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Contents

Introduction 2

Methods 3

Results 4

Discussion 9

References 12

Appendix A: CDC Form 52.13, Investigation of a Foodborne Outbreak 56

Appendix B: Guidelines for Confirmation of Foodborne-Disease Outbreaks 58

NOTE: Extensive charts and tables included in the original document could not be reproduced due to the large file size. It is recommended that the user consult the published version or access the online version found at the CDC Web site http://www.cdc.gov.

Surveillance for Foodborne-Disease Outbreaks — United States, 1988-1992

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Abstract

Problem/Condition: Since 1973, CDC has maintained a collaborative surveillance program for collection and periodic reporting of data concerning the occurrence and causes of foodborne-disease outbreaks (FBDOs).

Reporting Period Covered: This summary reviews data from January 1988 through December 1992.

Description of System: The surveillance system reviews data concerning FBDOs-- defined as the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food. Before 1992, only one case of intoxication by chemical, marine toxin, or Clostridium botulinum toxin as a result of the ingestion of food was required to constitute an FBDO. Since 1992, two or more cases have been required. State and local public health departments have primary responsibility for the identifying and investigating FBDOs. State and territorial health departments report these outbreaks to CDC on a standard form.

Results: During 1988-1992, a total of 2,423 outbreaks of foodborne disease were reported (451 in 1988, 505 in 1989, 532 in 1990, 528 in 1991, and 407 in 1992). These outbreaks caused a reported 77,373 persons to become ill. Among outbreaks for which the etiology was determined, bacterial pathogens caused the largest percentage of outbreaks (79%) and the largest percentage of cases (90%). Salmonella serotype Enteritidis accounted for the largest number of outbreaks, cases, and deaths; most of these outbreaks were attributed to eating undercooked, infected eggs. Chemical agents caused 14% of outbreaks and 2% of cases; parasites, 2% of outbreaks and 1% of cases; and viruses, 4% of outbreaks and 6% of cases.

Interpretation: The number of FBDOs reported per year did not change substantially during the first 4 years but declined in 1992 as a result of the revised definition of an outbreak. During this reporting period, S. Enteritidis continued to be a major cause of morbidity and mortality. In addition, multistate outbreaks caused by contaminated produce and outbreaks caused by Escherichia coli O157:H7 became more prominent.

Actions Taken: State and local public health departments investigate FBDOs. At the regional and national level, surveillance data provide an indication of the etiologic agents, vehicles of transmission, and contributing factors associated with FBDOs and help direct public health actions.

INTRODUCTION

The reporting of foodborne and waterborne diseases in the United States began >50 years ago when state and territorial health officers, concerned about the high morbidity and mortality caused by typhoid fever and infantile diarrhea, recommended that cases of “enteric fever” be investigated and reported. The purpose of investigating and reporting these cases was to obtain information regarding the role of food, milk, and water in outbreaks of intestinal illness as the basis for public health action. Beginning in 1923, the Public Health Service published summaries of outbreaks of gastrointestinal illness attributed to milk. In 1938, it added summaries of outbreaks caused by all foods. These early surveillance efforts led to the enactment of important public health measures (e.g., the Model Milk Ordinance) that had a profound influence in decreasing the incidence of enteric diseases, particularly those transmitted by milk and water.

From 1951 through 1960, the National Office of Vital Statistics reviewed reports of outbreaks of foodborne illness and published annual summaries in Public Health Reports. In 1961, CDC--then the Communicable Disease Center--assumed responsibility for publishing reports concerning foodborne illness. During 1961-1965, CDC discontinued publication of annual reviews but reported pertinent statistics and detailed individual investigations in MMWR.

In 1966, the present system of surveillance of foodborne and waterborne diseases began with the incorporation of all reports of enteric-disease outbreaks attributed to microbial or chemical contamination of food or water into an annual summary. Since 1966, the quality of investigative reports has improved, primarily as a result of more active participation by state and federal agencies in the investigation of outbreaks. Since 1978, because of increasing interest and activity in waterborne-disease surveillance, waterborne- and foodborne-disease outbreaks (FBDOs) have been reported in separate annual summaries. A summary of FBDOs was published for the years 1983- 1987 (1). The present report summarizes data for FBDOs reported to CDC from 1988 through 1992.

Foodborne-disease surveillance has traditionally served three purposes:

Disease prevention and control. A main prevention and control measure that results from surveillance of foodborne disease is early identification and removal of contaminated products from the commercial market. Other resulting prevention and control measures include both the correction of faulty food-preparation practices in food-service establishments and in the home and identification and appropriate treatment of human carriers of foodborne pathogens.

Knowledge of disease causation. The responsible pathogen is not identified in more than half the FBDOs reported to CDC. In many of these outbreaks, pathogens might not have been identified either because laboratory investigations were initiated too late or were incomplete. In other outbreaks, the responsible pathogen may not have been identified, even after a thorough laboratory investigation, either because it may not have been recognized as a cause of foodborne disease or because it could not be identified by available laboratory techniques. If, in the future, more thorough clinical, epidemiologic, and laboratory investigations are conducted, perhaps many of these pathogens will be identified and suitable measures for prevention and control will be instituted.

Administrative guidance. The information derived from investigations of FBDOs enables both assessment of trends in the prevalence of outbreaks caused by specific etiologic agents and in vehicles of disease transmission. Such information also helps identify common errors in food handling. The compilation and publication of this information enables state and local health departments and others involved in the implementation of food-protection programs to remain informed of the factors involved in FBDOs. Comprehensive surveillance should result in a greater awareness of the most important food-protection methods, the institution of better training programs, and more effective use of available resources.

METHODS

Sources of Data for Foodborne-Disease Outbreaks

Outbreaks are reported to CDC on a standard reporting form (CDC Form 52.13, Investigation of a Foodborne Outbreak)(Appendix A). Most reports are received from state and local health departments; they also may be received from federal agencies (e.g., the U.S. Food and Drug Administration, the U.S. Department of Agriculture, and the U.S. Armed Forces) and occasionally from private physicians. Data on these report forms are reviewed at CDC to determine whether a specific food vehicle and etiologic agent for an outbreak have been confirmed (Appendix B). In some instances, questions concerning an etiology may be referred back to the reporting agency; otherwise, data are accepted as reported on the forms.

Limitations of the Surveillance System

FBDOs on cruise ships are not included in this surveillance system. Disease outbreaks also are not included if the food is eaten outside the United States, even if the illness occurs within the United States. Finally, FBDOs are not included in this surveillance system if the route of transmission from the contaminated food to the infected persons is indirect. Many foods contain several ingredients, but only one food-vehicle category is chosen for categorizing each outbreak. Therefore, the reported number of outbreaks attributed to a particular food item may not include all the reported outbreaks caused by that item. For example, homemade ice cream containing milk and eggs is listed under “ice cream” rather than “milk” or “eggs.” The category “Mexican food” includes vehicles made from beef, cheese, lettuce, and other ingredients.

Definition of Terms

An FBDO is defined as the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food. Before 1992, three exceptions existed to this definition; only one case of botulism, marine-toxin intoxication, or chemical intoxication was required to constitute an FBDO if the etiology for that type of FBDO was confirmed. The definition was changed in 1992; currently, two or more cases are required to constitute an outbreak.

Outbreaks of known etiology are those for which laboratory evidence of a specific agent is obtained and specified criteria are met. Outbreaks of unknown etiology are those for which adequate laboratory evidence of the etiologic agent is not obtained. Outbreaks of unknown etiology are divided into four subgroups by incubation period of the illness: <1 hour (probable chemical poisoning), 1-7 hours (probable Staphylococcus aureus or Bacillus cereus food poisoning), 8-14 hours, and 15 hours (other agents).

RESULTS

The results of this surveillance system are presented for each of the 5 years (1988- 1992) as follows: outbreaks by state (Figures 1-5); outbreaks, cases, and deaths by etiology (Tables 1-5); outbreaks by etiology and month of occurrence (Tables 6-10); outbreaks by etiology and place where food was eaten (Tables 11-15); outbreaks, cases, and deaths by vehicle of transmission (Tables 16-20); outbreaks by etiology and vehicle of transmission (Tables 21-25); and outbreaks by etiology and contributing factors (Tables 26-30).

For each of the years from 1988 through 1992, the most commonly reported food-preparation practice that contributed to foodborne disease concerned improper holding temperature; the second most commonly reported practice concerned poor personal hygiene of food handlers. Food obtained from an unsafe source was the least commonly reported factor for all 5 years. In most outbreaks caused by bacterial pathogens, the food was stored at improper holding temperatures. In outbreaks of trichinosis, the food was usually inadequately cooked. In outbreaks of ciguatoxin and mushroom poisoning, the food itself was unsafe, and illness was not related to improper handling or preparation.

1988

In 1988, 451 outbreaks involving 15,732 cases of foodborne diseases were reported to CDC. Reports were received from 44 states, the District of Columbia, and Puerto Rico (Figure 1). New York reported the largest number of outbreaks (106, including 17 from New York City). Washington reported the next largest number (45), followed by Illinois (37), Florida (24), Hawaii (22), Pennsylvania (21), and Wisconsin (20). The etiology was confirmed in 183 (41%) of the 451 outbreaks (Table 1).

Bacterial pathogens accounted for 139 outbreaks (7,156 cases). Salmonella caused most of the bacterial FBDOs (94 outbreaks, 2,987 cases) followed by Clostridium botulinum (20 outbreaks, 49 cases) and S. aureus (eight outbreaks, 245 cases). Salmonella serotype Enteritidis caused 44 (47%) of the 94 Salmonella outbreaks; eggs or foods containing eggs were implicated in 18 (64%) of the 28 S. Enteritidis outbreaks that had a known vehicle. Seven outbreaks (28 cases) of botulism occurred in Alaska and were associated with the preparation and storage of traditional foods of Alaskan Natives; one person died from botulism. A large outbreak of Shigella sonnei infections occurred among persons who ate a raw tofu salad at an outdoor music festival in Michigan; 3,175 persons became ill and 117 of these persons were hospitalized. A large number of volunteers handled the ingredients, and ill food handlers apparentlycontaminated the salad during preparation (2). An outbreak (120 cases) of Campylobacter jejuni infections was caused by drinking raw milk at a vacation Bible school in Kansas. Escherichia coli O157:H7 caused two outbreaks; one outbreak (54 cases) was caused by precooked meat patties served at a school cafeteria, and one (55 cases) was linked to roast beef served at a university banquet.

Chemical agents were responsible for 29 outbreaks (139 cases); scombrotoxin caused 16 of these 29 outbreaks (65 cases), and ciguatoxin caused four of them (eight cases). Tuna was implicated in 11 of the 16 scombrotoxin outbreaks. All three parasitic-disease outbreaks (34 cases) were caused by Trichinella spiralis; two were associated with meat obtained by hunting. All 12 viral-disease outbreaks (795 cases) were caused by hepatitis A. One hepatitis A outbreak (202 cases) occurred among restaurant patrons in Kentucky and was traced to iceberg lettuce contaminated before distribution (3). Another multistate hepatitis A outbreak (61 cases) was caused by eating raw oysters that apparently had been harvested illegally from an oyster bed in Florida that was contaminated by human feces (4).

Nineteen deaths from foodborne illness were reported; of these deaths, 14 were caused by Salmonella, three by hepatitis A, one by C. botulinum, and one by scombrotoxin. Nine of the deaths caused by Salmonella were attributed to S. Enteritidis, and seven of these deaths occurred in residents of nursing homes. The incubation period was reported for 211 (79%) of the 268 outbreaks that had an unknown etiology; in three outbreaks (1%) the incubation period was <1 hour; in 59 (28%), 1-7 hours; in 50 (24%), 8-14 hours; and in 99 (47%), 15 hours.

1989

During 1989, 505 outbreaks involving 15,867 cases of foodborne diseases were reported to CDC. Reports were received from 38 states, Guam, and Puerto Rico (Figure 2). New York reported the largest number of outbreaks (141, including 14 from New York City). Hawaii reported the next largest number (40), followed by Illinois (37), Washington (29), and Wisconsin (28). The etiology was confirmed in 221 (44%) of the 505 outbreaks (Table 2).

Bacterial pathogens accounted for 171 outbreaks (6,557 cases). Salmonella caused most of the bacterial FBDOs (117 outbreaks, 4,920 cases) followed by S. aureus (14 outbreaks, 524 cases) and C. botulinum (13 outbreaks, 24 cases). S. Enteritidis caused 72 (62%) of the 117 Salmonella outbreaks; eggs or foods containing eggs were implicated in 18 (58%) of the 31 S. Enteritidis outbreaks that had a known vehicle. An outbreak in a nursing home in Maryland, caused by both S. Enteritidis and S. Schwarzengrund, resulted in 69 cases, 11 hospitalizations, and four deaths (5). A multistate outbreak (295 cases) of S. Chester infections was traced to cantaloupes imported from Mexico (6). A multistate outbreak (164 cases) of S. Javiana and S. Oranienberg infections was caused by mozzarella cheese that had been contaminated during shredding before it was distributed (7). A multistate outbreak of staphylococcal food poisoning was caused by canned mushrooms imported from China; 162 persons became ill, and 18

of these persons were hospitalized (8). In a restaurant in Missouri, an outbreak (101 cases) caused by Campylobacter apparently resulted from cross-contamination of cantaloupes, honeydew melons, and pineapples when poultry and fruit were sliced on the same surfaces. An outbreak (242 cases) caused by C. perfringens occurred at aMotherís Day brunch in a hotel in New York when a seafood salad was held at room temperature for many hours.

Chemical agents accounted for 37 outbreaks (153 cases); ciguatoxin caused 19 of these outbreaks (66 cases), and scombrotoxin caused 17 (80 cases). One scombro-toxin outbreak (28 cases) in a prison was caused by eating contaminated mackerel. Four parasitic-disease outbreaks (15 cases) were caused by T. spiralis and one by Giardia lamblia (21 cases). Seven of the eight viral-disease outbreaks (329 cases) were caused by hepatitis A, including an outbreak (192 cases) caused by an infected food handler in a fast-food restaurant in Washington. Seventeen deaths from foodborne illness were reported: 14 from Salmonella, two from C. botulinum, and one from Listeria monocytogenes. Eleven of the deaths caused by Salmonella were attributed to S. Enteritidis, nine of these deaths occurred in residents of nursing homes. The incubation period was reported for 231 (81%) of the 284 outbreaks that had an unknown etiology; in eight outbreaks (3%) the incubation period was <1 hour; in 40 (17%), 1-7 hours; in 43 (19%), 8-14 hours; and in 140 (61%), 15 hours.

1990

During 1990, 532 outbreaks involving 19,885 cases of foodborne diseases were reported to CDC. Reports were received from 45 states, the District of Columbia, Guam, and Puerto Rico (Figure 3). New York reported the largest number of outbreaks (87, including 14 from New York City). Illinois reported the next largest number of outbreaks (43), followed by Hawaii (39), Washington (33), and Ohio (29). The etiology was confirmed in 237 (45%) of the 532 outbreaks (Table 3).

Bacterial pathogens were responsible for 196 outbreaks (9,002 cases). Salmonella caused most of the bacterial FBDOs (136 outbreaks, 6,290 cases) followed by S. aureus (13 outbreaks, 372 cases) and C. botulinum (12 outbreaks, 22 cases). S. Enteritidis caused 80 (59%) of the 136 Salmonella outbreaks; eggs or foods containing eggs were implicated in 21 (68%) of the 31 S. Enteritidis outbreaks that had a known vehicle. Undercooked eggs in a bread-pudding dessert caused an outbreak of S. Enteritidis infections among conventioneers attending a banquet in an Illinois hotel; 1,100 persons became ill, and 147 of these persons were hospitalized. An outbreak of S. Agona infections among conventioneers attending a buffet catered by a South Carolina restaurant was caused by improperly handled turkey meat; 851 persons became ill and 18 of these persons were hospitalized. An outbreak of S. Montevideo infections apparently occurred when salad-bar ingredients were cross-contaminated by uncooked meat and poultry in a restaurant kitchen; 320 persons became ill, and eight of these persons were hospitalized. Four outbreaks involving 66 cases (20 hospitalizations) were caused by S. typhi; three of these outbreaks involved contamination of cold food items by infected food handlers (9). Improper food-handling practices resulted in two C. perfringens outbreaks; beef and chicken tacos were the vehicles in the outbreak (700 cases) in a Missouri prison, and prime rib was the vehicle in the outbreak (204 cases) in a Wisconsin restaurant. An outbreak (400 cases) of S. sonnei infections was associated with food prepared by an infected food handler at a Texas restaurant. An outbreak of Vibrio cholerae infections in Guam was caused by eating contaminated reef fish; 26 persons became ill, and one of these persons died.

Chemical agents accounted for 27 outbreaks (270 cases); of these 27 outbreaks, 11 were caused by scombrotoxin (194 cases), and 11 were caused by ciguatoxin (44 cases). One scombrotoxin outbreak, caused by tainted mahi-mahi, resulted in 148 cases. Two outbreaks (24 cases, one death) of paralytic shellfish poisoning were reported; one was caused by blue mussels from Rhode Island and the other by butter clams and mussels from Alaska (10). Five outbreaks of parasitic diseases were reported (234 cases); G. lamblia caused three of these outbreaks (129 cases), and T. spiralis caused two of them (105 cases). In one of the G. lamblia outbreaks, sliced raw vegetables prepared by an infected food handler were implicated (11). All nine viral-disease outbreaks (452 cases) were caused by hepatitis A; three deaths occurred. A multistate outbreak of hepatitis A (51 cases) was caused by frozen strawberries that were most likely contaminated by an infected employee before distribution (12). Fifteen deaths from foodborne illness were reported; five from C. botulinum, three from hepatitis A, one from Salmonella,

one from V. cholerae, one from V. vulnificus, one from paralytic shellfish poisoning, and three from an unknown etiology. The incubation period was reported for 241 (82%) of the 295 outbreaks that had an unknown etiology; in six outbreaks (2%) the incubation period was <1 hour; in 44 (18%), 1- 7 hours; in 55 (23%), 8-14 hours; and in 136 (56%), 15 hours.

1991

During 1991, 528 outbreaks involving 14,876 cases of foodborne disease were reported to CDC. Reports were received from 40 states, the District of Columbia, and Guam (Figure 4). New York reported the largest number of outbreaks (115, including 35 from New York City). Washington reported the next largest number (47), followed by Illinois (42), Hawaii (36), New Jersey (35), and Pennsylvania (32). The etiology was confirmed in 214 (41%) of the 528 outbreaks (Table 4).

Bacterial pathogens accounted for 173 outbreaks (6,335 cases). Salmonella caused most of the bacterial FBDOs (122 outbreaks, 4,146 cases), followed by C. botulinum (11 outbreaks, 25 cases) and C. perfringens (10 outbreaks, 1,213 cases). S. Enteritidis caused 73 (60%) of the 122 Salmonella outbreaks; eggs or foods containing eggs were implicated in 17 (50%) of the 34 S. Enteritidis outbreaks that had a known vehicle. Inadequately cooked bread stuffing containing pooled raw eggs caused an outbreak of S. Enteritidis infections in a New York prison; 393 persons became ill, and nine of these persons were hospitalized. An outbreak (673 cases) of S. Heidelberg infections was caused by tainted chicken and beef fajitas that had been improperly stored and cooked by a food vender at a festival in Connecticut. Two outbreaks of Salmonella were associated with eating contaminated melons; S. Poona (143 cases) infections were associated with eating cantaloupes (13), and S. Javiana (39 cases) infections were associated with eating watermelon. An outbreak (600 cases) of C. perfringens infections was caused by improperly handled turkey meat served at a Motherís Day brunch in a Wisconsin restaurant. Three outbreaks (33 cases) were caused by E. coli O157:H7; one of these outbreaks (23 cases) was associated with contaminated apple cider (14). Two outbreaks of V. cholerae were caused by tainted food imported into the United States; one outbreak (four cases) was associated with frozen coconut milk imported from Thailand (15), and the other outbreak (two cases) was attributed to crabs that had been imported illegally from Ecuador (16). An outbreak (100 cases)of Group A Streptococcus infections was apparently caused by an infected food handler.

Chemical agents caused 31 outbreaks (159 cases); scombrotoxin caused 17 of these outbreaks (40 cases), ciguatoxin caused seven (50 cases), and paralytic shellfish poisoning caused two (35 cases). Parasitic diseases caused three outbreaks (73 cases); G. lamblia caused two of these outbreaks (32 cases), and T. spiralis caused one of them (41 cases). All seven viral-disease outbreaks (114 cases) were caused by hepatitis A virus. Ten deaths from foodborne illness were reported; five from Salmonella, two from C. botulinum, one from C. perfringens, one from paralytic shellfish poisoning, and one from an unknown etiology. Four of the Salmonella-associated deaths were caused by S. Enteritidis, and all were among residents of nursing homes. The incubation period was reported for 267 (85%) of the 314 outbreaks that had an unknown etiology; in 13 outbreaks (5%) the incubation period was <1 hour; in 67 (25%), 1-7 hours; in 60 (22%), 8-14 hours; and in 127 (48%), 15 hours.

1992

During 1992, 407 outbreaks involving 11,015 cases of foodborne diseases were reported to CDC. Reports were received from 35 states and Puerto Rico (Figure 5). New York reported the largest number of outbreaks (122, including 28 from New York City). Washington reported the next largest number (49), followed by California (23), Maryland (20), and New Jersey (20). The etiology was confirmed in 146 (36%) of the 407 outbreaks (Table 5).

Bacterial pathogens accounted for 117 outbreaks (4,156 cases). Salmonella caused most of the bacterial FBDOs (80 outbreaks, 2,834 cases) followed by C. perfringens (12 outbreaks, 912 cases), S. aureus (six outbreaks, 206 cases), and Campylobacter (six outbreaks, 138 cases). S. Enteritidis caused 60 of the Salmonella outbreaks; eggs or foods containing eggs were implicated in 22 (88%) of the 25 S. Enteritidis outbreaks that had a known vehicle. Cross-contamination of cooked foods by uncooked, pooled eggs

that were used for egg batter in a New York restaurant was associated with an outbreak of S. Enteritidis infection; 434 became ill, and seven of these persons were hospitalized. S. Enteritidis was the etiologic agent in four other outbreaks: one out-break (191 cases) in a New Jersey prison was associated with banana pudding that contained undercooked eggs; two outbreaks (130 cases)--one at a picnic in New York and one at a college in New Hampshire--were associated with eating egg sandwiches; one outbreak (105 cases) at a convention in Vermont was associated with an unidentified food vehicle. Undercooked, pooled eggs in a rice pudding also resulted in an outbreak (113 cases) of S. Infantis infections in a state prison in Georgia. An outbreak of S. Typhimurium associated with homemade ice cream containing raw eggs resulted in 31 cases and one death. An outbreak of C. fetus in an Ohio nursing home apparently was caused by contaminated cottage cheese; 13 residents became ill, and two of these residents died. In five outbreaks, several persons were infected by C. perfringens as a result of holding food at improper temperatures for several hours. These outbreaks occurred at a New York nursing home (196 cases), a Wisconsin prison (160 cases), a catered church supper in Wisconsin (120 cases), a Washington school (115 cases), and a catered family gathering in Minnesota (100 cases). E. coli O157:H7caused three outbreaks; one was associated with drinking raw milk from a dairy in Oregon (six cases) and two with vehicles that were not determined (13 cases).

Chemical agents were responsible for 19 outbreaks (206 cases); scombrotoxin caused 15 of these outbreaks (135 cases). Tuna was implicated in nine of the scombro-toxin outbreaks, including an outbreak (74 cases) involving 20 states caused by tuna imported from Ecuador. The only parasitic-disease outbreak (two cases) was caused by G. lamblia. Eight viral-disease outbreaks (419 cases) were caused by hepatitis A; seven of these outbreaks, including an outbreak (230 cases) in a Wisconsin sandwich shop, were associated with infected food handlers. In several Minnesota schools, one viral-disease outbreak (250 cases) caused by a Norwalk-like virus was associated with contaminated hamburger buns and cookies that were prepared by ill food handlers at a bakery. Eight deaths from foodborne-related illness were reported; four were caused by Salmonella, two by Campylobacter fetus, one by C. botulinum, and one by chemical intoxication (i.e., water-hemlock poisoning). Three of the deaths resulting from Salmonella infection were caused by S. Enteritidis and were among residents of nursing homes. The incubation period was reported for 203 (78%) of the 261 outbreaks that had an unknown etiology; in seven outbreaks (3%), this period was <1 hour; in 41 (20%), 1-7 hours; in 46 (23%), 8-14 hours; and in 109 (54%), 15 hours.

DISCUSSION

General Interpretation of Surveillance Data for Foodborne-Disease Outbreaks

The limitations concerning the quantity and quality of data presented in this report should be recognized. The number of FBDOs reported by this surveillance system represents only a small proportion of those that occur. The outbreaks reported also include only a fraction of the cases of foodborne disease that occur; an average of 15,475 cases (14 deaths) each year was reported by this surveillance system during 1988-1992, compared with a minimum estimate of 6 million cases per year (17). The likelihood of an outbreak being brought to the attention of health authorities depends on consumersí and physiciansí awareness, their interest, their motivation to report the incident, and the disease-surveillance activities of state and local health and environmental agencies. For example, large outbreaks, interstate outbreaks, restaurant-associated outbreaks, and outbreaks involving serious illness, hospitalizations, or deaths are more likely to be brought to the attention of health authorities than are outbreaks of mild illness in a single family.

The quality of the data in this surveillance summary depends on the commitment to surveillance of foodborne diseases by state and local health departments, as well as other factors. A departmentís interest in foodborne disease and its investigative and laboratory capabilities are important determinants of the quality of any investigation. Furthermore, the likelihood that the findings of the investigation will be reported to CDC differs by the locality in which the outbreak occurs. Thus, this report should not be the basis of conclusions concerning the absolute incidence of foodborne disease or the relative incidence of foodborne diseases by specific causes. For example, food-borne diseases characterized by short incubation periods (e.g., those caused by a chemical agent or staphylococcal enterotoxin) are more likely

to be recognized as common-source FBDOs than are those diseases that have longer incubation periods (e.g., hepatitis A). Outbreaks involving less commonly identified pathogens (e.g., B. cereus, E. coli, or G. lamblia) are less likely to be confirmed because these organisms are sometimes not considered in clinical, epidemiologic, and laboratory investigations of FBDOs. Also, pathogens that usually cause mild illness will be under-represented, whereas those causing serious illness (e.g., C. botulinum) are more likely to be identified and reported. Similarly, outbreaks associated with restaurants or commercial products are more likely to be reported.

Foodborne-Disease Outbreaks During 1988-1992

The annual numbers for outbreaks reported during 1988-1992 ranged from 407 to 532. When the change in the outbreak definition in 1992 is considered, these numbers were comparable with those in other recent years. During this period, both multistate outbreaks caused by contaminated produce and outbreaks caused by E. coli O157:H7 became more prominent. In addition, unexpected vehicles of transmission (e.g., apple cider) were described. Several outbreaks also involved imported food items, which demonstrated the complexity of modern food production and distribution.

FBDOs on cruise ships are not included in this surveillance system (18). FBDOs also are not included if the food is eaten outside the United States, even if the illness occurs within the United States. For example, an outbreak (75 cases) of cholera occurred among persons who ate seafood salad during an airline flight from Peru to Los Angeles; although the onset of illness began after these persons arrived in California, the outbreak was not included in this report because the salad was eaten outside the United States (19). Finally, disease outbreaks are not included in this surveillance system if the route of transmission from the contaminated food to the infected persons is indirect. For example, although chitterlings (i.e., pig intestines) were ultimately established as the source of Yersinia enterocolitica infections for several infants in Georgia in 1988, these cases are not included in this report because the infants did not eat the chitterlings; the infants apparently became infected from person-to-person contact or from an item touched by a food preparer (20).

The etiology was not determined for 59% of the reported outbreaks. This percentage reflects the need for improved investigative skills so that known pathogens can be recognized more readily and new pathogens can be identified. Most of the outbreaks that had an unknown etiology had an incubation period 15 hours, suggesting an infectious agent; many of these outbreaks may have had a viral etiology. Viruses are probably a much more important cause of disease than this report indicates. The capability of testing serum for antibody to viruses involved in FBDOs (e.g., Norwalk and Norwalk-like viruses) is not widely available and makes identification of such outbreaks difficult. Investigators have analyzed reports of FBDOs and have reported that as many as 35% of these outbreaks were probably caused by viruses (21).

The etiology was determined for 1,001 (41%) of the 2,423 outbreaks reported to CDC for 1988-1992; these outbreaks involved 36,890 cases. Of those outbreaks for which an etiology was determined, bacterial pathogens caused the largest percentage of outbreaks (79%) and cases (90%). Chemical agents caused 14% of outbreaks and2% of cases; parasites, 2% of outbreaks and 1% of cases; and viruses, 4% of outbreaks and 6% of cases.

Salmonella caused 549 (69%) of the 796 bacterial FBDOs during 1988-1992; 60% of these 549 outbreaks were caused by S. Enteritidis. During this reporting period, an increasing number of Salmonella outbreaks were caused by S. Enteritidis (e.g., 47% in 1988 versus 75% in 1992). S. Enteritidis also was the most frequently reported cause of FBDOs during this period, accounting for 14% of all outbreaks and 33% of outbreaks for which an etiology was determined; most of these outbreaks for which a food vehicle could be determined were attributed to eating undercooked eggs. S. Enteritidis also resulted in more deaths (27) than any other pathogen; 23 (85%) of these deaths occurred among residents of nursing homes, which reflects the seriousness of S. Enteritidis infections in elderly persons, many of whom may be immunocompromised. Persons can decrease their risk for egg-associated infections caused by S. Enteritidis by not eating raw or undercooked eggs. Nursing homes, hospitals, and commercial kitchens only should use pasteurized egg products for all recipes requiring pooled or lightly

cooked eggs (22).

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