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Incidence and Trends of Infections with Pathogens Transmitted Commonly Through Food and the Effect of Increasing Use of Culture-Independent Diagnostic Tests on Surveillance — Foodborne Diseases Active Surveillance Network, 10 U.S. Sites, 2013–2016

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Foodborne diseases represent a substantial public health concern in the United States. CDC's Foodborne Diseases Active Surveillance Network (FoodNet) monitors cases reported from 10 U.S. sites* of laboratory-diagnosed infections caused by nine enteric pathogens commonly transmitted through food. This report describes preliminary surveillance data for 2016 on the nine pathogens and changes in incidences compared with 2013–2015. In 2016, FoodNet identified 24,029 infections, 5,512 hospitalizations, and 98 deaths caused by these pathogens. The use of culture-independent diagnostic tests (CIDTs) by clinical laboratories to detect enteric pathogens has been steadily increasing since FoodNet began surveying clinical laboratories in 2010 (*1*). CIDTs complicate the interpretation of FoodNet surveillance data because pathogen detection could be affected by changes in health care provider behaviors or laboratory testing practices (*2*). Health care providers might be more likely to order CIDTs because these tests are quicker and easier to use than traditional culture methods, a circumstance that could increase pathogen detection (*3*). Similarly, pathogen detection could also be increasing as clinical laboratories adopt DNA-based syndromic panels, which include pathogens not often included in routine stool culture (*4*,*5*). In addition, CIDTs do not yield isolates, which public health officials rely on to distinguish pathogen subtypes, determine antimicrobial resistance, monitor trends, and detect outbreaks. To obtain isolates for infections identified by CIDTs, laboratories must perform reflex culture†; if clinical laboratories do not, the burden of culturing falls to state public health laboratories, which might not be able to absorb that burden as the adoption of these tests increases (*2*). Strategies are needed to preserve access to bacterial isolates for further characterization and to determine the effect of changing trends in testing practices on surveillance.

FoodNet is a collaboration among CDC, 10 state health departments, the U.S. Department of Agriculture's Food Safety and Inspection Service, and the Food and Drug Administration. FoodNet personnel conduct active, population-based surveillance for laboratory-diagnosed infections

* Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York (https://www.cdc.gov/foodnet).

† Culturing of a specimen with a positive culture-independent diagnostic test (CIDT) result.

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caused by *Campylobacter*, *Cryptosporidium*, *Cyclospora*, *Listeria*, *Salmonella*, Shiga toxin-producing *Escherichia coli* (STEC), *Shigella*, *Vibrio*, and *Yersinia* for 10 sites covering approximately 15% of the U.S. population (an estimated 49 million persons in 2015). Confirmed bacterial infections are defined as isolation of the bacterium from a clinical specimen by culture. Confirmed parasitic infections are defined as detection of the parasite from a clinical specimen by direct fluorescent antibody test, polymerase chain reaction, enzyme immunoassay, or light microscopy. CIDTs detect bacterial pathogen antigen, nucleic acid sequences, or for STEC, Shiga toxin or Shiga toxin genes, in a stool specimen or enrichment broth.[§] A CIDT positive–only bacterial infection is a positive CIDT result that was not confirmed by culture. Hospitalizations occurring within 7 days of specimen collection are recorded. The patient's vital status at hospital discharge (or 7 days after specimen collection if not hospitalized) is also recorded. Hospitalizations and deaths occurring within 7 days of specimen collection are attributed to the infection. FoodNet also conducts surveillance for physician-diagnosed postdiarrheal hemolytic uremic syndrome (HUS), a potential complication of STEC infection, by review of hospital discharge data through a network of nephrologists and infection preventionists. This report includes HUS cases among persons aged <18 years for 2015, the most recent year with available data.

[§] For Shiga toxin-producing *Escherichia coli*, only CIDT reports that were positive at a state public health laboratory were counted.

Incidence of infection for each pathogen is calculated by dividing the number of infections in 2016 by the U.S. Census estimates of the surveillance area population for 2015. Incidence is calculated for confirmed infections alone and for confirmed or CIDT positive–only infections combined. A negative binomial model with 95% confidence intervals (CIs) was used to estimate changes in incidence of confirmed bacterial and parasitic infections and confirmed or CIDT positive–only bacterial infections in 2016 compared with 2013–2015, adjusting for changes in the surveillance population over time. For STEC, incidence is reported for all STEC serogroups combined because it is not possible to distinguish between serogroups using CIDTs. Insufficient data were available to assess change for *Cyclospora*. For HUS, the 2015 incidence was compared with incidence during 2012–2014.

Cases of Infection, Incidence, and Trends

During 2016, FoodNet identified 24,029 cases, 5,512 hospitalizations, and 98 deaths caused by confirmed or CIDT positive–only infections (Table 1). The largest number of confirmed or CIDT positive–only infections in 2016 was reported for *Campylobacter* (8,547), followed by *Salmonella* (8,172), *Shigella* (2,913), STEC (1,845),[¶] *Cryptosporidium* (1,816), *Yersinia* (302), *Vibrio* (252), *Listeria* (127), and *Cyclospora* (55). The proportion of infections that were CIDT positive without

[¶] Excludes Shiga toxin–positive reports from clinical laboratories that were Shiga toxin–negative at a public health laboratory (n = 568).

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TABLE 1. Number of confirmed and CIDT positive–only* bacterial and confirmed parasitic infections, hospitalizations, and deaths, by pathogen — FoodNet, 10 U.S. sites,† 2016§

	Confirmed			Confirmed or CIDT positive–only		
		Hospitalizations	Deaths		Hospitalizations	Deaths
Pathogen	No. cases	No. (%)	No. (%)	No. cases	No. (%)	No. (%)
Bacteria						
Campylobacter	5,782	1,082 (19)	10 (0.2)	8,547	1,697 (20)	26 (0.3)
Listeria¶,**	127	123 (97)	17 (13.4)	127	123 (97)	17 (13.4)
Salmonella	7,554	2,163 (29)	39 (0.5)	8,172	2,255 (28)	40 (0.5)
Shigella	2,256	519 (23)	2 (0.1)	2,913	579 (20)	2 (0.1)
STEC††	1,399	326 (23)	3 (0.2)	1,845	408 (22)	3 (0.2)
Vibrio	218	61 (28)	4 (1.8)	252	73 (29)	4 (1.6)
Yersinia	205	54 (27)	3 (1.5)	302	83 (28)	3 (1.0)
Parasite						
*Cryptosporidium***	1,816	291 (16)	3 (0.2)	1,816	291 (16)	3 (0.2)
*Cyclospora***	55	3 (5)	0 (—)	55	3 (5)	0 (—)
Total	**19,412**	**4,622**	**81**	**24,029**	**5,512**	**98**

Abbreviations: CIDT = culture-independent diagnostic test; FoodNet = CDC's Foodborne Diseases Active Surveillance Network; STEC = Shiga toxin-producing *Escherichia coli*.

* CIDT positive–only is defined as detection of the bacterial pathogen, or for STEC, Shiga toxin, or the genes that encode a Shiga toxin, in a stool specimen or enrichment broth using a CIDT. Any positive CIDT result that was confirmed by culture is counted only among the confirmed infections. For STEC, only CIDT reports that were positive at a state public health laboratory were counted.

† Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.

§ Data for 2016 are preliminary.

¶ *Listeria* cases are defined as isolation of *L. monocytogenes* from a normally sterile site or, in the setting of miscarriage or stillbirth, isolation of *L. monocytogenes* from placental or fetal tissue.

** All *Listeria*, *Cryptosporidium*, and *Cyclospora* infections were confirmed, so confirmed numbers are displayed in both columns.

†† For STEC, all serogroups were combined as it is not possible to distinguish between serogroups using CIDTs. Shiga toxin–positive reports from clinical laboratories that were Shiga toxin–negative at a state public health laboratory were excluded (n = 568).

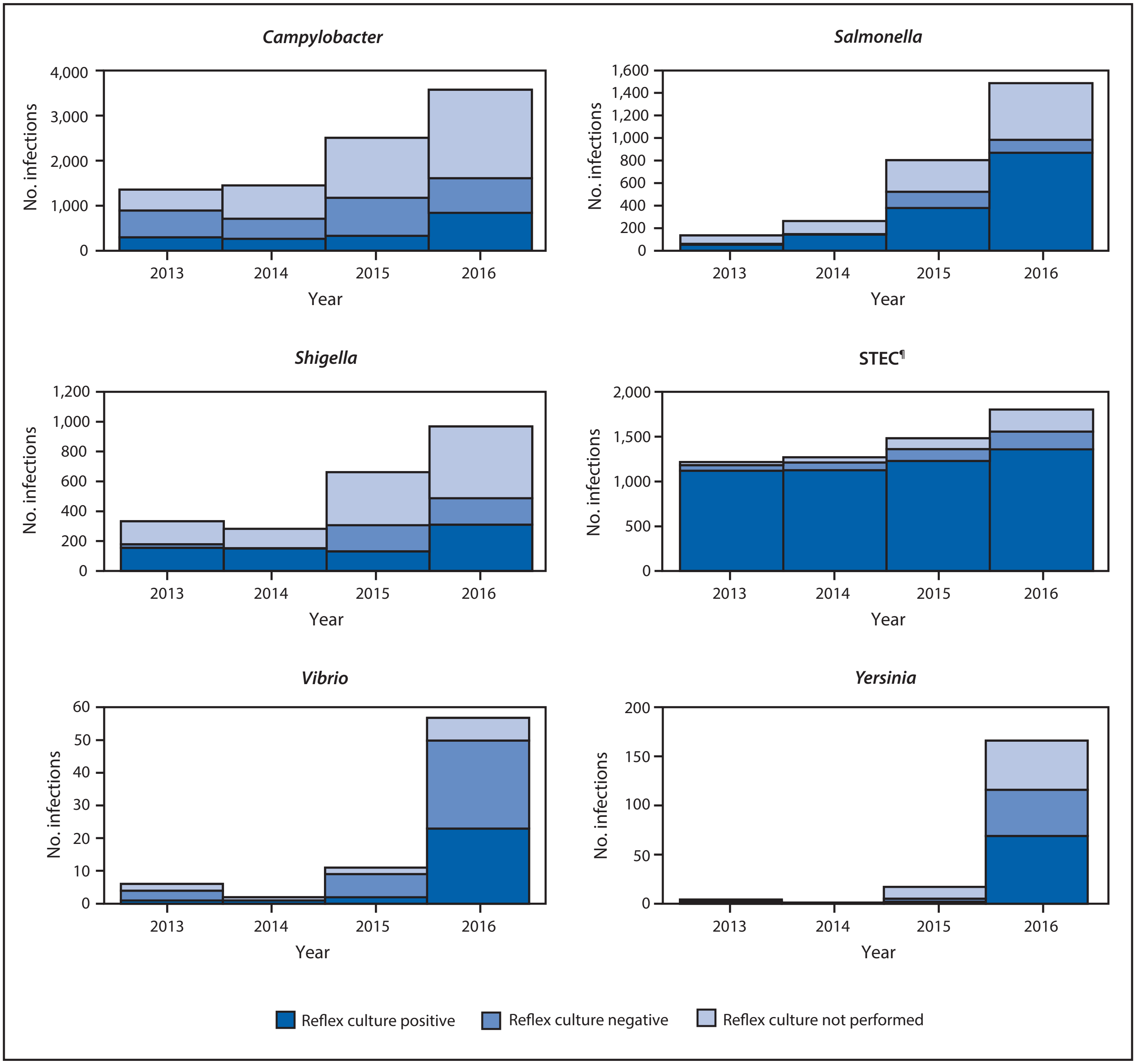
culture confirmation in 2016 was largest for *Campylobacter* (32%) and *Yersinia* (32%), followed by STEC (24%), *Shigella* (23%), *Vibrio* (13%), and *Salmonella* (8%). The overall increase in CIDT positive–only infections for these six pathogens in 2016 was 114% (range = 85%–1,432%) compared with 2013–2015. Among infections with a positive CIDT result in 2016, a reflex culture was attempted on approximately 60% at either a clinical or state public health laboratory. The proportion of attempted reflex cultures differed by pathogen, ranging from 45% for *Campylobacter* to 86% for STEC and 88% for *Vibrio* (Figure). Among infections for which reflex culture was performed, the proportion of infections that were positive was highest for *Salmonella* (88%) and STEC (87%), followed by *Shigella* (64%), *Yersinia* (59%), *Campylobacter* (52%), and *Vibrio* (46%).

The incidence of confirmed infections and of confirmed or CIDT positive–only infections per 100,000 persons was highest for *Campylobacter* (confirmed = 11.79; confirmed or CIDT positive–only = 17.43) and *Salmonella* (15.40; 16.66), followed by *Shigella* (4.60; 5.94), *Cryptosporidium* (3.64; N/A**), STEC (2.85; 3.76), *Yersinia* (0.42; 0.62), and lowest for *Vibrio* (0.45; 0.51), *Listeria* (0.26; N/A), and *Cyclospora* (0.11; N/A) (Table 2). Compared with 2013–2015, the 2016 incidence of *Campylobacter* infection was significantly lower (11% decrease) when including only confirmed infections, yet was not significantly different when including confirmed or CIDT positive–only infections. Incidence of STEC infection was significantly higher for confirmed infections (21% increase) and confirmed or CIDT positive–only infections (43% increase). Similarly, the incidence of *Yersinia* infection was significantly higher for both confirmed (29% increase) and confirmed or CIDT positive–only infections (91% increase). Incidence of confirmed *Cryptosporidium* infection was also significantly higher in 2016 compared with 2013–2015 (45% increase).

Among 7,554 confirmed *Salmonella* cases in 2016, serotype information was available for 6,583 (87%). The most common serotypes were Enteritidis (1,320; 17%), Newport (797; 11%), and Typhimurium (704; 9%). The incidence in 2016 compared with 2013–2015 was significantly lower for Typhimurium (18% decrease; CI = 7%–21%) and unchanged for Enteritidis and Newport. Among 208 (95%) speciated *Vibrio* isolates, 103 (50%) were *V. parahaemolyticus*, 35 (17%) were *V. alginolyticus*, and 26 (13%) were *V. vulnificus*. Among 1,394 confirmed and serogrouped STEC cases, 503 (36%) were STEC O157 and 891 (64%) were STEC non-O157. Among 586 (70%) STEC non-O157 isolates, the most common serogroups were O26 (190; 21%), O103 (178; 20%), and O111 (106; 12%). Compared with 2013–2015, the incidence of STEC non-O157 infections in 2016 was significantly higher (26% increase; CI = 9%–46%) and the incidence of STEC O157 was unchanged.

** Not applicable: all infections were confirmed.

FIGURE. Number of infections with positive culture-independent diagnostic test (CIDT) results,* by pathogen, year, and culture status — FoodNet, 10 U.S. sites,† 2013–2016§



Abbreviations: FoodNet = CDC's Foodborne Diseases Active Surveillance Network; STEC = Shiga toxin–producing *Escherichia coli*.

* Positive CIDT results are defined as detection of the bacterial pathogen, or for STEC, Shiga toxin or the genes that encode a Shiga toxin in a stool specimen or enrichment broth using a CIDT. For STEC, only CIDT results that were positive at a state public health laboratory were counted.

† Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.

§ Data for 2016 are preliminary.

¶ For STEC, all serogroups were combined because distinguishing between serogroups using CIDTs is not possible. Shiga toxin–positive reports from clinical laboratories that were Shiga toxin–negative at a state public health laboratory were excluded (n = 568).

TABLE 2. Percentage change in incidence of confirmed and CIDT positive–only* bacterial and confirmed parasitic infections in 2016† compared with 2013–2015 average annual incidence, by pathogen — FoodNet, 10 U.S. sites,§ 2013–2016

	Confirmed			Confirmed or CIDT positive–only		
Pathogen	**2016 IR¶**	**% Change****	**95% CI**	**2016 IR¶**	**% Change****	**95% CI**
Campylobacter	11.79	-11	-18 to -3	17.43	+3	-4 to +10
Listeria††	0.26	+4	-18 to +30	—§§	—§§	—§§
Salmonella	15.40	+2	-4 to +8	16.66	+6	-1 to +12
Shigella	4.60	+7	-17 to +38	5.94	+25	-3 to +62
STEC¶¶	2.84	+21	+3 to +42	3.76	+43	+22 to +67
Vibrio	0.45	+2	-18 to +26	0.51	+16	-6 to +42
Yersinia	0.42	+29	+2 to +64	0.62	+91	+52 to +140
Cryptosporidium	3.70	+45	+11 to +89	—§§	—§§	—§§

Abbreviations: CI = confidence interval; CIDT = culture-independent diagnostic test; FoodNet = CDC's Foodborne Diseases Active Surveillance Network; IR = incidence rate; STEC = Shiga toxin–producing *Escherichia coli*.

* CIDT positive only is defined as detection of the bacterial pathogen, or for STEC, Shiga toxin or the genes that encode a Shiga toxin, in a stool specimen or enrichment broth using a CIDT. Any positive CIDT result that was confirmed by culture is counted only among the confirmed infections. For STEC, only CIDT reports that were positive at a state public health laboratory were counted.

† Data for 2016 are preliminary.

§ Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.

¶ Per 100,000 population.

** Percentage change reported as increase (+) or decrease (-).

†† *Listeria* cases defined as isolation of *L. monocytogenes* from a normally sterile site, or in the setting of miscarriage or stillbirth, isolation of *L. monocytogenes* from placental or fetal tissue.

§§ All infections were confirmed.

¶¶ For STEC, all serogroups were combined, because it is not possible to distinguish between serogroups using CIDTs.

FoodNet identified 62 cases of postdiarrheal HUS in children aged <18 years (0.56 cases per 100,000) in 2015; 33 (56%) occurred in children aged <5 years (1.18 cases per 100,000). Compared with 2012–2014, in 2015, no significant differences in incidence among all children or children aged <5 years were observed.

Discussion

The number of CIDT positive–only infections reported to FoodNet has been increasing markedly since 2013, as more clinical laboratories adopt CIDTs. Initially, increases were primarily limited to *Campylobacter* and STEC; followed by substantial increases in *Salmonella* and *Shigella* beginning in 2015 (*6*). The pattern continued in 2016, with large increases in the number of CIDT positive–only *Vibrio* and *Yersinia* infections. When including both confirmed and CIDT positive–only infections, incidence rates in 2016 were higher for each of these six pathogens. The increasing use of CIDTs presents challenges when interpreting the corresponding increases in incidence. For example, the incidence of confirmed *Campylobacter* infections in 2016 was significantly lower than the 2013–2015 average. However, when including CIDT positive–only infections, a slight but not significant increase occurred. For STEC and *Yersinia*, the incidence of confirmed infections alone and confirmed or CIDT positive–only infections in 2016 were both significantly higher than the 2013–2015 average; the magnitude of change approximately doubled when analyzing CIDT positive–only infections.

Because of the ease and increasing availability of CIDTs, testing for some pathogens might be increasing as health care provider behaviors and laboratory practices evolve (*2*). Among clinical laboratories in the FoodNet catchment, the use of CIDTs to detect *Salmonella*, for which the only CIDTs available are DNA-based gastrointestinal syndrome panels, increased from 2 per 460 laboratories (<1%) in 2013 to 59 per 421 laboratories (14%) in 2016 (FoodNet, unpublished data). This increased use paralleled significant increases in incidence of *Cryptosporidium*, STEC, and *Yersinia*, and slight but not significant increases in incidence of *Campylobacter, Salmonella, Shigella,* and *Vibrio*, all of which are also included in these panel tests. The increase in STEC incidence is driven by the increase in STEC non-O157, which is not typically included in routine stool culture testing because it requires specialized methods. Routine stool cultures performed in clinical laboratories typically include methods that identify only *Salmonella*, *Campylobacter*, *Shigella*, and for some laboratories, STEC O157 (*4*,*5*). The increased use of the syndrome panel tests might increase identification, and thus, improve incidence estimates of pathogens for which testing was previously limited.

Results are more quickly obtained using CIDTs than traditional culture methods (*3*). Because of this, health care providers might be more likely to order a CIDT than traditional culture (*2*). Increased testing might identify infections that previously would have remained undiagnosed. However, sensitivity and specificity vary by test type. Evaluations of DNA-based syndrome panel tests have indicated high sensitivity and specificity for most targets (*3*). However, among pathogens for which antigen-based CIDTs are often used, such as *Campylobacter* and *Cryptosporidium*, sensitivity and specificity have varied more widely, with a large number of false positive results (*7*,*8*). Including CIDT positive infections to calculate incidence, some of which could be false positives, might provide an inaccurate estimate. When interpreting incidence and trends in light of changing diagnostic testing, considering frequency of testing, sensitivity, and specificity of these tests is important. The observed increases in incidence of confirmed or CIDT positive–only infections in 2016 compared with 2013–2015 could be caused by increased testing, varying test sensitivity, an actual increase in infections, or a combination of these reasons.

These changes in testing are also important to consider when monitoring progress toward *Healthy People 2020* objectives.[††] The current objectives were created before the use of CIDTs and were based on confirmed infections. In the future, just as incidence measures should adjust for these changes, objectives should also be evaluated in light of changing diagnostics.

CIDTs pose additional challenges because they do not yield the bacterial isolates necessary for essential public health surveillance activities, such as monitoring trends in pathogen subtypes, conducting molecular testing, detecting outbreaks and implicating vehicles, and determining antimicrobial susceptibility. Reflex culture performed to yield an isolate places an additional burden on laboratories' budgets, personnel, and time. Specimen submission requirements differ by state and pathogen, and this responsibility often falls to state public health laboratories (*9*). As CIDT use increases and more pathogens are affected, state public health laboratories will be challenged to sufficiently increase their testing capacity and will likely have to prioritize specimens on which to perform reflex culture (*10*). Clinical laboratories should review state specimen submission requirements and the Association of Public Health Laboratories guidelines[§§] for reflex culture and submission of CIDT positive specimens.

The findings in this report are subject to at least two limitations. First, the changing diagnostic landscape with unknown changes in frequency of testing, varying test performance, and decreasing availability of isolates for subtyping make interpreting incidence and trends more difficult. Second, changes in health care–seeking behavior, access to health services, or other population characteristics might have changed since the comparison period, which could affect incidence.

Foodborne illness remains a substantial public health concern in the United States. Previous analyses have indicated that the number of infections far exceeds those diagnosed; CIDTs might be making those infections more visible (*11*). Most foodborne infections can be prevented, and substantial progress has been made in the past in decreasing contamination of some foods and reducing illness caused by some pathogens. More prevention measures are needed. Surveillance data can provide information on where to target these measures. However, to accurately interpret FoodNet surveillance data in light of changes in diagnostic testing, more data and analytic tools are needed to adjust for changes in testing practices and differences in test characteristics. FoodNet is collecting more data and developing those tools. With these, FoodNet will continue to track the needed progress toward reducing foodborne illness.

Summary

What is already known about this topic?

The incidence of infections transmitted commonly through food has remained largely unchanged for many years. Culture-independent diagnostic tests (CIDTs) are increasingly used by clinical laboratories to detect enteric infections.

What is added by this report?

Compared with the 2013–2015 average annual incidence, the 2016 incidence of confirmed *Campylobacter* infections was lower, incidences of confirmed Shiga toxin-producing *Escherichia coli* (STEC), *Yersinia*, and *Cryptosporidium* infections were higher, and incidences of confirmed or CIDT positive–only STEC and *Yersinia* infections were higher. However, CIDTs complicate the interpretation of surveillance data; testing for pathogens might occur more frequently because of changes in either health care provider behaviors or laboratory testing practices. A large proportion of CIDT positive specimens were not reflex cultured, which is necessary to obtain isolates for distinguishing pathogen subtypes, determining antimicrobial resistance, monitoring trends, and detecting outbreaks.

What are the implications for public health practice?

Some information about the bacteria causing infections, such as subtype and antimicrobial susceptibility, can only be obtained for CIDT positive specimens if reflex culture is performed. Increasing use of CIDTs affects the interpretation of public health surveillance data and ability to monitor progress toward prevention measures.

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[††] https://www.healthypeople.gov/2020/topics-objectives/topic/food-safety/objectives.

[§§] https://www.aphl.org/aboutAPHL/publications/Documents/FS-Enteric_Pathogens_Guidelines_0216.pdf.

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Restaurant Food Allergy Practices — Six Selected Sites, United States, 2014

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Food allergies affect an estimated 15 million persons in the United States (*1*), and are responsible for approximately 30,000 emergency department visits and 150–200 deaths each year (*2*). Nearly half of reported fatal food allergy reactions over a 13-year period were caused by food from a restaurant or other food service establishment (*3*). To ascertain the prevalence of food allergy training, training topics, and practices related to food allergies, CDC's Environmental Health Specialists Network (EHS-Net), a collaborative forum of federal agencies and state and local health departments with six sites, interviewed personnel at 278 restaurants. Fewer than half of the 277 restaurant managers (44.4%), 211 food workers (40.8%), and 156 servers (33.3%) interviewed reported receiving food allergy training. Among those who reported receiving training, topics commonly included the major food allergens and what to do if a customer has a food allergy. Although most restaurants had ingredient lists for at least some menu items, few had separate equipment or areas designated for the preparation of allergen-free food. Restaurants can reduce the risk for allergic reactions among patrons by providing food allergy training for personnel and ingredient lists for all menu items and by dedicating equipment and areas specifically for preparing allergen-free food.

Within each of the six EHS-Net sites (California, Minnesota, New York, New York City, Rhode Island, and Tennessee), data collectors chose a convenient geographic area, based on reasonable travel distance, in which to survey restaurants by telephone to determine their study eligibility and request participation. Within each geographic area, a random sample of restaurants was selected using statistical software. Restaurants were defined as facilities that prepare and serve food or beverages to customers and are not food carts, mobile food units, temporary food stands, or caterers, and are not located in supermarkets or institutions. Only restaurants with an English-speaking manager were eligible to be included in the study. Data collectors assessed approximately 50 restaurants in each of the sites. Data were collected during January 2014–February 2015.

After obtaining permission from the restaurant manager, data collectors conducted an on-site interview with a worker who had authority over the kitchen (manager), a worker who primarily prepared or cooked food (food worker), and a worker who primarily took orders or served food to customers (server). To increase participation and cooperation, data collectors asked the manager to select the English-speaking food worker and server to be interviewed. Data collectors interviewed all three personnel groups about food allergy training they had received while working at their current restaurant, including training topics covered (e.g., what are the major food allergens?). Managers also were asked whether the restaurant had ingredient lists for menu items accessible to the staff, customers, or both and whether special equipment or resources were dedicated to serving customers with food allergies (i.e., does this restaurant have a special area in the kitchen for making allergen-free food?).

Among the 1,307 restaurants contacted for participation in the study, 852 met the study eligibility criteria, and 278 (32.6%) of those agreed to participate; 58 restaurants were excluded because they did not have an English-speaking manager, and another 177 were excluded because they did not meet the restaurant definition for EHS-Net inclusion. Data on restaurant, manager, food worker, and server characteristics have been published previously (*4*). Among 277 managers, 123 (44.4%) reported that they had received training on food allergies while working at their respective restaurants (Table 1). Manager food allergy trainings most often covered how to prevent cross-contact (the inadvertent transfer of allergens from food, equipment, or surfaces containing an allergen to a food that does not contain the allergen) (96.7%); the major food allergens (milk, eggs, fish, shellfish, tree nuts, peanuts, wheat, and soybeans) (92.7%); and what to do if a customer has a food allergy (80.5%).

Among 211 food workers, 86 (40.8%) reported receiving food allergy training while working at their respective restaurants. Food worker food allergy trainings most often covered how to prevent cross-contact (98.8%), what to do if a customer has a food allergy (90.7%), and the major food allergens (86.0%).

Among 156 servers, 52 (33.3%) reported receiving food allergy training while working at their respective restaurants. Server food allergy trainings most often covered what to do if a customer has a food allergy (94.2%), the major food allergens (86.5%), and how to prevent cross-contact (84.6%). Across all three restaurant personnel groups, fewer participants reported that training covered menu items with food allergens (69.1% of managers, 76.7% of food workers, and 78.8% of servers), symptoms of an allergic reaction (67.5% of managers, 62.8% of food workers, and 61.5% of servers), and what to do if a customer has a bad allergic reaction (e.g., difficulty breathing)

(64.2% of managers, 69.8% of food workers, and 73.1% of servers) (Table 1).

Among managers, 55.2% reported that their restaurants had ingredient lists or recipes for all or most menu items, 18.4% reported ingredient lists for some menu items, and 25.3% reported having no lists (Table 2). Among managers, 19.1% reported that their restaurants had a dedicated set of utensils or equipment for making allergen-free food (a meal free of the allergen to which a patron is allergic), and 78.0% reported no dedicated set of utensils or equipment. Few managers reported that their restaurant had a special area in the kitchen for preparing allergen-free food (7.6%), a special fryer for cooking allergen-free food (10.3%), or a special pick-up area for customers with food allergies (7.2%).

Discussion

The findings in this report suggest that there is considerable opportunity for restaurants to improve their practices to prevent allergic reactions among their patrons with food allergies. The 2013 Food and Drug Administration Food Code (*5*), which provides the basis for state and local codes that regulate retail food service, recommends that the person-in-charge (i.e., the manager) be knowledgeable about food allergies. Managers are also responsible for ensuring that employees are properly trained in food safety, including food allergy awareness. The organization Food Allergy Research & Education (FARE) encourages food allergy training for all new restaurant employees before they begin serving patrons, and periodic training updates for current staff members (*6*). However, the findings in this report indicate that employee training might not be occurring according to recommendations. Approximately half of surveyed restaurants did not provide food allergy training for their staffs, and the training provided often did not cover important information such as what to do if a customer has an allergic reaction (e.g., difficulty breathing). FARE guidance stresses the importance of staff members responding appropriately to allergic reactions (*6*).

Approximately one fourth of surveyed managers reported having no ingredient lists or recipes for menu items. Ingredient lists are important to help the staff determine which menu items contain common allergens. FARE recommends that a restaurant be able to supply, upon request, a list of ingredients for any menu item (*6*).

Few surveyed restaurants had dedicated equipment for preparing allergen-free food. This is concerning because proteins from allergens can remain on equipment even after it is wiped clean, and dedicated equipment for making allergen-free food can reduce the risk for cross-contact. Dedicated equipment can be color-coded for quick identification, and designating areas in the kitchen for preparing allergen-free meals can further reduce the risk to patrons with food allergies. In addition, having a separate pick-up area can prevent problems such as delivering the wrong food to patrons, adding inappropriate garnishes, or exposing allergen-free meals to cross-contact with a food allergen (e.g., unclean hands, trays, or splashed food). Oils in deep fryers that are used to cook several different foods can contain protein from previously fried foods; therefore, restaurants should consider designating a fryer for one type of food. These recommendations for separate equipment, preparation and pick-up areas, and fryers might be difficult for many restaurants to implement, given resource and space limitations. Although research in this area is limited, one study found that conventional cleaning methods were effective in removing peanut proteins (*7*). Therefore, as an alternative in restaurants with limited resources or space, equipment and workspaces could be cleaned according to Food Code guidance (*5*) before preparing an allergen-free dish.

TABLE 1. Responses to questions regarding food allergy training reported by restaurant managers, food workers, and servers* — six Environmental Health Specialists Network sites,† United States, 2014

Question	Managers (N = 277)	Food workers (N = 211)	Servers (N = 156)
	No. (%)	No. (%)	No. (%)
Have you had training on food allergies while working at this restaurant?			
Yes	123 (44.4)	86 (40.8)	52 (33.3)
No	152 (54.9)	123 (58.3)	103 (66.0)
Unsure	2 (0.7)	2 (1.0)	1 (0.6)
Did your training cover§			
How to prevent cross-contact from food allergens to other foods?	119 (96.7)	85 (98.8)	44 (84.6)
The most common, or major, food allergens?	114 (92.7)	74 (86.0)	45 (86.5)
What to do if a customer says they have a food allergy?	99 (80.5)	78 (90.7)	49 (94.2)
The menu items with food allergens in this restaurant?	85 (69.1)	66 (76.7)	41 (78.8)
The symptoms of an allergic reaction?	83 (67.5)	54 (62.8)	32 (61.5)
What to do if a customer has a bad food allergic reaction (e.g., trouble breathing)?	79 (64.2)	60 (69.8)	38 (73.1)

* Percentages might not sum to 100% because of rounding.
† California, Minnesota, New York, New York City, Rhode Island, and Tennessee.
§ Denominators for percentages are the number of respondents in each group who said they had received training: 123 managers, 86 food workers, and 52 servers.

TABLE 2. Restaurant manager responses to questions regarding food allergy practices — six Environmental Health Specialists Network sites,* United States, 2014

Question (No. of respondents)	No. (%)
Does this restaurant have lists or recipes with the ingredients for the food it makes? (277)	
Yes for all or most menu items	153 (55.2)
Yes for some menu items	51 (18.4)
No	70 (25.3)
Unsure	3 (1.1)
Does this restaurant have a special set of utensils or equipment for making allergen-free food? (277)	
Yes	53 (19.1)
No	216 (78.0)
Unsure	8 (2.9)
Does this restaurant have a special area in the kitchen for making allergen-free food? (277)	
Yes	21 (7.6)
No	251 (90.6)
Unsure	5 (1.8)
If there is a fryer in the restaurant, is there a special fryer for cooking allergen-free food? (214)	
Yes	22 (10.3)
No	188 (87.8)
Unsure	4 (1.9)
If there is a pick-up area in the restaurant, is there a special pick-up area for food for food allergic customers? (249)	
Yes	18 (7.2)
No	228 (91.6)
Unsure	3 (1.2)

* California, Minnesota, New York, New York City, Rhode Island, and Tennessee.

The findings in this report are subject to at least four limitations. First, because the interview responses were self-reported, they are subject to social desirability bias, which might have resulted in over-reporting of appropriate practices. Second, because interviewed food workers and servers were selected by managers, and not at random, their responses might not represent the experiences or practices of all food workers and servers. Third, because the data were collected from English-speaking staff members only, they might not reflect practices in restaurants where no one speaks English. Finally, the low response rate (32.6%) might have resulted in an overrepresentation of restaurants with better food allergy practices.

Current recommendations for preventing allergic reactions in restaurants are based on actual cases of allergic reactions in restaurants, on expert opinion, and on research about how allergen proteins react. However, limited evaluation data currently exist on the effectiveness of the recommendations, and more research is needed on this topic. Food allergies are a serious food safety issue. Restaurants should ensure that all staff members are knowledgeable about food allergies, from preventing cross-contact to knowing how to respond in an emergency. Investing in and using dedicated equipment and designating areas for preparing allergen-free food can also reduce the risk for cross-contact. Increasing staff knowledge and awareness of food allergens can help restaurants better accommodate patrons with food allergies and increase the probability of a safe dining experience.

Summary

What is already known about this topic?

Food allergies affect an estimated 15 million persons in the United States and are responsible for approximately 30,000 emergency department visits and 150–200 deaths each year. Nearly half of fatal food allergy reactions over a 13-year period were caused by food from a restaurant or other food service establishment.

What is added by this report?

Fewer than half of members of the restaurant staffs surveyed in 278 restaurants had received training on food allergies. Topics frequently covered in the trainings were identifying the major food allergens, what to do if a customer has a food allergy, and how to prevent cross-contact of allergens. Although most restaurants have ingredient lists or recipes for at least some menu items, few have separate equipment or areas designated specifically for the preparation of allergen-free food.

What are the implications for public health practice?

It is important for restaurants to provide food allergy training for staff members and ensure that the training covers critical information. Restaurants can dedicate equipment and create separate areas that are specifically designated for preparing meals for customers with food allergies. Adopting these practices can reduce the risk for an allergic reaction among patrons.

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Notes from the Field

Powassan Virus Disease in an Infant — Connecticut, 2016

Jessica W. Tutolo, MD[1]; J. Erin Staples, MD, PhD[2]; Lynn Sosa, MD[3]; Nicholas Bennett, MBBChir, PhD[1]

In early November 2016, a previously healthy male infant aged 5 months from eastern Connecticut developed fever and vomiting. Right-sided facial twitching began over the next several days, and progressed to seizures that included rightward eye deviation and right arm stiffening. He was admitted to the hospital for evaluation and management of his seizures. There was no travel history; however, the parents reported that 2 weeks earlier, the infant had been bitten by a tick most likely carried into the home on a family member's clothing. The estimated time of tick attachment was <3 hours.

Head computed tomography scan, complete blood count, and serum electrolytes were normal. A lumbar puncture was performed; white blood cell count in the cerebrospinal fluid (CSF) was 125/μL (81% lymphocytes) (reference range = 0–15 cells/μL). Magnetic resonance imaging (MRI) of the brain showed a symmetric pattern of restricted diffusion (suggestive of cellular edema) involving the basal ganglia, rostral thalami, and left pulvinar, consistent with encephalitis. There were no findings of hemorrhage, and the lesions did not enhance, indicating normal local blood flow and minimal inflammation. Testing for common nonarboviral causes of encephalitis was negative, as were CSF bacterial cultures and respiratory viral cultures.

Because of the clinical and MRI findings, and the confirmed brief tick attachment, CDC testing for evidence of infection with Powassan virus (POWV) was requested by the attending infectious diseases specialist. The CSF sample obtained on admission (4 days after illness onset) was positive for POWV immunoglobulin M, with a POWV-specific neutralizing antibody titer of 32. The child's seizures were controlled with anticonvulsant therapy with fosphenytoin and levetiracetam, and he was discharged home after 7 days on oral levetiracetam. One month after the onset of symptoms the parents noted that he could no longer sit up unaided, a milestone that he had met prior to the illness. Four months after his illness (aged 10 months), he was reported to have normal motor and verbal development (crawling, walking with a walker, and babbling). He was noted to have a distinct left-handed preference. He was no longer receiving physical or occupational therapy, and was no longer on any antiepileptics. A second MRI performed 4 months after the first revealed gliosis and encephalomalacia in the thalami and basal ganglia bilaterally, with volume loss and evidence of early mineralization in the left basal ganglia.

POWV is a tickborne flavivirus, similar to tickborne encephalitis virus, transmitted by *Ixodes scapularis, I. cookei,* and *I. marxi* ticks (*1*). Transmission of POWV occurs as quickly as 15 minutes after tick attachment (*2*). Clinical presentations of POWV infection range from a febrile illness to severe neurologic disease, with death occurring in approximately 10% of reported cases; long-term sequelae are common (*1*).

During 2006–2015, a median of seven cases of POWV disease (range = 1–12) were reported annually in the United States (*1*). Cases occur predominantly in the Northeast and Great Lakes region; several states (Minnesota, New Hampshire, and Virginia) reported their first POWV disease cases during the last 7 years; it is not known whether this represents spread of the virus within the local tick population, or increased testing and recognition of the virus as a cause of human disease. Despite POWV-infected ticks having been found in Connecticut (*3*), this is the first report of a human case of POWV disease in the state and highlights the importance of considering POWV disease in persons with a clinically compatible illness and obtaining a comprehensive exposure history. Although the illness onset for this patient (early November) was later than might be expected for encephalitis caused by mosquitoborne arboviruses (e.g., West Nile virus, which is more common in the summer months), ticks can be active well before and after peak mosquito season. It is important for clinicians to consider POWV disease whenever a patient in a tick-endemic area is evaluated for encephalitis. Testing for POWV infection is not usually included on arbovirus encephalitis panels and should be requested specifically, as was done in this case. The short attachment time required to transmit POWV highlights the importance of avoiding tick exposure through the use of repellents or wearing permethrin-treated clothing. Tick checks should be performed as soon as possible after exposure, including showering to remove any nonattached ticks, and clothing should be changed afterward.

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Notes from the Field

Varicella Fatality on a Cargo Vessel — Puerto Rico, 2015

Misty Ellis, MPH[1]; Carolina Luna-Pinto, MPH[1]; Thomas George, MPH[1]; Joanna J. Regan, MD[1]; Mona Marin, MD[2]; Adriana Lopez, MHS[2]; Brenda Rivera-Garcia, DVM[3]; Kara Tardivel, MD[1]

The U.S. Code of Federal Regulations (42 §71.21) requires that the master of a ship destined to a U.S. port of entry report certain illnesses, as well as any death onboard to the nearest CDC Quarantine Station (*1*). On December 30, 2015, the U.S. Coast Guard notified CDC of the death of a crew member of a foreign cargo vessel off the coast of Puerto Rico. Four days earlier, on December 26, the patient, a man aged 50 years from India, developed abdominal pain, headache, and fever (103.0°F [39.4°C]), followed by loose stools and pruritus. On December 28, a vesicular rash appeared on his face, neck, and shoulders. Medical consultants suspected varicella and recommended shipboard isolation. On December 29, the vesicles had begun to dry and scab, and he developed a nonproductive cough and reported chest congestion. On December 30, he had difficulty breathing and collapsed; cardiopulmonary resuscitation was unsuccessful. The Puerto Rico Department of Health was contacted to liaise with the medical examiner. Lung tissue and skin lesion specimens collected at autopsy were positive for varicella-zoster virus DNA by polymerase chain reaction at CDC. The cause of death was reported as varicella pneumonia. No other medical conditions were reported.

Per CDC recommendations, all 24 shipmates were considered contacts of the index patient; the master of the ship instituted daily temperature and rash surveillance for 21 days (i.e., one incubation period) after the death. On days 13 and 16 of surveillance, two crew members were sent home because of emergencies unrelated to varicella. San Juan and Houston CDC Quarantine Stations coordinated varicella vaccination for the 22 remaining and five new crew members boarding after the end of the 21-day surveillance, all of whom had unknown varicella immunity. Acyclovir was procured by the ship for treatment of possible additional cases; however, none occurred.

Varicella, a highly contagious disease caused by the varicella-zoster virus, is transmitted by direct contact with vesicle fluid, or through breathing infectious droplets. Varicella is typically a mild disease; however, adults are at risk for more severe illness and have a higher incidence of complications, most commonly pneumonia (*2*). Adults who grew up in tropical countries or countries where varicella vaccination is uncommon might have increased varicella susceptibility (*3*). Varicella rarely results in death; mortality rates during 1990–1994 (before vaccine licensure) were 0.3 per 1,000,000 population among persons aged ≥20 years. Pneumonia was the most common cause of death in previously healthy persons with varicella in this age group (*4*). Before effective chemotherapy, a case fatality rate of 10%–30% was reported among adults with varicella pneumonia (*5*).

This investigation highlights the importance of early notification of illness or death to CDC by ships arriving to U.S. ports of entry, and the use of CDC's varicella management guidance to prevent further transmission (*6*), including surveillance for febrile rash illness, isolation of cases, screening for varicella immunity, and vaccination of nonimmune persons. Collaboration with the U.S. Coast Guard was critical for expediting communication with the master of the ship. Assistance from the Puerto Rico Department of Health and the Puerto Rico Forensic Sciences Institute was instrumental in ensuring a thorough and timely investigation and public health response. Keeping a stock of acyclovir onboard was added to the CDC maritime varicella management guidance (*6*).

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Announcements

National Infertility Awareness Week, April 23–29, 2017

April 23–29 is National Infertility Awareness Week and is intended to increase awareness of infertility, which affects the reproductive systems of both women and men (*1*). In general, infertility is defined as the inability of couples to achieve pregnancy after ≥1 year of trying (*1*). However, given that fertility in women is known to decline steadily with age, some providers evaluate and treat women aged ≥35 years after 6 months of intercourse without the use of contraception (*1*). Causes of infertility include genetic abnormalities, certain acute and chronic diseases, exposure to certain environmental toxins, smoking, and excessive alcohol use (*2*).

During 2011–2013, approximately 1.6 million (6%) married women aged 15–44 years in the United States reported difficulty getting pregnant (*3*). Approximately 4 million (9%) men aged 25–44 years reported that they or their partner had consulted a doctor for advice, testing, or treatment for infertility during their lifetime (*4*). Infertility might contribute to stress, anxiety, and depression in couples trying to conceive, and treatment can be medically invasive and expensive. In addition, fertility treatments can be associated with health problems for women and resulting children (*2*), especially those related to the increased risk for multiple gestation.

In collaboration with partners, CDC developed the *National Public Health Action Plan for the Detection, Prevention, and Management of Infertility*, which identifies opportunities to prevent and reduce infertility and improve outcomes for couples undergoing fertility treatment. Additional information regarding infertility is available at https://www.cdc.gov/reproductivehealth/Infertility/index.htm. Information on National Infertility Awareness Week is available at http://www.resolve.org/national-infertility-awareness-week/home-page.html.

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Sleep Awareness Week, April 23–29, 2017

Sleep Awareness Week, the National Sleep Foundation's annual campaign to educate the public about the importance of sleep in health and safety, will be observed April 23–29, 2017. The amount of sleep a person needs changes with age. Adults need ≥7 hours each night to promote optimal health and well-being (*1*); children and adolescents require even more sleep. Sleep needs decrease from 12–16 hours of sleep per 24 hours (including naps) for infants aged 4–12 months to 8–10 hours of sleep for teenagers aged 13–18 years (*2*). Children who regularly sleep less than the recommended amount are more likely to have behavior and learning problems, physical and mental health conditions such as obesity, diabetes, depression, or injuries (*2*). A regular bedtime routine can help children get adequate sleep. The American Academy of Pediatrics provides advice for parents at https://www.healthychildren.org/English/healthy-living/sleep/. Additional details about how much sleep is recommended across a lifespan is available at https://www.cdc.gov/sleep/about_sleep/how_much_sleep.html.

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Announcements

World Malaria Day — April 25, 2017

World Malaria Day is commemorated each year on April 25, the date in 2000 when leaders of 44 African nations met in Abuja, Nigeria, and committed their countries to reducing the number of malaria-related deaths. Approximately 90% of all malaria deaths occur in Africa (*1*). During the last 15 years, donors have collectively supported the procurement and distribution of billions of insecticide-treated bed nets and courses of artemisinin-based combination therapy globally. These improvements in malaria control are estimated to have saved an estimated 6.8 million lives, mostly among children aged <5 years. From 2010 to 2015, the World Health Organization (WHO) reported that the estimated number of malaria deaths worldwide declined by approximately 60%, including a 69% decline among children aged <5 years (*1*). This year, as in 2016, the theme of World Malaria Day is "End Malaria for Good," reflecting the increased interest in and commitment to eliminating malaria.

CDC provided support to the mid-20th century global public health push for malaria elimination, which resulted in eliminating local malaria transmission in the United States, much of Europe, nearly all of the Caribbean, and parts of the Middle East. Current malaria control initiatives led by WHO, including the Roll Back Malaria Partnership (http://www.rollbackmalaria.org/); the Global Fund to Fight AIDS, Tuberculosis and Malaria (https://www.theglobalfund.org/en/); and the U.S. President's Malaria Initiative (https://www.pmi.gov/), working in partnership with countries with endemic malaria transmission, have contributed to important reductions in malaria incidence and deaths during the last 15 years. CDC conducts multidisciplinary research globally to increase knowledge about malaria and develop safe, effective interventions that can lead to the elimination and eventual eradication of malaria. CDC also provides evidence-based recommendations to protect Americans from malaria while living, working, and traveling in countries where malaria is endemic. Additional information about CDC's malaria activities is available at https://www.cdc.gov/malaria.

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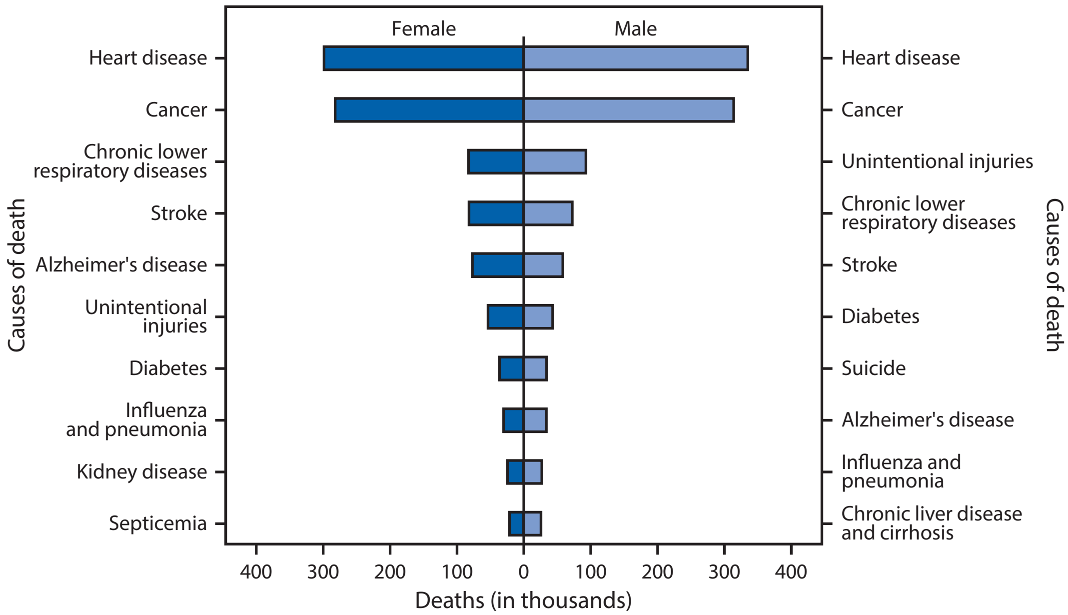
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Number of Deaths from 10 Leading Causes,* by Sex — National Vital Statistics System, United States, 2015



* Causes of death are ranked according to number of deaths.

In 2015, a total of 1,339,226 deaths among females and 1,373,404 deaths among males occurred. Heart disease and cancer were the top two causes of death for both females and males; other leading causes varied in rank by sex. The 10 leading causes of death accounted for approximately three-quarters of all deaths.

Source: National Vital Statistics System. Underlying cause of death data, 2015. https://wonder.cdc.gov/ucd-icd10.html.

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