



Coliforms in Distribution Systems: Integrated Disinfection and Anti-Microbial Resistance (Water Research Foundation Report)

G Gagnon, H Murphy, J Rand

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More than 20 years ago, researchers documented increased levels of antibiotic resistant bacteria as a result of water treatment processes including disinfection. Under controlled conditions, sublethal exposures of bacteria to disinfectants can result in altered and often reduced susceptibility to other antimicrobials, including antibiotics. In addition to disinfectants and their by-products, bacteria in drinking water are subject to several, almost continuous, ecological stressors that include nutrient depletion/starvation, metals from pipe corrosion, and microbial competition/predation. The major objective of this project was to understand the potential mechanisms of anti-microbial resistance of *E. coli* and opportunistic pathogens under disinfection conditions that are relevant to drinking water distribution systems. The research was conducted under controlled laboratory conditions and at the field level to provide closer approximations to the microbiological reactions in distributions systems. The project involved molecular techniques to understand genetic changes in microbial population in response to different disinfectant conditions. The researchers recommend implementing UV light as a primary disinfectant with chlorine-based secondary disinfection to enhance removal of heterotrophic plate count (HPC) bacteria due to synergistic effects and the previously established added benefit of a wider range of bacteria and protozoa inactivated (i.e., chlorine-resistant pathogens such as *Cryptosporidium parvum*). Utilities will benefit from high reductions in HPC bacteria and lower formation of biofilm in the distribution systems. There would also be potential for lower contact times (CTs) required for chlorine-based disinfectants with UV light pre-treatment to achieve higher reductions than chemical disinfectant alone at high CT. However, utilities would not be able to depend on UV pre-treatment to lower required dosages of chlorine-based disinfectant to maintain minimum residual concentrations. The researchers also recommend that UV light not be used as the primary and only disinfection because bacteria counts actually increased with UV-treated water when no residual protection was supplied.

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