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Microbiological Risk Assessment in Water Treatment Plants Based on a Combination of Event Analysis, Failure Trees and Predictive Modelling

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Extended Abstract

The increasing occurrence of waterborne diseases related to the presence of pathogenic microorganisms is causing serious damage to the health of people in various regions of the world and disruption of epidemiological surveillance and control systems. (1) Protozoa are waterborne pathogens. The first cases of human infection were detected in 1976 associated with watery diarrhoea (4.5) and 1982 in HIV-positive individuals (6), and their importance for public health was not recognised until 1993 when they caused a major epidemic outbreak of drinking water contamination affecting more tan 400 people.Conventional drinking water treatment plants are not completely effective in removing oocysts from water or inactivating them if they pass through the appropriate filters, as they are resistant to chlorination. Cryptosporidium is currently considered the most important microorganism related to drinking water safety risk (10) (11), due to its strong infectivity and resistance to chemical disinfection. It is therefore present in the face of a detected and existing threat, but does not know how DWTP can respond to it. The WHO guidelines for drinking water (12) recommend the implementation of water safety plans (WSPs) that require a comprehensive risk-based approach to manage hazards from source to tap (13). This is, therefore, the spirit of the present work: to provide a useful tool to evaluate the exposure of this type of persistent microorganisms from the PTS to the population supplied from PTS operation data. In 1994, Havelaar explored the application of HACCP (Hazard Analysis and Critical Control Points), a food safety management system, to drinking water supply systems (Havelaar, 1994). Between 1999 and 2001, an international group of experts discussed the potential for increasing consistency in approaches to the assessment and management of water-related microbial risks, leading to the "Stockholm Framework" (Fewtrell and Bartram, 2001). This further explored the application of HACCP to the drinking water supply. Domenech, Escriche and Martorell (2009), proposed a new approach to integrate Critical Control Point (CCP) assessment of the effectiveness of predictive modelling to represent the effect of failures related to process parameters in the food industry. A new predictive model incorporating process control was developed based on the concept of a control cell. This paper presents an extension of the approach proposed in Domenech et al (2009). The new approach is based on a combination of traditional predictive models and event/fault tree analysis techniques are proposed, which allow the representation of normal and abnormal variations of parameters throughout the water treatment process in the drinking water plant for a better estimation of the real impact of such deviations or failures on consumer safety. The aim is to extend the new approach focused on water safety. An example of application is a drinking water treatment plant with conventional treatment where human exposure to Cryptosporidium via drinking water is evaluated

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