these compounds are botanical derivatives. Three nosocomial pneumonia compounds are currently awaiting Food and Drug Administration approval.

The papers summarized in this issue include presentations on methicillin-resistant *Staphylococcus aureus*, penicillin-resistant pneumococci, and hospital- and community-acquired gram-negative pathogens. The final paper in the summary of the first day presents data on the increasing incidence of vancomycin-resistant enterococci in New York City, New York State, and the US. It also examines several questions that should be addressed regarding vancomycin-resistant enterococci.

CATEGORY: ASSOCIATED MODES OF TRANSMISSION

TOPIC: WATERBORNE PATHOGENS

PRESENTER: ROSEMARY SOAVE, MD, ASSOCIATE PROFESSOR OF MEDICINE AND PUBLIC HEALTH, CORNELL UNIVERSITY MEDICAL COLLEGE*

As demonstrated by an April 1993 outbreak in Milwaukee, Wisconsin, which infected over 400,000 people and killed more than 100 mostly immunocompromised victims, *Cryptosporidium* is a waterborne pathogen with the potential to cause massive municipal outbreaks. It has a chlorine contact time 640 times that of *Giardia lamblia*, which makes the oocyst of *Cryptosporidium* resistant to chlorination by municipal water supplies and gives it the ability to survive in the natural environment with little nutrition for many months. After ingestion by a human host, the oocyst undergoes excystation in the intestine, releasing a motile, much more fragile sporozoite. After developing into protozoites and then forming merozoites, the organism enters its sexual phase; this phase carries with it the capacity for autoinfection.

This "recycling," or continual reinfection by the merozoites, reaches its epitome in immunocompromised patients—such as patients with human immunodeficiency virus (HIV) infection, people with immunoglobulin A deficiency or chronic hypogammaglobulinemia, and those chronically immunosuppressed by steroids following cancer therapy.

Due to sustained cholera-like diarrhea, immunosuppressed individuals shed enormous numbers of organisms into the environment: from 1.2 million to 12 billion organisms per day. It is not known how the pathogen causes diarrhea, but the watery nature and the lack of inflammatory changes in the host both suggest toxin mediation.

Many species of animals can be infected with *Cryptosporidium*. There are

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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,
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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

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