Bioterrorism and Intentional Contamination of Drinking Water

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Biohazardous Agents

Water sources, drinking water supply systems and treated drinking water can become contaminated with naturally occurring microbes or toxins, but may also be targets of bioterrorism, sabotage and intentional contamination (Burrows and Renner, 1999; Khan et al., 2001; McAvin, 2004). The United Nations Biological Weapons Convention of 1972 prohibits member states from developing, producing and using bioweapons, but monitoring compliance with this convention has proven difficult. Even the definition of a bioweapon or bioagent (B-agent) has proven to be elusive, since the Convention prohibits only the use of bioweapons and not the B-agent itself. The intentional destruction of drinking water resources leading to water-borne diseases without a committed microbial contamination with a certain B-agent can be viewed as a type of biological warfare (White, 2002). Moreover, the bioweapons are most probably used by individual terrorist organisations and disturbed individuals rather than governments or nations.

B-agents which may be utilised in intentional contamination of drinking water include naturally occurring human enteropathogenic microbes, eradicated or uncommon pathogens, genetically modified organisms or microbial toxins (McAvin, 2004). In theory, any microbe or microbial toxin possessing the potency to cause illness or disorder in man can be used as a B-agent against a target population through the drinking water supply.

The most frightening B-agents include microbes and microbial toxins, which have low infective, incapacitating or lethal dose, high contagiousness, no acquired immunity in the population and no medication or preventive means available. To be able to infect or intoxicate through drinking water, the organism or toxin should survive in the aquatic environment and tolerate other unfavourable environmental conditions. Intentional contamination of drinking water with microbes or toxins that are colourless, odourless and tasteless presents a serious threat and this threat cannot be assessed by sensory testing of water. Botulinum neurotoxins (BoNTs) produced by Clostridium botulinum present this kind of severe threat and are the most potent biotoxins known (Gill, 1982a; Schechter and Arnon, 2000).

Detection of Bioterrorism

Distinguishing between a naturally occurring disease or outbreak and intentionally spread disease may be ex-
tremely difficult. The uncommon symptoms, high infectivity, severity or other abnormal factors may direct suspicions towards B-terrorism. Surveillance for infectious diseases and early notice of single cases and outbreaks of emerging diseases are essential for the prevention of further infection (Hugh-Jones, 2003). Unfortunately, surveillance systems have been found to be insufficient to detect possible intentional release of B-agents (Ashford et al., 2003).

Rapid and sensitive tests are needed for detection of B-agents and biotoxins, as well as for rapid screening for susceptible samples. Some devices are already developed for use and an expanding market is predicted for detection industry (Alocilja and Radke, 2003). Real-time PCR methods have provided some promising results for detection of *Fransella tularensis* (McAvin et al., 2004), *E. coli* and *Bacillus antracis* (Higgins et al., 2003). Some multiplex diagnostic platforms have also been described (Cirino et al., 2004). Fundamental differences in detection principles between microbes and inorganic chemicals probably mean that similar easy real-time detection of microbes, similar to that for chemicals, will be not be available in the near future (Green et al., 2003).

### Protection Against Bioterrorism

All actions taken to ensure the drinking water safety and security are also actions against bioterrorism and vice versa. There are only limited means to specially protect against B-agents used to intentionally contaminate the drinking water apart from controlling all critical control points, guaranteeing the treatment efficiency and securing the treated drinking water from manipulation. The most effective general protection against B-agents is to maintain high general and drinking water hygiene and use adequate treatment and common sense. Probiotic microbes, e.g. *Lactobacillus* spp. are well known to have beneficial effects on stabilising intestinal disturbances (Isolauri, 2001; Ried, 2004) but may provide only some protection for less severe B-agents.

Vaccination and immunisation can be implemented in the event of a special threat, e.g. against *B. antracis*, smallpox or BoNT (Arnon et al., 2001; Grabenstein, 2003). If exposure or suspected infection has occurred or clinical disease has developed, specific medication with appropriate antibiotics or antidotes can be initiated after consulting the medical experts.

Protecting the population against bioterrorism or intentional contamination of drinking water is a multidisciplinary challenge in which close collaboration and cooperation between veterinary, public health and medical professionals together with experts on security, water engineering and communication are essential (Mossel, 1990; Hartung, 1992; de Balogh et al., 2002; Rose, 2002).
References


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