approximately 20 species within the *Cryptosporidium* genus that have been named for different animal hosts, but cross-transmission experiments suggest little species specificity. It is, therefore, important to determine how many of these species have the capacity to infect human hosts.

Initially, diagnosis of cryptosporidiosis was made utilizing acid-fast staining techniques. However, this test was determined to be very insensitive, requiring 10,000 to 100,000 organisms for a positive response, depending on the consistency of the stool sample. Immunofluorescent assay is currently used to look for *Cryptosporidium* in the water supply; however, there are data indicating that the presence of algae in a sample increases the probability of false positivity. There is also an enzyme-linked immunosorbent assay test that uses an antigen capture method that has proven more sensitive and more specific, but it is somewhat more costly.

The transmission of *Cryptosporidium* has received considerable attention. Outbreaks have been attributed to day-care centers and to nosocomial transmission in renal and bone marrow transplant units, and one outbreak was due to foodborne contamination of homemade apple cider. Waterborne outbreaks have occurred in swimming pools, beaches, and other surface water supplies. Association with recreational water thus constitutes a potential health liability for immunocompromised patients; therefore, they should be warned not to swim in such areas.

Outbreaks due to municipal water supplies have had several characteristics in common. The municipal water supplies implicated in all cases were filtered and chlorinated and had no record of coliforms present at the time of the outbreak.

TOPIC: FOODBORNE PATHOGENS

**PRESENTER: ANN MARIE MCNAMARA, SCD, DIRECTOR,
MICROBIOLOGY DIVISION, SCIENCE AND TECHNOLOGY,
US DEPARTMENT OF AGRICULTURE***

Despite the fact that the US has one of the safest food supplies in the world, historic outbreaks of *Escherichia coli* O157:H7 and a growing concern regarding salmonellosis have established foodborne pathogens as being capable of causing significant morbidity.

During the period from 1973 to 1987, there were 1,879 foodborne disease outbreaks and an associated 108,000 cases in the US.¹ For those cases with known etiology, 92% were bacterial, with viruses, parasites, and chemicals combining to account for the remaining cases.¹ The most frequently identified bacterial agent

*Dr. McNamara's address is US Department of Agriculture, Food Safety and Inspection Service, Washington, DC 20250.

was *Salmonella*, followed by *Staphylococcus aureus*, *Shigella*, *Clostridium perfringens*, and *Campylobacter*. More-current data on foodborne disease are difficult to obtain, with data on sporadic cases of foodborne illness particularly scarce.

Data on foodborne outbreaks obtained by the Centers for Disease Control and Prevention (CDC) are collected through a passive reporting system that involves local doctors and health departments, as well as state and federal public health authorities. Limitations of the current reporting system are exacerbated by a variety of factors, including the fact that mild cases of foodborne illnesses are often resolved without medical intervention. Laboratories frequently fail to screen stool specimens for foodborne pathogens. As a result, the incidence of foodborne disease is believed widely to be under-reported. There are estimates that, for every case of salmonellosis reported, another 3.8 to 7,326 cases occur but are not recorded.² Therefore, current US estimates of foodborne disease predict that 6.5 million to 33 million cases of foodborne illness occur annually, with an associated 500 to 9,000 deaths.³ Associated medical costs and productivity losses are estimated at more than \$5 billion per year.⁴

Prior to 1970, 14 microbial foodborne pathogens had been identified. From 1970 to the present, 7 more foodborne agents were recognized, including *Campylobacter jejuni* and *E. coli* O157:H7. It is theorized that these new pathogens represent agents that are gaining new ecological niches due to changes in US population demographics or changes in the production, distribution, and consumer-handling practices of agricultural products.⁵

Additions to the above seven agents on the list of foodborne infectious diseases include (1) *Borrelia burgdorferi*, the etiologic agent of Lyme disease, which may be transmissible via meat and milk and may survive heat-treatment processes; (2) *Cryptosporidium*, which has been linked to hand-pressed cider; and (3) *Mycobacterium paratuberculosis* in cow's milk, which can survive pasteurization and has been linked to Crohn's disease in humans.

Population demographics can assist in predicting the importance of various foodborne pathogens. For instance, an increasing proportion of elderly citizens and persons with underlying medical conditions means that more of the population is susceptible to opportunistic infections. CDC data indicate that, from 1973 through 1987, nursing home residents comprised 25% of all those affected by reported foodborne disease outbreaks, but accounted for 19% of all outbreak-associated deaths.⁶ In immunocompromised individuals, such as HIV-infected persons, infections with *Salmonella*, *Shigella*, *Campylobacter*, and *Cryptosporidium* are generally more severe and persist longer than in immunocompetent individuals. An increasing number of meals eaten outside the home in food-service

establishments potentially could result in a higher incidence of outbreaks; CDC has indicated that 79% of outbreaks can be traced to food prepared in commercial or institutional settings.⁶

Other factors in foodborne disease emergencies include

- innovations in food-processing techniques, which have broadened the choice of foods available to the consumer and have increased the foods' shelf life
- animal husbandry practices involving intensive rearing operations that have been blamed for the spread between animals of such diseases as *Salmonella* and *Campylobacter*
- administration of antibiotics to farm animals, with human salmonellosis traced to hamburgers infected with chloramphenicol-resistant *Salmonella newport*
- rapid interstate and international distribution of foods
- dietary choices, such as potential anisakiasis infection due to increased consumption of sushi or botulism from salsa made with low-acid tomatoes

The majority of foodborne outbreaks are preventable with proper cooking procedures and good food-handling practices. New foodborne pathogens will continue to be recognized, however, as improved detection methodologies are developed.

REFERENCES

1. Bean NH, Griffin PM, Goulding JS, Ivey CB. Foodborne disease outbreaks, 5-year summary, 1983–1987. *J Food Prot.* 1990;53:711–728.
2. Chalker RB, Blaser MJ. A review of human salmonellosis: III. Magnitude of *Salmonella* infections in the US. *Rev Infect Dis.* 1988;10:111–124.
3. Council for Agricultural Science and Technology. Foodborne pathogens: risks and consequences. Task Force Report No. 122. Ames, Iowa: Council for Agricultural Studies and Technology; 1994.
4. Todd ECD. Preliminary estimates of costs of foodborne disease in the US. *J Food Prot.* 1989;52:595–601.
5. Lederberg J, Shope RE, Oaks CS Jr. (eds.). *Technology and Industry in Emerging Infections: Microbial Threats to Health in the United States*. Washington, DC: National Academy Press; 1992:63–70.
6. Bean NH, Griffin PM. Foodborne disease outbreaks in the United States, 1973–1987: pathogens, vehicles, trends. *J Food Prot.* 1990;53:804–817.