On Tap

Emerging Waterborne Pathogens

By Kelly A. Reynolds

Many of the pathogens considered 'emerging' may have been around for decades, but with new routes of exposure and increased susceptibility they have found new opportunities to reproduce. Microbes continue to surprise (and maybe even outsmart) us with regard to their continued ability to change, adapt and wreak havoc on public health. Technically, a pathogen is considered emerging, or reemerging, if the incidence in humans has increased within the past 20 years or if increased incidence is suspected to occur in the future. New microbial insults seemingly appear overnight, while others follow somewhat predictable patterns of emergence. A range of factors contribute to the appearance of a new pathogen. For example, a pathogen may be previously unrecognized, undetectable or un-diagnosed but prevalent in the community for some time; a pathogen may have always been present but harmful only to a specific group of individuals, such as the immunocompromised, or transmitted by a new exposure route; climate changes or a change in the environment may impact pathogen survival or transmission; or a pathogen may truly be a newly evolved genetic sequence, never before present.

Factors of disease emergence

Reynolds will be presenting Significance of Emerging Contaminants in Drinking Water at WQA Aquatech 2006. The following is a print preview. Don't miss it!

It is difficult to predict where new health threats will emerge. Common ailments such as ulcers and some cases of diabetes and heart disease have recently been linked to microbial agents. Detection methods are continually improving for better isolation and diagnosis of microbes and their associative illnesses, but efficient and reliable cultural methods have yet to be developed for some of the most common microbial health threats.

Changes in lifestyles and cultures play a role in the emergence of new pathogens. For example, compared to 20years ago, more children are in-group day-care environments and more people are traveling nationally and internationally, contributing to an increase in pathogen exposures in new populations. Today, more than 20 percent of our population is considered immunocompromised, including HIV, organ transplant and chemotherapy patients. One study found that up to 85 percent of Cryptosporidium infections acquired by AIDS patients were from drinking tap water.[1] The susceptibility of these growing populations has led to an increased incidence and awareness of microbial infections and their subsequent consequences.

In addition to knowing where to look for pathogens, we must know how to look for them. The advent of molecular-based detection methods has opened new doors toward the understanding of emerging microbes. Molecular methods enable us to characterize genetic variations in the same organism. These variations can lead to increased virulence in a pathogen where characteristics such as growth temperatures, heat stability, toxin production, resistance mechanisms, etc. essentially owe to a brand new organism. The waterborne nor virus, for example, consists of numerous, genetically distinct strains, much like the common cold and influenza viruses. Such strain variation can complicate the efficacy of natural immunity and targeted medical interventions (such as vaccines). We now know that nor viruses are a primary cause of human infections in the U.S., including a significant portion of waterborne outbreaks where a causative agent was previously unrecognized.

With continued improvements in methods for monitoring and identifying pathogens transmitted in the environment, emerging disease can be better identified both on an epidemic and endemic level. Waterborne disease is generally recognized as being significantly underreported and seldom diagnosed. Thus, the true impact of microbial contaminants in water is difficult to assess. Endemic (low baseline level) waterborne disease is thought to be highly prevalent in the U.S. population. Based on extrapolation from existing databases, researchers estimate that seven million people become ill and more than 1,000 die each

Table 1. U.S. EPA's Contaminant Candidate List (CCL)

Acanthamoeba (guidance)
*Adenoviruses
Aeromonas hydrophilic
Caliciviruses
Coxsackieviruses
Cyan bacteria (blue-green algae)
Echoviruses
Helicobacter pylori
*Microsporidia
**Mycobacterium avium intercellular*

year from disease-causing microbes in drinking water in the U. S. alone.[2] During 2001-2002, the Centers for Disease Control and Prevention (CDC) reported only 31 drinking water outbreaks resulting in 1,020 cases of illness and seven deaths. The agents significant for endemic infections may be different than those targeted from outbreak data.

Evolution of a deadly microbe

Genetic mutations are common in nature; however, most have no notable effect on the organism or its virulence properties. Microbial sequences may mutate due to either an outside stress (i.e., exposure to ultraviolet light) or the inherent inefficiency in the nucleic acid replication process of the organism. In either case, the genetic sequence of the organism is altered. Another common event is the exchange of genetic information—such events have been purposefully orchestrated by scientists to enhance positive attributes of microbes. For example, the properties of a fast-growing bacteria may be genetically combined with an organism capable of degrading toxic pollutants to produce an ideal or-

characteristics have complicated treatment efforts for some common pathogens, now considered emerging, or reemerging. Some strains of bacteria that cause tuberculosis are resistant to the three major antibiotic treatments, meaning that an infection with one of these strains may be virtually untreatable, as was the case before the advent of antibiotics.

Conclusion

As with most pathogens, the best way to combat new microbes is to avoid initial exposure. Since the exposure routes are common sources such as food, water and direct human contact, it is important to follow precautionary guidelines for safe food handling, water treatment and good personal hygiene. Waterborne disease microbes promise to continue emerging as we recognize their presence in new environments. Nearly half of drinking water related outbreaks are associated with small, no community water systems or private wells, not currently regulated by federal agencies. Groundwater systems are now known to be vulnerable to many of the same pathogens that surface water hosts; however, there are far less treatment requirements for underground water sources. Evidence is emerging that *Naegleria,* a highly fatal amoebic pathogen, is commonly present in tap water sources, but with few incidences of recognized disease. Evaluating the risk of exposure to this pathogen is an important next step in disease prevention. Improved or added treatment of source water supplies is one avenue for control but maintaining the water quality throughout the distribution system is an added challenge that is best combated at the point of use.

References

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