distributed widely and rapidly, and because detection methods have improved, outbreaks that occur in multiple states and that even span the entire country are being recognized with increasing frequency.

Methods: This report analyzes data from CDC's Foodborne Disease Outbreak Surveillance System to describe multistate foodborne outbreaks that occurred in the United States during 2010–2014.

Results: During this 5-year period, 120 multistate foodborne disease outbreaks (with identified pathogen and food or common setting) were reported to CDC. These multistate outbreaks accounted for 3% (120 of 4,163) of all reported foodborne outbreaks, but were responsible for 11% (7,929 of 71,747) of illnesses, 34% (1,460 of 4,247) of hospitalizations, and 56% (66 of 118) of deaths associated with foodborne outbreaks. *Salmonella* (63 outbreaks), Shiga toxin-producing *E. coli* (34), and *Listeria monocytogenes* (12) were the leading pathogens. Fruits (17), vegetable row crops (15), beef (13), sprouts (10), and seeded vegetables (nine) were the most commonly implicated foods. Traceback investigations to identify the food origin were conducted for 87 outbreaks, of which 55 led to a product recall. Imported foods were linked to 18 multistate outbreaks.

Conclusions: Multistate foodborne disease outbreaks account for a disproportionate number of outbreak-associated illnesses, hospitalizations, and deaths relative to their occurrence. Working together, food industries and public health departments and agencies can develop and implement more effective ways to identify and to trace contaminated foods linked to multistate outbreaks. Lessons learned during outbreak investigations can help improve food safety practices and regulations, and might prevent future outbreaks.

Introduction

Each year, millions of U.S. residents become ill from eating contaminated food (*1*). Some of these illnesses are associated with a recognized foodborne disease outbreak. Although most outbreaks occur locally, some are widely dispersed, affecting persons in more than one state, or even nationally.

This report characterizes the epidemiology of multistate foodborne disease outbreaks that occurred in the United States during 2010–2014 and describes how the food industries and local, state, and federal agencies collaborate to investigate outbreaks and use lessons learned to prevent future outbreaks.

Methods

Local, state, and federal public health officials submit reports on multistate foodborne disease outbreaks to CDC's Foodborne Disease Outbreak Surveillance System, which is part of CDC's National Outbreak Reporting System. Foodborne outbreaks are defined as two or more cases of a similar illness caused by ingesting the same food. Multistate foodborne disease outbreaks are defined as foodborne outbreaks in which the exposure occurred in more than one state. Information reported includes dates of the outbreak; number

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of illnesses, hospitalizations, and deaths; states and territories involved; etiologic agent; and food involved (*2*).

Foods were categorized according to methods developed by the Interagency Food Safety Analytics Collaboration (*3*), a partnership between CDC, the Food and Drug Administration (FDA), and the Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS).

Results

During 2010–2014, 120 multistate foodborne disease outbreaks were reported to the Foodborne Disease Outbreak Surveillance System. An average of 24 outbreaks occurred per year (range = 19–26). The median number of states involved in each outbreak was six (range = 2–37). All states, the District of Columbia, and Puerto Rico were affected by one or more multistate foodborne disease outbreaks during the 5-year period. The median number of cases per outbreak was 22 (range = 2–1,939). Overall, these multistate outbreaks accounted for 3% (120 of 4,163) of all U.S. foodborne disease outbreaks, but they were responsible for 11% (7,929 of 71,747) of illnesses, 34% (1,460 of 4,247) of hospitalizations, and 56% (66 of 118) of deaths in foodborne outbreaks. The leading etiologic agents in multistate foodborne outbreaks were *Salmonella* (63 outbreaks), Shiga toxin-producing *E. coli* (STEC) (34), and *Listeria monocytogenes* (12) (Table 1).

Salmonella accounted for the majority of illnesses (82%; 6,530 of 7,929) and hospitalizations (65%; 952 of 1,460) associated with multistate foodborne disease outbreaks (Table 2), and was responsible for the three largest outbreaks, which were linked to eggs (an estimated 1,939 illnesses), chicken (634), and a raw scraped ground tuna product (425). *Salmonella* outbreaks involved nearly twice as many food categories as any other pathogen, including fruit (13 outbreaks; 21%), the most frequent category, followed by seeded vegetables (nine outbreaks), nuts and seeds (eight), and sprouts (seven). Foods from land animals, such as beef (five outbreaks), chicken (four), and eggs (one), also were sources of multistate *Salmonella* outbreaks (Table 1). The three most common *Salmonella* serotypes were Newport (10 outbreaks; 16%), Enteritidis (six; 10%), and Javiana (five; 8%).

Among the 34 STEC outbreaks, almost half (14 outbreaks; 41%) were linked to vegetable row crops (e.g., leafy greens) and another quarter (8 outbreaks; 24%) to beef. Dairy products (two outbreaks), sprouts (two), and fish (one) also were reported (Table 1). Twenty (59%) of the multistate STEC outbreaks were caused by serogroup O157. Serogroups O26 and O145 were responsible for three outbreaks each.

Listeria monocytogenes caused 12 multistate outbreaks. Six resulted from contaminated dairy products, three from contaminated fruit, and one from sprouts (Table 1). *Listeria* was the most deadly pathogen among those isolated in multistate foodborne disease outbreaks, accounting for 57 deaths, 86% of the total. Thirty-three (58%) of the deaths occurred in a single outbreak linked to cantaloupe.

Eighteen (15%) outbreaks were linked to imported foods (Table 3). These outbreaks accounted for 18% (1,439 of 7,929) of illnesses, 21% (300 of 1,460) of hospitalizations, and 9% (6 of 66) of deaths. Mexico was the leading source of imported food linked to multistate outbreaks (six), followed by Turkey (three). Six of the outbreaks caused by imported food (35%) were linked to fruit, four to nuts and seeds, and

TABLE 1. Multistate foodborne disease outbreaks (N = 120), by pathogen and food category — Foodborne Disease Outbreak Surveillance System, United States, 2010–2014

Food category	Pathogen					Total	
	Salmonella	STEC*	*Listeria*	*Vibrio*	Other†	No.	(%)
Fruits	13	—	3	—	1	**17**	**(14)**
Vegetable row crops	1	14	—	—	—	**15**	**(13)**
Beef	5	8	—	—	—	**13**	**(11)**
Sprouts	7	2	1	—	—	**10**	**(8)**
Seeded vegetables	9	—	—	—	—	**9**	**(8)**
Dairy	—	2	6	—	—	**8**	**(7)**
Nuts/Seeds	8	1	—	—	—	**9**	**(8)**
Mollusks	—	—	—	6	1	**7**	**(6)**
Chicken	4	—	—	—	1	**5**	**(4)**
Fish	3	1	—	—	—	**4**	**(3)**
Turkey	3	—	—	—	—	**3**	**(3)**
Eggs	1	—	—	—	—	**1**	**(<1)**
Game	—	1	—	—	—	**1**	**(<1)**
Oils/Sugars	1	—	—	—	—	**1**	**(<1)**
Pork	1	—	—	—	—	**1**	**(<1)**
Other§	7	5	2	—	2	**16**	**(13)**
Total (%)	**63 (53)**	**34 (28)**	**12 (10)**	**6 (5)**	**5 (4)**	**120**	**(100)**

* Shiga toxin–producing *E. coli*.
† Includes one outbreak each caused by *Campylobacter*, a chemical, *Cyclospora*, Hepatitis A virus, and norovirus.
§ Includes multiple foods (seven outbreaks), uncategorized food (four), and unknown food (five).

TABLE 2. Number of outbreaks, illnesses, hospitalizations, and deaths associated with multistate foodborne disease outbreaks (N = 120) — Foodborne Disease Outbreak Surveillance System, United States, 2010–2014

Pathogen	Outbreaks		Illnesses		Hospitalizations		Deaths	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Salmonella	63	(53)	6,530	(82)	952	(65)	8	(12)
STEC*	34	(28)	636	(8)	178	(12)	1	(2)
Listeria	12	(10)	271	(3)	244	(17)	57	(86)
Vibrio	6	(5)	89	(1)	6	(<1)	0	(0)
Other†	5	(4)	403	(5)	80	(5)	0	(0)
Total (%)	**120**	**(100)**	**7,929**	**(100)**	**1,460**	**(100)**	**66**	**(100)**

* Shiga toxin–producing *E. coli*.
† Includes one outbreak each caused by *Campylobacter*, a chemical, *Cyclospora*, Hepatitis A virus, and norovirus.

TABLE 3. Multistate foodborne diseases outbreaks (N = 18) from imported foods, by selected characteristics — Foodborne Disease Outbreak Surveillance System, United States, 2010–2014

Year	Country of origin	Pathogen	Food category	Food	No. of states	No. of illnesses	No. of hospitalizations	No. of deaths
2010	Guatemala	*Salmonella*	Fruits	Mamey shake	3	12	9	0
2010	Unknown	*Salmonella*	Fish	Ahi tuna	12	51	Unknown	Unknown
2011	Guatemala	*Salmonella*	Fruits	Cantaloupe	10	20	3	0
2011	Lebanon	*Salmonella*	Nuts/Seeds	Hummus	8	23	0	0
2011	Mexico	*Salmonella*	Fruits	Papaya	25	106	10	0
2011	Turkey	*Salmonella*	Nuts/Seeds	Pine nuts	6	53	2	0
2012	India	*Salmonella*	Fish	Scraped ground tuna	29	425	55	0
2012	Italy	*Listeria*	Dairy	Ricotta cheese	14	23	21	5
2012	Mexico	*Salmonella*	Fruits	Mango	15	129	33	0
2013	Mexico	*Cyclospora*	No category*	Bagged salad mix	2	161	10	0
2013	Mexico	*Salmonella*	Seeded vegetables	Cucumber	18	84	17	0
2013	Turkey	*Salmonella*	Nuts/Seeds	Tahini	10	17	1	1
2013	Turkey	Hepatitis A virus	Fruits	Pomegranate seeds	10	157	69	0
2013	Vietnam	*Salmonella*	Oils/Sugars	Sugarcane	2	7	1	0
2014	Canada	*Salmonella*	Nuts/Seeds	Chia seed powder	16	31	5	0
2014	China	*Salmonella*	Sprouts	Mung bean sprouts	12	115	19	0
2014	Mexico	*Salmonella*	Fruits	Mango	4	4	1	0
2014	Mexico	*Salmonella*	Seeded vegetables	Sweet mini peppers	10	21	5	0

* The outbreak was not attributed to a single food.

two each to fish and seeded vegetables. *Salmonella* was the etiologic agent for 15 (83%) outbreaks. The only multistate foodborne outbreak attributed to a parasite (*Cyclospora*) was associated with a bagged salad mix imported from Mexico.

During 2010–2014, investigators conducted product tracebacks for 87 of the multistate outbreaks (73%). The tracebacks led to food product recalls in 55 outbreaks (46%).

Conclusions and Comment

Multistate foodborne outbreaks were responsible for a disproportionate number of outbreak-associated hospitalizations and deaths compared with single state outbreaks in the United States during 2010–2014. The pathogens that caused most of the multistate outbreaks (*Salmonella*, STEC, and *Listeria monocytogenes*) are more likely to cause severe disease and death than the leading cause of single state outbreaks, norovirus, which typically causes a milder illness (*4*). Rapid identification of the food that caused the outbreak, discovering where the contamination occurred along a complex supply chain, and recalling a food distributed across the country and perhaps around the world are challenging tasks. Public health departments and government agencies can work more closely with the food industries, which understand how their foods are produced and distributed, to speed up multistate state foodborne disease outbreak and traceback investigations. Lessons learned from these investigations can inform industry and government efforts to improve food safety practices.

Focusing on foods that are prominent in multistate outbreaks can guide industry and government in targeting interventions. The finding that many multistate outbreaks were caused by contaminated produce suggests a need for strengthening produce safety. Stronger safety measures in the production of fruits and vegetables are a key provision in the Food Safety Modernization Act (FSMA), enacted in 2011. FSMA granted FDA, the federal agency responsible for oversight of produce safety, new powers to improve the safe production and harvesting of produce by creating standards for environmental factors including staff hygiene, microbial levels in agricultural water, uses of animal waste in growing foods, and equipment sanitation (*5*).

A second important area for improving food safety is through enhanced ability to monitor the quality and to improve traceability of imported foods. Tracking suspected foods to their source is often arduous for domestic products, and is even more difficult for imported products, in part because of different food traceability standards in other countries. In addition, U.S. food safety laws and regulations are difficult to enforce for foods produced in foreign countries. FSMA addresses these issues by granting FDA, which is responsible for monitoring most imported foods, new import authorities and mandates, including importer food safety accountability, third-party certification of food safety compliance for high-risk foods, and increased authority to refuse entry of imported foods (*6*).

Industry-led best practices also help improve food safety and can be informed by lessons learned from outbreaks. For example, the Beef Industry Food Safety Council was created in 1997 following a large STEC outbreak caused by contaminated beef a few years earlier. The council endorses the principle that "food safety is a noncompetitive issue" and that best practices should be shared throughout the industry (*7*). The California Leafy Green Products Handler Marketing Agreement was drafted by California farmers after a 2006 STEC O157 outbreak linked to produce and consists of best practices to

ensure leafy green vegetable safety. Members also consent to audits by USDA-certified inspectors throughout the growing season (*8*). Industry best practices can complement food safety laws and regulations and help ensure that foods remain safe during growing, processing, and shipping.

Regulations, performance standards, and adherence to industry-developed best practices can improve food safety but are not a guarantee that food products will be contaminant-free; even in highly sanitary environments, contamination can occur. When an outbreak occurs, local, state, and federal investigators need state-of-the-art tools, such as whole genome sequencing (which is expected to replace current PulseNet subtyping methods over the next few years) and electronic platforms for data sharing, to identify the suspected food item and trace it to its source. Rapidly determining common food exposures among patients, often in distant localities, is the key, yet patients sometimes have difficulty remembering the foods they have eaten and when and where they purchased these foods. Therefore, investigators are collaborating with retailers to use data from loyalty cards (i.e., shopper cards) and store membership programs to obtain specific purchase date and brand information on products that consumers purchased before their illness (*9*). Investigators also seek out clusters of illnesses within an outbreak among persons who reported eating at the same restaurant location, attending the same event, or shopping at the same grocery store because these clusters can provide critical clues about the source of an outbreak. Once a specific food is identified, detailed records are essential to trace it back to the processing plant, the producer, or the farm. Without such records, outbreak investigators might not be able to identify the ultimate source of the contaminated food, even when they have identified the food itself (*10*).

When industry and government agencies collaborate, they not only speed up outbreak investigation and traceback processes but also can use lessons learned to reduce the likelihood of future outbreaks. For example, during 2013–2014, investigators linked an outbreak of 634 *Salmonella* serotype Heidelberg infections to handling or consuming chicken from a single producer (*11*). Despite the large number of reported infections, they likely represent only a small fraction of the actual number of infected persons, as with all foodborne disease outbreaks (*1*). Public health agencies worked with the involved industry to identify the ultimate sources of the outbreak and to implement control measures. The affected company has since established new hygiene requirements at its farms and processing plants and in its product transportation practices (*12*). In January 2015, in part in response to this outbreak, USDA-FSIS proposed new production facility performance standards intended to reduce *Salmonella* and *Campylobacter* contamination of chicken and turkey parts (*13*). These standards are part of the larger body of USDA-FSIS guidance aimed at improving food safety in the meat, poultry, and egg industries (*14*). The development and implementation of industry best practices and standards, coupled with regulations that enable a rapid public health response can help enhance food safety and prevent future multistate foodborne disease outbreaks in the United States.

Key Points

- Multistate foodborne outbreaks are being identified more often in the United States because of better surveillance. Greater centralization of food processing and distribution practices could be increasing the frequency and size of multistate foodborne outbreaks.
- From 2010 through 2014, multistate foodborne outbreaks accounted for only 3% of all U.S. foodborne outbreaks detected, but caused over one third of the hospitalizations and more than half of the deaths.
- *Salmonella*, Shiga toxin-producing *Escherichia coli*, and *Listeria monocytogenes* were the leading pathogens causing multistate foodborne outbreaks. In order of frequency, fruits, vegetable row crops, beef, sprouts, and seeded vegetables were the leading contaminated foods.
- Food industries can effectively prevent or limit the size of outbreaks by making food safety a core part of company culture and by meeting or exceeding new food safety regulations and standards. Companies can maintain records that enable rapid tracing of foods from source to destination and use only those suppliers that use food safety best practices. Store loyalty cards can help identify foods that caused illness and enable more rapid notification of customers who bought a specific product.
- Additional information is available at http://www.cdc.gov/vitalsigns.

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