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Short report

A fatal case of Shiga toxin-producing *Escherichia coli* linked to a private drinking water supply

Rebecca M Schack, Mark Handby, Joy Gregory, Nela Subasinghe, Shaun P Coutts

Abstract

In May 2017, a fatal case of Shiga toxin-producing *Escherichia coli* (STEC) with haemolytic uremic syndrome was investigated by the Victorian Department of Health and Human Services and a local government authority. Investigation revealed the case used rainwater harvested from the roof of their home and stored in tanks as a private drinking water supply, despite the availability of a reticulated supply from the local water authority. *Escherichia coli* Stx1 and Stx2 genes were detected in a water sample collected from the private drinking water supply, consistent with those earlier identified in the case's faecal sample. This case study highlights the potential risks of STEC infection from private drinking water supplies, the importance of proper maintenance of such supplies, and the preferable use of reticulated water supplies when available. It also demonstrated an effective collaboration between local and state government for an environmental public health investigation.

Introduction

Shiga toxin-producing *Escherichia coli* (STEC) are a group of bacteria that express Shiga toxins (Stx) 1 and 2.^{1,2} Cattle and other ruminants are the main reservoirs,^{3,4} with transmission to humans primarily occurring through the ingestion of contaminated food and water, direct contact with animals and their faeces, and cross-contamination of fomites. It can survive in animal faeces, water and soil for months.^{1,5}

STEC is infectious at very low doses and can cause illness in humans including severe abdominal pain, cramping and watery diarrhoea which may become bloody.¹ In approximately 3–7% of cases, infection with STEC may lead to haemolytic uraemic syndrome (HUS).⁶ HUS is characterised by acute renal failure, haemolytic anaemia, thrombotic thrombocytopenic purpura and is fatal in approximately 12% of cases.⁷ Children less than five years of age, the elderly and the immunocompromised are at greater risk of developing HUS.^{8,9}

In Victoria, laboratories and medical practitioners are required to notify STEC to the

Department of Health and Human Services (DHHS) within five days of diagnosis. HUS requires immediate notification by telephone on suspicion.¹⁰

A standardised questionnaire is administered to all STEC cases by DHHS investigators to identify risk factors for infection. Single case investigations rarely result in the definitive identification of a source of infection due to delays in diagnosis, inadequate case recall of risk factors, exposure to multiple risk factors, and the inability of investigators to obtain suitable food and environmental samples for timely analysis (primarily due to delays in diagnosis).

Investigation

Case investigation

On 9 May 2017, DHHS was notified by the Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL) of a polymerase chain reaction (PCR) result identifying *E. coli* Stx1 and *E. coli* Stx2 genes in a faecal specimen from a 77-year-old hospitalised female. This notification triggered a STEC case investigation in accord-

ance with DHHS protocols. Ethics approval was not required for this case study or investigation and it was carried out under Victorian public health legislation.

Discussion of the case with the admitting hospital medical practitioner revealed the case had been clinically diagnosed with HUS. This diagnosis had not been previously notified to the department.

As the case was too unwell for interview, the standardised STEC questionnaire was completed with the next of kin and a friend of the case. Identified risk factors included bushwalking, handling sheep manure in the garden, handling raw meat in the home and consumption of water from a private drinking water supply.

The case subsequently died from acute renal failure.

Environmental Investigation

On 9 May 2017, a local government Environmental Health Officer conducted an on-site assessment of the case's rural property to identify potential sources of infection. The case had used rainwater harvested from the roof of their house and stored in two water tanks as a private drinking water supply, despite the availability of a reticulated water supply from the local water authority. The drinking water tanks appeared modern and well-sealed, with no obvious signs that animal faeces could have directly contaminated the water. Both tanks were fed by piping from the same section of roof, through screens that would prevent the entry of large contaminants such as sticks and leaves. No further treatment steps were applied to the tank water prior to consumption.

The officer returned on 11 May 2017 to collect samples of standing water from a drinking water jug in the case's bedroom, sheep manure used in the garden, suspected unpasteurised cream from the refrigerator and two water samples directly from each of the drinking water tanks.

All samples were tested for the presence of STEC using real-time TaqMan PCR at MDU PHL. The presence of *E. coli* Stx1 and *E. coli* Stx2 genes was detected in a sample collected from one of the water tanks, consistent with the genes detected in the case's faecal specimen. STEC was not able to be cultured from either the case's faecal specimen or the PCR-positive water sample. No Shiga toxin genes were detected in any other food, water or environmental samples collected from the property.

Public health response

To reduce the risk of further infection and illness associated with consumption of water at the property, DHHS and the local government authority advised three options to the case's family: disinfect, replace, or remove the water tanks. The family chose to disinfect and remove the water tanks from the property.

The roof of the case's house was cleaned, including the spouting and downpipes. The water tanks and internal pipework were dosed and flushed with 5 mg/L chlorine solution, emptied and removed from the property.

The house was subsequently connected to the reticulated drinking water supply, which was used to flush the internal pipework. Follow-up water samples were collected from the kitchen and bathroom taps in the house on 14 June 2017. STEC was not detected in these follow-up samples.

Discussion/Conclusion

This case study highlights the potential risks of STEC infection from private drinking water supplies. Although the source of the STEC and the route of transmission to the case could not be definitively identified, it is likely the roof of the case's home was directly or indirectly contaminated by animal faeces, resulting in contaminated runoff entering the drinking water tanks.

The investigation was an effective collaboration between local and state government and ensured

a swift investigation to remove the potential health risk to people who may consume water at the property. Unfortunately, both PCR-positive samples were unable to be cultured, meaning further typing could not be completed to further verify a link between the samples. The inability to interview the case directly meant that other potential sources of infection may have gone unidentified.

This case study also emphasises the importance of effectively managing private drinking water supplies, particularly untreated supplies where the water is not filtered or disinfected prior to consumption.^{11,12} Hazards associated with private drinking water supplies can include microbial pathogens; chemical contamination from pipes, tanks or roof materials; contamination from dust, agricultural or industrial material; mosquitoes; elevated levels of metals and nitrates in groundwater; and taste and odour issues from algae.¹³

Where available, reticulated drinking water supplies provide a safe, regulated option and do not depend on individual preventative maintenance and treatment of microbiological hazards. In many parts of Victoria, people have no alternative to the use of a private drinking water supply, as a reticulated supply is not available. DHHS guidance for people using private drinking supplies recommends ensuring water comes from a good quality source, regularly maintaining the water supply systems, and using appropriate treatment where required.¹³ Although this general advice is available to the public, the number and quality of private drinking water supplies in use throughout Victoria is currently unknown.

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