Public Health England

Protecting and improving the nation's health

Escherichia coli O55:H7 outbreak in Dorset

July 2014 to December 2015

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Executive summary

In July 2014, Public Health England (PHE) South East centre received notification of two children with Haemolytic Uraemic Syndrome (HUS) in the county of Dorset. Routine local investigations were negative for Shiga-toxin producing Escherichia coli (STEC) O157. Testing at the reference laboratory identified the causative organism as STEC O55:H7. The outbreak strain carries a sub-type verocytotoxin (VT2a) and another gene (eae) associated with elevated risk of HUS. Laboratory records showed that this strain had not previously been isolated from humans or animals in England.

By November 2015 there were 31 confirmed cases of STEC O55:H7 linked to this outbreak in the Dorset area. Twenty one cases were symptomatic with 13 developing HUS (11 children and two adults).

Detailed epidemiological, microbiological and environmental investigations were carried out, including international links to the Republic of Ireland. The only epidemiological link common to all the cases was that they either lived or had close links to Dorset County. Whole Genome Sequencing (WGS) data confirmed that all the cases were infected with the same strain. Animal and pets were also tested as part of the investigation; STEC O55:H7 was isolated from two cat faecal samples.

The outbreak was managed by an Outbreak Control Team (OCT) calling on expertise from a variety of agencies including environmental health teams; Directors of Public Health; Animal and Plant Health Agency; Food Standards Agency; Environment Agency; PHE Gastrointestinal Infections Department, PHE Gastrointestinal Bacterial Reference Unit; PHE Field Epidemiology Service; PHE Food Water and Environment laboratory and Public Health England South East Centre.

Control measures included extended screening and exclusion of cases and contacts in high risk groups. Enhanced surveillance of faecal samples in Dorset laboratories and environmental sampling occurred to help determine the extent of this organism in the community.

The outbreak was initially managed at a local level. In September 2015 additional resources and expertise were committed to this incident by PHE to explore and coordinate the wide ranging investigations that were underway. Despite this, no causal link could be made and on 16 December 2015, following a period without cases, the OCT agreed to scale back the level of involvement.

Introduction

This report describes an outbreak of gastrointestinal illness, affecting 31 people in the Dorset area, caused by a strain of Shiga-toxin producing Escherichia coli (STEC) not identified before in England and Wales. The outbreak strain, STEC O55:H7 carried verocytotoxin (VT2a) and gene (eae) associated with an elevated risk of Haemolytic Uraemic Syndrome (HUS)(1). This report summarises the investigative methods and the control measures applied in this incident following the formation of a multiagency Outbreak Control Team (OCT). Despite best efforts no source for the outbreak was identified.

Background

STEC infection is a relatively rare cause of gastrointestinal illness in England, with Dorset seeing about 10 of the 800 cases reported each year. Symptoms can range from mild gastroenteritis through to severe bloody diarrhoea with two serious conditions; haemolytic uraemic syndrome affecting the kidney, and Thrombotic Thrombocytopenic Purpura (TTP) casuing clotting problems, sometimes seen.

The main reservoir for STEC is cattle and other ruminants. Transmission to humans occurs through consumption of contaminated food or water, or exposure to a contaminated environment involving direct or indirect contact with animals or their faeces. The low infectious dose of STEC means that once in the population, person-to-person spread is common via the faecal-oral route. The incubation period is between three and four days and prolonged excretion can occur notably in young children.

Non-O157 STEC is not routinely tested for in local laboratories and only samples from HUS cases are referred to the reference laboratory at Colindale for analysis, therefore under-ascertainment of milder cases is likely.

Incident co-ordination

The incident was coordinated by the PHE South East Centre Hampshire and Isle of Wight Unit (formerly known as Wessex). A multiagency OCT was convened within 24 hours of the PHE identifying linked cases of STEC O55:H7 in October 2014.

The outbreak was initially managed at a local level. In September 2015 additional resources and expertise were committed to this incident by PHE to explore and coordinate the wide ranging investigations that were underway.

All the members of the OCT played a part in the investigation and management of this outbreak. Each organisation investigated a particular aspect pertaining to their expertise and experience. The findings were fed back to the OCT on a regular basis to aid and support decision making.

Outbreak investigation methods

The aim of the outbreak investigation was to protect public health by identifying the source of the outbreak and implementing control measures to prevent further spread or recurrence of the infection. Extensive epidemiological, environmental and microbiological investigations were carried out. The OCT also contacted the Republic of Ireland (ROI) about cases and possible animal sources there.

Epidemiological investigation

Using case definitions agreed by the OCT, all potential cases of STEC O55:H7 were investigated. Information collected from cases included clinical history, contact with animals, food consumed, venues visited, and activities undertaken in the 14 days prior to developing symptoms. The outbreak team investigated the following possibilities:

1) Contaminated foodstuff or drinking water
2) Specific recreational/environmental exposure (e.g. farm, food outlet, park, swimming pool etc.)
3) Epizootic (animal) vector +/- general environmental contamination

Microbiological testing

Local laboratories use standard methods to culture STEC O157, while other types (such as O55) can only be tested in the reference laboratory in the Gastrointestinal Bacteria Reference Unit (GBRU) in Colindale. This includes samples from the Republic of Ireland (ROI) which are routinely forwarded to the GBRU. Eleven of the Irish STEC O55 isolates were investigated for possible links to the STEC O55 outbreak in the Dorset area.

Whole genome sequencing testing was carried out on all available isolates, 24 human and two animal faecal specimens, together with 11 background STEC O55:H7 isolates from the Republic of Ireland.

Environmental investigation

Environmental contamination by birds or cattle was considered as a possible source of the outbreak therefore food, water and environmental samples including Bootsock samples were tested.

A number of restaurants, food retailers and venues were identified by cases and were inspected and sampled by specialist teams.

Water samples from River Stour above and below Blandford; Bourne stream and the bathing water at Bournemouth pier were taken for testing.

In addition, the Environment Agency (EA) provided hydrological data for Dorset which was analysed to investigate temporal associations between flooding events and symptom onset.

Veterinary and animal movement investigations

Animal faecal samples were collected during the Bootsock walks and from pet dogs and cats belonging to cases/contacts and tested in Colindale. The OCT team investigated bird population migration and international cattle movement from the Republic of Ireland to Dorset.

Results

Epidemiological

The investigations covered two periods between July 2014 to December 2015 during which 31 confirmed cases were identified. The data analysis revealed that 28 cases were associated with 6 epidemiological clusters; three cases could not be linked to a cluster.The majority of the cases were children under 17 years old (20/31), female (18/31), and were symptomatic (21/31). Thirteen of the cases developed HUS (11 children and two adults).

From July 2014 to December 2014 there were 21 confirmed cases. Thirteen of these were symptomatic and eight went on to develop HUS (7 children and 1 adult). Twelve cases were associated with a nursery (9 children and 3 adults). Five of the cases associated with the nursery were asymptomatic and identified through screening of contacts. There were five cases in a family cluster and three sporadic cases that had no identified epidemiological link to the nursery or any of the other cases. Although no cases were identified between November 2014 and May 2015 the investigations remained open as no source could be found.

In May 2015 a child with HUS and who was positive for STEC O55 was reported to PHE. Detailed investigations identified a cluster of 4 cases belonging to the same household (2 adults and 2 children). All but one adult developed HUS. No link to the 2014 cases was found although a cat faecal sample found outside the family home was tested positive for STEC O55:H7.

Between July and September 2015, two unrelated cases were detected, and four more cases were identified through enhanced surveillance of contacts. One of the cases had a cat that tested positive for STEC O55:H7 and was a possible source of the infection into the household.

The network analysis of the 31 cases revealed nine of the ten (co)primary cases had domestic contact with cats (five cases) or dogs (five cases). In addition to domestic animal contact, the only common factor among the (co)primary cases was residing in or around, or having links to, Bournemouth and Weymouth in Dorset.

Microbiological

The causative organism was identified and serotyped as STEC O55:H7. The samples were positive for eae (intimin) and had a stx subtype profile that was stx2a. Whole Genome Sequencing (WGS) was undertaken on isolates from 24 Dorset cases, 2 cats and 11 Irish cases. All Dorset isolates formed a distinct cluster. Isolates from the nursery cases were more closely linked to each other compared to isolates from earlier cases in 2014, suggesting person to person transmission. The Dorset isolates were very similar to six of the Irish isolates but relatively distant from the other 5 Irish isolates.

Environmental

More than 100 samples of food, water, surface swabs, cleaning cloths and environmental bootsocks were examined for STEC and hygiene indicators. No STEC O55:H7 was detected in any sample of ready to eat food, drinking water, surface swabs or cloths.

The investigations into food sources and food serving premises did not result in any significant findings.

The OCT further carried out hydrological data analysis and examined 6 flooding reports in the area from December 2014 to September 2015. Five flooding events occurred 1-9 days prior to symptoms onset among five of the six (co)primary cases linked to Bournemouth. Three of these cases reported having visited the affected areas in their exposure histories.

Veterinary and animal movement

STEC O55:H7 was isolated from cat faeces taken from a concrete path outside the home of one case. Although the pet cat of this household had been ill, testing was negative. All pets of (co)primary cases were tested retrospectively following this finding but yielded negative results. The faeces of a symptomatic pet cat belonging to one of the sporadic cases, tested prospectively, was positive for STEC O55:H7. The cat's illness preceded symptom onset in the case. These two positive cat specimens were taken approximately 4.5 kilometres and two months apart. In total, samples were taken from 17 animals including cases' family pets and petting farms in the area.

The OCT examined bird populations in the South West and South East England from 2013-15, which remained constant suggesting no new risks. Teal and black-headed gulls were the only species identified where there was significant level of movement between Republic of Ireland

(ROI), South England and Europe. Black headed gulls are common in Great Britain and there are large colonies along the south and east coasts of England.

Cattle movements between Ireland and Dorset were investigated; a total 1,149 cattle from ROI were moved to 69 separate premises in Dorset in the two year period 2013-14. These premises are located mainly in the north and west of the county, away from, but upstream of, the residences of (co)primary cases in the south of the county near the coast.

Control measures

As per national guidelines (2), general advice on hand and food hygiene were provided to all cases and contacts together with guidance on environmental cleaning and disinfection. In addition, all cases and contacts had a 14 day exposure history taken instead of seven and all household contacts were screened and excluded until microbiological clearance, whether symptomatic or not.

It was agreed by the OCT that for a period all bloody diarrhoea samples sent to the three laboratories in Dorset should be tested for STEC O55, in an attempt to identify further possible cases.

All actions were taken in partnership with local GPs, microbiologists and paediatricians in an effort to increase awareness and referrals for testing.

Proactive media releases were issued to inform the public of basic infection control measures to prevent infection and targeted letters were sent to parents and teachers in schools with a case.

At all times the PHE South East communications team co-ordinated the media response and kept the public informed of any new developments to the situation. A documentary was produced by the BBC South's Inside Out programme that highlighted the large amount of work put in to the investigation and was well received by both professionals and the public.

Discussion

The epidemiological investigations into the possible source of the first recorded outbreak of STEC O55:H7 in England followed three lines of enquiry: contaminated foodstuff or drinking water, specific recreational/environmental exposure or general environmental contamination.

The data from enhanced questionnaires found no common exposures linking all primary cases. All food, water and environmental testing was negative for contamination by STEC O55 and there was little evidence to support the view that contaminated foodstuff or drinking water or a specific recreational/environmental exposure was the cause of the outbreak.

Results from WGS analysis suggested person to person transmission within the nursery cluster. The Dorset cases had genetic similarity with the 2013-14 Irish cases. This suggests infection by the same or closely related populations of STEC O55:H7 and may represent a common live reservoir.

The positive sample from the symptomatic cat of a case and from another cat sample linked to a different human case, suggests that domestic pets may act as a vector for infection. It is also possible that several vectors may be responsible for the environmental spread of the bacteria.

The geographic clustering around two areas of Dorset (Bournemouth and Weymouth) suggests local infection acquired by humans from infected pets and/or directly from the environment seems the most likely cause of this outbreak. Investigations into migratory birds, cattle movement and flooding in the area also provided additional perspectives on the outbreak however the source still could not be identified.

The investigation presented the OCT with a number of challenges – the difficulty in identifying the organism at local laboratories, the protracted nature of the outbreak, the extensive number of possible sources to explore resulting in the use of a wide range of methods such as enhanced surveillance through local laboratories, WGS, bootsock sampling, the combined use of hydrological and cattle census data, and the international links to help informing control measures.

This outbreak has provided insights that would help the investigation of any future cases of STEC O55:H7 or other emerging pathogens of unclear epidemiology. The WGS data provided additional evidence where the epidemiological links were not clear.

The multi-agency approach was important in ensuring all possible sources/theories were explored thoroughly. The OCT engaged proactively with the media and communicated the risks throughout the investigation and management of the outbreak.

Conclusions

This is the first outbreak of STEC O55:H7 recorded in the UK. PHE led the investigations and management of this outbreak with input from a wide range of agencies. A comprehensive risk assessment was carried out by the OCT members which included epidemiological, microbiological and environmental aspects. Further, animal and bird movements were investigated combined with hydrological data analysis to inform the investigations. Genetic links with known international cases from the Republic of Ireland were also explored using WGS technology.

The risks posed by this outbreak were initially managed at a local level however the challenges faced in dealing with an emerging pathogen with no clear source and the severity of illness caused by the organism meant that additional resources and expertise were committed to this

incident by PHE to explore and coordinate the wide ranging investigations that were undertaken. the level of response was escalated in PHE to ensure that appropriate resources were available to the OCT.

The complexity of the situation required a dedicated team of communication experts to communicate the risks to all concerned parties including the affected families and the general public via different mechanisms.

Recommendations

A number of recommendations were formulated to ensure effective response in case new cases of STEC O55:H7 are identified in the future. The general infection control principles for STEC O157 still apply with additional measures to ensure actions are taken promptly to help identifying the source of the infection.

For a new single case or an outbreak the following measures should be undertaken:

- A 14 day exposure history including detailed questions about places visited, food consumed and exposures of pets.
- All household contacts screened regardless of being symptomatic or not with consideration to extend the screening to wider network as deemed necessary.
- Environmental sampling of all gardens and places visited, using bootsocks methodology.
- Testing of all household pets whether symptomatic or not and non-domestic animals if considered necessary such as if the case visited petting farms.
- Enhanced surveillance with local laboratories can be considered by the OCT for bloody diahrea cases.

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Appendices

APPENDIX I Case definition (revised October 2015)

Confirmed case:

Person with STEC O55:H7 (with WGS within 5 SNPs of outbreak strain, where WGS available) identified in stool sample
OR
STEC O55:H7 antibodies identified by serology.

Probable case:

Symptoms of gastrointestinal disease, haemorrhagic colitis, HUS or TTP
AND
Epidemiological links to a confirmed case of STEC O55:H7

Possible case:

Any patient presenting with HUS in the Dorset population (could also include bloody diarrhoea with unknown cause)

Note that serological definition of confirmed cases may include cases that are not of the same serotype, as we have now have removed the Dorset linkage. This is necessary to pick up the HUS cases that are only confirmed on serology but who may need to be reviewed in future

APPENDIX II: List of agencies at the OCT

- PHE South East: Hampshire Isle of Wight
- PHE Communications
- PHE Food Water & Environment Laboratory
- PHE Field Epidemiology Service
- PHE Gastrointestinal Infections Department
- PHE Gastrointestinal Bacterial Reference Unit, Colindale
- Public Health Dorset
- Hampshire County Council
- New Forest District Council
- Weymouth & Portland District Council
- University Hospitals Southampton
- Environment Agency
- Food Standard Agency