

Critical review of the literature on the association between water discolouration and acute gastrointestinal illness in settings relevant to the United Kingdom

Executive Summary

Background It is not clear whether events resulting in a sudden obvious discolouration of the water supply could result in an increase in the risk of gastrointestinal illness among those exposed. The reviewers were commissioned by the Drinking Water Inspectorate to evaluate the available evidence relevant to the potential association between drinking water discolouration at point of use and risk of acute gastrointestinal illness. The purpose of this review is to assess the existing evidence, to make recommendations regarding the need for a further study in England and Wales, and to inform the design of such a study.

Questions Addressed by the Review This review sought to find evidence relevant to a UK setting of an association between discoloured tap water and the risk of acute gastrointestinal illness and to determine what proportion of acute gastrointestinal illness in England and Wales might be attributable to exposure to discoloured water.

Review Methods The reviewers identified peer reviewed research from structured searches of databases, and non-peer reviewed research from relevant websites. Studies were included in the review if they addressed the question of the association between discolouration of a public water supply in a setting relevant to the United Kingdom and risk of acute gastrointestinal illness. Eligible papers were assessed independently by two reviewers in terms of appropriateness of the study design and analysis, results, interpretation, and the overall quality of the paper.

Results of the Review Time-series studies investigating the effect of temporal variations in turbidity at the treatment plant and subsequent incidence in acute gastrointestinal illness were the only category of studies reviewed deemed sufficiently rigorous to be informative; in general these studies provided evidence of an increase in acute gastrointestinal illness at varying lags following days of high turbidity (range 3 to 29 days). One study investigating the effect of turbidity at point of use was identified, but was judged to be insufficiently rigorous to be informative.

Discussion No studies were identified in this review that specifically addressed the issue of water discolouration incidents and their effect on the risk of acute gastrointestinal illness. With the exception of contamination with highly toxic metals, we have found no evidence that water discolouration at point of use is associated with acute gastrointestinal illness. Only one poor-quality study identified in this review measured water quality at point of use and this study found no association. Most studies identified in this review investigated the effect of variations in turbidity within normal limits at point of treatment or water treatment works final water. These studies address a fundamentally different hypothesis and their results cannot be used to assess the likely effect of water discolouration at point of use. In order to establish whether there is an association between discolouration events and risk of acute gastrointestinal illness in the United Kingdom setting, an epidemiological study specifically designed to address this question would be needed.

Conclusions There is some evidence that increases in turbidity of final water are associated with subsequent increases in the incidence of acute gastrointestinal illness at varying lags. Lags of between 4 and 13 days were commonly reported. A peak in acute gastrointestinal illness at certain lags following days of high final water turbidity was consistently found across studies. This association is unlikely to be the result of measurement error, bias or random error and warrants further investigation. The potential for residual confounding (due to inadequate

adjustment for time-varying confounding factors such as seasonal effects, temperature and precipitation) in these studies remains unclear. Further methodological work in this area could clarify this issue. No evidence was found as to whether turbidity levels at point of use- in the absence of increased turbidity at the treatment plant- increase the risk of acute gastrointestinal illness.

Background

Forty-four incidents of discoloured water affecting approximately 1.4 million people were reported in 2003 to the Drinking Water Inspectorate of England and Wales (DWI), based on complaints from members of the public (1). This was down from 95 such incidents reported in 1999. Most of these incidents involved concomitant increases in turbidity far above the threshold of action of 4 Nephelometric Turbidity Units (NTU). Discolouration of tap water can be caused by the disturbance of sediment, particularly corrosion products, within the distribution systems. Poor control of the distribution system and ingress into the distribution system may coincide with presence of gastrointestinal bacterial species such as *Salmonella*, *Campylobacter*, *Shigella* or toxigenic strains of *E. coli*, or the parasites *Giardia* or *Cryptosporidium* that transiently pass through the system.

The reviewers were commissioned by the DWI to write a study proposal investigating the potential association between incidents of drinking water discolouration at point of use and risk of acute gastrointestinal (GI) illness. The purpose of this review is to evaluate the existing evidence in order to establish what is known on this topic, to make recommendations regarding the need for a further study addressing this issue in England and Wales, and to inform the design of the proposed study.