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Consensus report: *E. coli* O104:H4 (HUSEC041) and the potential threat to European water supplies

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ABSTRACT

Among the 3rd Seminar for PhD students working on Water and Health which was held in Cannes on 27–29 June 2011, experts from a number of universities and research institutes took the opportunity to discuss the emergence of *Escherichia coli* O104:H4 in Europe. Especially, possible threats for European water suppliers were considered. The consensus is summarized in this report. The main conclusion was that *E. coli* O104:H4 would not pose a substantial risk to well managed water supplies, especially where regular monitoring of indicator *E. coli* is negative. However, this may not apply for small and very small water systems which are quite common in Europe. New strategies like the Water Safety Plan approach are needed to protect also small scale drinking water systems and private wells in Europe. Water used in the processing of foods likely to be eaten raw, especially sprouts, should be of drinking water quality.

Consensus report

The 3rd Seminar for PhD students working on Water and Health was held in Cannes on 27–29 June 2011. This seminar was attended by PhD students and also senior professors (in alphabetic order: Prof. Dr. M. Exner, Bonn, Prof. Dr. P. Hartemann, Nancy, Prof. P.R. Hunter, Prof. Dr. Y. Levi, Paris, Dr. J.F. Loret, Paris, Dr. D. Villesot, Paris, and Prof. Dr. M. Wilhelm, Bochum) with special expertise in water and health from a number of universities and research institutes. At this conference the opportunity was taken to discuss the emergence of *Escherichia coli* O104:H4 in Europe and to consider what if any additional threats this may present for drinking water supplies in Europe which was also consented with Prof. Dr. W. Mathys, Münster. The following summarises the main conclusions.

1. At present it is not possible to predict how the epidemiology of this re-emergent, exceptionally virulent strain may develop (Frank et al., 2011). It is plausible that the strain may not become established but disappears. On the other hand it is also plausible that the strain may become established in a human

or perhaps in a still unknown animal reservoir and continues to pose a threat to public health for many years.

2. It is also not possible to state with certainty whether it will retain its apparent increased virulence.
3. To our knowledge there is no indication that this re-emergent strain has been transmitted by drinking water.
4. However, other enterohemorrhagic/Shiga toxin producing (STEC) strains of *E. coli* such as *E. coli* O157:H7 have caused well described drinking water outbreaks such as the Walkerton outbreak in Canada that was associated with more than 2000 cases and 7 deaths. Most drinking water associated outbreaks were associated with deficiencies in water treatment and/or disinfection especially in small water scale utilities and after heavy rainfall (Ackman et al., 1997; Bruneau et al., 2004; Friedman et al., 1999; Harrison and Kinra, 2004; Holme, 2003; Jones and Roworth, 1996; Olsen et al., 2002; Paunio et al., 1999; Wang et al., 2004). To the best of our knowledge, no outbreaks have been associated with well managed water systems. The exposure route drinking water is favoured by the very low infectious dose of *E. coli* O157:H7.
5. Until now it must be assumed that the emerging pathogen *E. coli* O104:H4 seems to have similar properties as *E. coli* O157:H7 such as low infectious dose, broad temperature range, high resistance against acids, broad antibiotic resistance (ESBL), biofilm production which are possible risk factors for

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- transmission by drinking water or other waters (Askar et al., 2011; Scheutz et al., 2011). Other environmental characteristics for tenacity are under investigation.
6. At the time of writing there is no evidence of an animal host for *E. coli* O104:H4 and infection seems, for the time being at least to be restricted to human. This is unlike the case for *E. coli* O157:H7 which has as its main reservoir domestic livestock in which it is often asymptomatic. It is not yet clear whether *E. coli* O104:H4 has the potential for colonising animals, or developing a reservoir in livestock. If the strain does widely colonise livestock or other animals then the risks associated with the contamination of the environment and water reservoirs will increase.
 7. The finding of *E. coli* O104:H4 in a creek influenced by a sewage utility in the German Federal State of Hesse is an indication that the emerging strain could begin to be distributed in the environment by the faecal route, though we are aware that subsequent samples taken from the creek were negative.
 8. It seems reasonable to us that should *E. coli* O104:H4 become established in humans or animals in Europe then, on account of its increased virulence, it will pose an additional risk to some drinking water supplies over and above that posed by established pathogens.
 9. Given the propensity for *E. coli* O157:H7 to cause waterborne outbreaks primarily in small and very small inadequately managed drinking water systems it is likely that *E. coli* O104:H4 would also be of primary concern in such systems.
 10. Similarly it is unlikely that *E. coli* O104:H4 would pose a substantial risk to well managed water supplies, especially where regular monitoring of indicator *E. coli* is negative.
 11. Small and very small water systems are common in Europe. For example, in Germany up to 20% (about 16 million people) have drinking water distributed by small scale water utilities and private wells (WHO, 2011). In the Federal State of Baden-Württemberg, as an example, 523 selected samples from the approximately 13,500 private wells were analysed in 2007; non-compliance rates for *E. coli* and total coliforms were at 18% and 43%, respectively. Non-compliance rates for small public water supplies serving fewer than 5000 people were at 2% and 5% for *E. coli* and total coliforms, respectively (cited from WHO, 2011). These figures are probably not specific to Germany, since in a survey carried out in 2009, one third of all small water supplies (serving from 50 to 5000 citizens) of European member states did not comply with the requirements of the Drinking Water Directive (Falkenberg, 2011).
 12. In accordance with the proposal of the WHO Europe new strategies like the Water Safety Plan (WSP) approach are needed to protect also small scale drinking water systems and private wells in Europe. The emergence of a new bacterial strain with enhanced virulence makes this proposal even more urgent (WHO, 2011).
 13. Where *E. coli* is detected in drinking water samples the owners of such supplies need to be strongly advised to disinfect or boil or treat by point of use filtration system any water prior to consumption as an acute reaction. Independent of the acute risk management strategies there is also an urgent need for a detailed risk evaluation of the quality of the drinking water system based on the WHO Water Safety Plan Concept.
 14. We strongly recommend that sampling methods for *E. coli* O104:H4 in water be harmonised and laboratory proficiency tests performed as soon as possible.
 15. International Guidelines for irrigating water quality should be re-evaluated. Water for irrigation for raw food vegetables and fruits should not be taken from creeks directly influenced by sewage.
 16. Water used in the processing of foods likely to be eaten raw, especially sprouts, should be of drinking water quality. If such water is taken from a private supply then that supply should be subject to a risk assessment and regular microbiological monitoring.

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