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Summary

Shiga toxin positive Toxin positive *E. coli* O157 and related STEC strains are amongst the most serious of waterborne pathogens that pose a threat to drinking water supplies. The concern is particularly due to that fact that about 10% of cases in children go on to develop haemolytic uraemic syndrome and also the high mortality rates in the very young and very old. Whilst most concern relates to *E. coli* O157 other STEC strains are increasingly being recognised, but as yet they are less commonly identified as being associated with waterborne outbreaks. The recent emergence of *E. coli* O104:H4 in Germany raised especially great concerns due to the high fatality rate in previously healthy adults. Although *E. coli* O157 has been reported to cause outbreaks associated with drinking water in the UK and elsewhere, there is still little information about how common sporadic waterborne infections may be. In the few well conducted case control studies of sporadic disease, potable water from public supplies has not been implicated, although unchlorinated surface water has been identified as a risk factor. This paper reports a study aimed at trying to estimate the risk of STEC infections due to drinking water in the absence of detectable outbreaks of disease. The report follows a series of studies that included systematic reviews, surveys of water utilities and private supplies and a quantitative microbiological risk assessment with the ultimate aim of determining the risk to health associated with this pathogen in English and Welsh drinking water supplies

We report a systematic review of the literature to determine the prevalence of *E. coli* O157 in raw waters and in livestock that may be sources of contamination of such raw water. There was a dearth of studies that reported on concentration of *E. coli* O157 in raw waters or indeed in water intended for consumption. We were however, able to identify several papers that addressed the detection of *E. coli* O157 in livestock, though most gave only presence-absence data. We were able to find one PhD thesis that derived a distribution of counts in positive livestock. In addition we reviewed evidence on the susceptibility of *E. coli* O157 to disinfection and concluded that the evidence suggests that *E. coli* O157 has the same susceptibility as indicator *E. coli*.

Several water utilities were contacted about their disinfection policies and more detailed information obtained on a number of Water Treatment Works. Chlorination policies differed from utility to utility but ranged from A Ct of 15 to 60 mg.min L⁻¹ depending on water quality. Across England and Wales DWI recorded on average one chlorination failure per month, the majority of which lasted less than 24 hours (median 6 hours). During 2010 there were 38 reported breaches in the integrity of water mains.

The results of a sanitary survey of 270 private water supplies in Herefordshire and East Anglia are also reported. Only 40% of owners reported using any disinfection and of these only 59% kept a record of water treatment maintenance. There were in addition a range of other problems such as

on site sewerage, proximity of livestock and unsatisfactory repair of the systems that would pose an increased risk of contamination.

A quantitative microbial risk assessment (QMRA) was conducted, using data collected from the literature, water utilities and the drinking water inspectorate. We conducted a separate QMRA for private supplies and for 13 randomly selected public water supplies owned by four different water companies. The risk assessment was based on data of indicator *E. coli* concentrations in tap water for private supplies (obtained from DWI) and in raw water for the public supplies (obtained from the utilities). The O157: indicator *E. coli* ratio was estimated for each catchment from the known number of livestock occupying the catchment, the estimate of the proportion excreting and a model of shedding intensity. Daily water consumption was modelled from the recent DWI water consumption survey and the risk model was the Beta Poisson model with parameters according to Teunis et al. (2004). Risk was calculated by MonteCarlo modelling using @Risk5.

The mean annual risk in adults consuming unboiled tap water from private supplies is 5 cases per 10000 person years. However, almost all of this risk is experienced by people whose water quality fails the statutory *E. coli* standard. When the modelling was restricted to those supplies that complied with current standards the mean annual risk was estimated to be only 0.8 cases per 10000 person years. The annual risk in the 13 water utility sites range from 0.00065 cases per 10000 person years in adults to 0.69 cases per 10000 person years. All water utilities are able to provide water with an annual risk of less than 1 per 10000 person years. In the model that included one day chlorination failure risk remained than 1 per 10000 person years. It is likely that the estimated risks for the public water supplies are over-estimates as we used a very conservative estimate of chlorination.