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TECHNICAL BULLETIN

HEALTH EFFECTS INFORMATION

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CRYPTOSPORIDIUM

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WATERBORNE DISEASE AND MICROORGANISMS

Microorganisms are widely spread over the earth and throughout its atmosphere. Microorganisms include bacteria, viruses, and protozoan parasites; they are microscopic and therefore invisible to the naked eye. They are found in all surface waters, including lakes, streams, and rivers. They can be found in shallow and unprotected wells and springs and, less often, in deep and protected well waters. Many microorganisms can survive extremes of climate. Most microorganisms in the environment and found in water are not harmful, but enough of them are harmful that we strive to maintain drinking water nearly microorganism-free. However, drinking water is not sterile.

Microorganisms that have the most significance to human health are those that cause disease, called pathogens. Examples of common pathogens include bacteria such as *Salmonella* and *Shigella*, protozoans such as *Giardia* and *CRYPTOSPORIDIUM*, and viruses such as hepatitis A and Norwalk. Most of the pathogens that can cause diarrheal disease are transmitted by the fecal-oral route of exposure; this means that feces from an infected person or animal are transmitted directly or indirectly to another person's mouth. An example of direct transmission would be from person-to-person, such as in day care settings serving young children in diapers. Examples of indirect transmission include food contaminated due to poor food handling and sanitation practices, and contaminated drinking water.

It is not possible to regularly test drinking water for the presence of most disease-causing organisms because they exist in very low numbers in water, are hard to isolate and detect, and there are so many different kinds it would be impractical and expensive to test for them all regularly. Consequently, public health agencies and water suppliers in this country rely on certain kinds of bacteria that are known as "indicator" organisms. These indicators, such as coliform bacteria, do not generally cause disease, but do occur in large numbers, are associated with fecal pollution, are generally hardier in the environment than pathogens, and are easy to test for. In other words, the indicators serve as markers for the kind of fecal contamination that can lead to disease under some circumstances. However, we know now that the absence of indicator organisms does not always assure that pathogens are absent in our drinking water. This is because some pathogens are more resistant to water treatment processes than coliform bacteria. Continuous and effective water treatment remains the best protection for the water-using public.

WHAT IS *CRYPTOSPORIDIUM*?

CRYPTOSPORIDIUM is a microscopic protozoan parasite that can infect a variety of

animals as well as humans. It was first identified in 1907, but was not recognized as a cause of human illness until 1976. At least four species of this organism exist, with *CRYPTOSPORIDIUM parvum (C. parvum)* primarily responsible for human illness. In the Technical Bulletin - Health Effects Information environment, the organism exists in a protective package, called an "oocyst", which is spherical and about 4 to 6 micrometers in diameter. When ingested by people or animals, the oocysts split open in the small intestine and invade the cells lining the intestinal tract, impairing their ability to absorb food and water. These organisms then reproduce and form more oocysts that are passed out of the body in feces and can infect others.

This organism was responsible for the large waterborne outbreak in Milwaukee, Wisconsin, in 1993, that caused an estimated 400,000 cases of illness.

HOW COMMON IS *CRYPTOSPORIDIUM*?

CRYPTOSPORIDIUM is very common in the environment. Oocysts have been found in rivers and streams, raw and treated sewage, and even in treated drinking water supplies. Concentrations vary widely in natural waters, but tend to be quite low in pristine, isolated, and protected surface water bodies, and higher in waters that receive discharges from sewage treatment plants or runoff from and domestic animal operations. All surface waters should be assumed to be at risk of contamination to some degree. Oocysts can survive for weeks in open surface waters, especially at low temperatures. Oocysts have been isolated in humans and a variety of wild and domestic warm-blooded animals, especially cattle and their calves.

DISEASE AND SYMPTOMS

Not everyone exposed to *CRYPTOSPORIDIUM* becomes infected, and some who are infected may not show symptoms. The illness caused by this organism is called cryptosporidiosis. After ingesting oocysts, people can develop disease symptoms in 2-12 days, with an average incubation period of 7 days. Symptoms include diarrhea, abdominal cramps, nausea, occasionally vomiting, and low-grade fever. The illness can last from a few days to several weeks, occasionally for longer than a month. There is no effective medical treatment to cure the illness and recovery is dependent on the patient's own immune system. The illness can be very severe and can persist indefinitely in people with weakened immune systems, such as those with AIDS, people receiving treatment for cancer, and those recovering from organ transplants. In these patients, cryptosporidiosis can be fatal.

It is not certain how many oocysts are required for people to become ill. Studies to date suggest that the dose required for infection may be less than 100 oocysts. In comparison, an infected calf can shed more than ten million oocysts in a single stool. Confirmation of infection in a patient is done by clinical analysis of fecal material to identify oocysts. Physicians making a positive diagnosis of cryptosporidiosis in Oregon are required to report the finding to the Department of Human Services.

CRYPTOSPORIDIUM AND DRINKING WATER

Direct measurement of numbers of oocysts in drinking water supplies is very difficult. Currently available water testing procedures consist of filtering very large volumes of water to capture the oocysts, washing the filter to recover the oocysts, separating the oocysts from other debris, staining to improve the visibility of the oocysts and to differentiate them from other organisms, and then visually observing the oocysts and their internal structure under a microscope. These methods are not fully standardized; they recover very few oocysts, and they can not tell whether the oocysts are alive or dead or even if they are capable of causing illness. Very few laboratories are available that have appropriately trained technicians and capabilities to perform these tests. Finally, interpretation of results is difficult; the presence of oocysts does not directly translate into a health risk, and the absence of oocysts does not mean that there is no risk.

CRYPTOSPORIDIUM oocysts are highly resistant to traditional disinfection treatment using chlorine. Oocysts can be effectively inactivated with ozone, if properly applied, but ozonation is not in wide use yet in the U.S. Conventional filtration processes, in common use in utilities using surface water sources, have been shown to remove greater than 99% of oocysts when the treatment is optimally operated at all times. In fact, several outbreaks of cryptosporidiosis in municipal water systems have been attributed to inadequate treatment plant operation, particularly during periods of poor quality source water, and the outbreaks were ended by improving the operation of existing filtration treatment systems.

REDUCING RISK FROM *CRYPTOSPORIDIUM* IN OREGON

The Department of Human Services is working with Oregon public water suppliers to assure that public water supplies are as safe as they can be. Some water systems have begun testing for oocysts in their water sources, and some are working with landowners and other interested parties to control potential sources of contamination in their watersheds. Department of Human Services staff has conducted detailed reviews of existing water filtration treatment systems to identify ways to improve operations to

produce water of higher quality than required under current standards. The Department continues to work with the 30 communities that are currently unfiltered and must install filtration treatment. Finally, the Department continues to advocate for and promote efforts by citizens, local governments, and state and federal agencies to protect and improve watersheds used for public water supply sources. The Department of Human Services will continue efforts to keep water system operators and managers informed on recent research developments as they occur. Research on *CRYPTOSPORIDIUM*, lab methods, and water treatment processes by EPA and the water supply community is continuing. New knowledge is being applied to water systems as it becomes available. A number of Oregon water utilities have joined with the EPA and the Department in a voluntary cooperative program to share knowledge and information and to meet stringent new goals for water treatment in advance of any future regulatory standards that may be developed.

EMERGENCY TREATMENT OF DRINKING WATER

Small quantities of water containing *CRYPTOSPORIDIUM* oocysts can be made safe for drinking by bringing the water to a full rolling boil for one minute