

Guidelines for the control of infection with Vero cytotoxin producing *Escherichia coli* (VTEC)

Subcommittee of the PHLS Advisory Committee on Gastrointestinal Infections

Summary: *Increasing numbers of cases of Vero cytotoxin producing Escherichia coli (VTEC) O157 infection, well publicised incidents, and new scientific evidence make it appropriate to produce new guidelines for their control. This document reviews the clinical and epidemiological features of VTEC O157 infection, describes the principles of microbiological investigation and laboratory safety, and presents recommendations for the prevention of spread of VTEC O157. The recommendations consider direct spread of infection from animals, foodborne spread, the institutions in which spread is more likely to occur (nursing homes, schools, and children's day nurseries), and groups at particular risk of acquiring and transmitting infection (in essence, food handlers, and those unable to maintain high standards of hygiene for themselves and their carers).*

Key words:

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guidelines
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nursing homes
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Introduction

The threat to public health of infections with Vero cytotoxin producing *Escherichia coli* (VTEC), and VTEC O157 in particular, led the PHLS to develop interim guidelines for control that were published in 1995¹. These remain largely appropriate but are expanded

and updated here to take account of the surge in interest caused by increasing numbers of reported cases, well-publicised incidents, and new scientific evidence. These guidelines are intended mainly for consultants in communicable disease control (CCDCs) and environmental health officers (EHOs), but will be relevant to workers in many areas of the investigation and control of infection. They represent good practice in the light of current knowledge, particularly of the situation in the United Kingdom (UK), and reflect more general advice available in a number of useful documents²⁻⁶. Their style is somewhat didactic, in places, for clarity and ease of use. Guidelines should help inform local professional judgement but can never be a substitute for it.

Strains of *E.coli* that produce potent cytotoxins active on Vero cells were first reported in Canada in 1977⁷. These organisms are described as Vero cytotoxin producing *E.coli* (VTEC) but have also been called Shiga-like toxin producing *E.coli* and Shiga toxin producing *E.coli*, and the term enterohaemorrhagic *E.coli* was introduced for strains that cause bloody diarrhoea^{8,9}. These guidelines use the term VTEC, VTEC O157 for strains belonging to serogroup O157, and *E.coli* O157 if tests for Vero cytotoxins have not been performed.

Clinical and epidemiological features of VTEC infections

General

E.coli O157 is the commonest VTEC responsible for human infection in the UK and the only serogroup of VTEC sought routinely by diagnostic laboratories in the UK. *E.coli* O157 and other VTEC infections cause a spectrum of illnesses, from mild non-bloody

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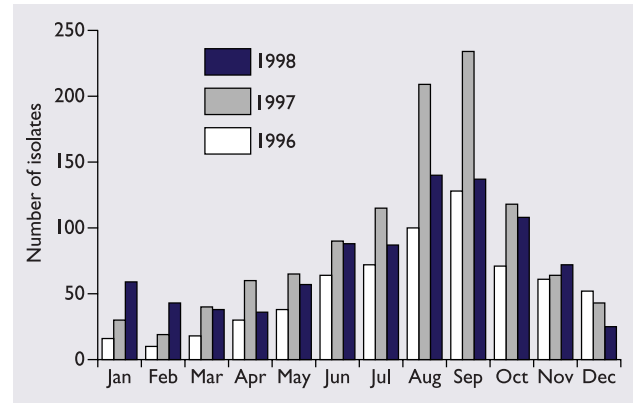
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diarrhoea to haemorrhagic colitis (a triad of severe abdominal pain, diarrhoea, and frank red blood)¹⁰. Bloody diarrhoea is seen in about 50% of VTEC O157 cases in England and Wales¹¹. The illness is usually self limiting and resolves within seven days¹². About a third of diagnosed cases are admitted to hospital¹²⁻¹⁴. Haemolytic uraemic syndrome (HUS) – in which renal failure is accompanied by microangiopathic haemolytic anaemia, thrombocytopenia, and central nervous system manifestations – complicates 2% to 7% of cases overall¹⁵. The reported case fatality rate of HUS is from 3% to 17%^{14,16,17}, and a substantial proportion of survivors suffer long term residual impairment¹⁸. HUS develops between two and 14 days (median 6) after the onset of diarrhoea¹⁹. In outbreaks of VTEC infection up to 30% of cases have developed HUS²⁰ (although less severe cases may not have been ascertained). VTEC infection may also be complicated by thrombotic thrombocytopenic purpura (TTP), particularly in adults¹⁰. Outbreaks involving elderly patients may have substantial case fatality rates – for example, 35% in a nursing home in London, Ontario in 1985²¹ and 6% in a community outbreak in Central Scotland in 1996^{2,22}. The morbidity associated with outbreaks of VTEC O157 infection in England and Wales – 31% of cases requiring hospital admission and an overall mortality rate of 3.7% between 1992 and 1996 – greatly exceeds that seen in outbreaks of infectious intestinal disease caused by other pathogens (1.6% admissions and 0.1% mortality¹⁴).

Incidence and distribution

The incidence of VTEC O157 infection in the UK has increased markedly between 1981, when it was first reported in the UK^{22a}, and 1997 when 1540 diagnosed cases were reported. Most cases in England and Wales (over 80%) appear to be sporadic²³. Diagnoses of VTEC O157 infection peak in incidence in the third quarter of the year (figure). The age specific incidence is highest in children under 5 years of age. About 10%

FIGURE Human strains of VTEC O157 in England and Wales received per month by LEP



of VTEC O157 infections are acquired abroad.

The reported incidence varies between and within countries of the UK (table). In 1997, the English regions recording the highest incidence were Trent (3.25 cases per 100 000 population), West Midlands (2.58/100 000), and South and West (2.47/100 000). The incidence for South Thames was only 1.05/100 000. The geographical variation is influenced by the occurrence of outbreaks but has not been fully explained.

Outbreaks of VTEC O157, first reported in the England and Wales in 1983, have risen in number from three in 1992 to 25 in 1997. Most are transmitted by food but animal contact (direct or indirect) and person to person spread are also important modes of transmission. Differing laboratory criteria with respect to testing faecal specimens might cause surveillance artefacts but in 1995 the Advisory Committee on the Microbiological Safety of Food (ACMSF) advised that all diarrhoeal stools should be tested for the presence of *E.coli* O157²⁴. Different policies for follow up testing might also affect the apparent incidence.

The incidence of VTEC O157 infection in Scotland is considerably higher than elsewhere in the UK, but even within Scotland the incidence varies widely. In

TABLE Geographical distribution of VTEC O157 isolated in the United Kingdom: 1992 to 1997 (rates per 100 000 population)

	1992		1993		1994		1995		1996		1997	
	No	Rate	No	Rate	No	Rate	No	Rate	No	Rate	No	Rate
Northern and Yorkshire	77	1.13	62	0.91	75	1.13	126	1.90	109	1.64	150	2.26
Trent	64	1.35	43	0.90	41	0.86	65	1.36	105	2.19	156	3.25
Anglia and Oxford	77	1.65	38	0.81	55	1.04	63	1.19	62	1.17	113	2.13
North Thames	21	0.28	25	0.34	28	0.41	43	0.63	50	0.73	94	1.37
South Thames	34	0.50	40	0.60	23	0.34	55	0.81	46	0.68	71	1.05
South and West	49	0.78	45	0.69	67	1.03	165	2.51	110	1.68	162	2.47
West Midlands	44	0.83	56	1.06	46	0.87	106	2.00	57	1.07	137	2.58
North West	72	1.12	45	0.70	50	0.76	88	1.33	85	1.29	161	2.43
England	438	0.9	354	0.73	385	0.79	711	1.45	624	1.28	1044	2.13
Wales	32	1.10	31	1.07	26	0.89	81	2.78	36	1.23	43	1.47
Scotland	115	2.25	108	2.11	217	4.23	206	4.01	475	9.25	422	8.23
Northern Ireland	1	0.06	2	0.12	3	0.18	7	0.42	14	0.85	31	1.86
Total	586		495		631		1005		1149		1540	

1997 there was a more than 12-fold difference between the health board with the highest incidence (Borders – 40.5/100 000) and the health board with the lowest incidence (Fife – 3.15/100 000). Between 1995 and 1996 the incidence in Scotland doubled, an increase largely attributable to an outbreak in Central Scotland in November and December 1996^{2,22}.

Reservoirs, sources, and modes of infection

Cattle have been shown to be a reservoir of infection in many countries²⁵⁻²⁹. In England and Wales VTEC O157 were recovered from 0.47% of beef carcasses at slaughter and from 0.83% of faeces from live cattle submitted for diagnostic purposes in 1994 and 1995^{30,31}. VTEC O157 was identified in 15.4% of faecal specimens from cattle for slaughter at one British abattoir and from 2.2% of sheep, but not from the pigs and poultry²⁹. Husbandry practices may influence the prevalence in herds^{32,33}. VTEC O157 have been isolated from live sheep³⁴, horses³⁵, farmed deer³⁶, goats³⁷, dogs³⁸, geese (Fiona Thomson-Carter, personal communication), pigs (Peter Chapman, personal communication), and wild birds (mainly gulls)³⁹. VTEC O157 can survive for over 12 months in cattle faeces and for over 20 weeks in soil samples⁴⁰.

Direct spread has been shown to occur from animals to their keepers³⁵, to farmers' children⁴¹, and to visitors to farms⁴², including 'open' farm visitor centres^{37,43,44}. Members of the households of people whose occupations bring them into contact with farm animals are at increased risk⁴¹.

Large outbreaks of VTEC O157 infection in the United States have been associated with eating undercooked beefburgers^{45,46}. Beefburgers have been linked to outbreaks^{11,47-49} and sporadic cases⁴¹ in the UK, where official advice on adequate cooking was issued in February 1991⁵⁰ and was recently reiterated⁵¹. Outbreaks have also been linked to cooked meats, presumably resulting from cross contamination^{21,41,52,53}.

Other vehicles of infection implicated in the UK are unpasteurised milk⁵⁴, cream^{55,56}, and cheese made from raw milk⁵⁷, milk following pasteurisation failure⁵⁸, yoghurt²⁰, and faecally contaminated raw vegetables⁵⁹ and water⁶⁰⁻⁶².

Outbreaks due to person to person spread by the faecal oral route have occurred in households⁶³, child daycare facilities^{64,65}, and hospitals and nursing homes²³, particularly those caring for elderly people and people with learning disability⁶⁶. Spread to staff, including nurses^{66,67}, has been described in North America and the UK. Outdoor swimming/paddling pools have been linked to outbreaks^{60,68} and sporadic cases⁴¹. Laboratory acquired infection has also been described (see *Laboratory safety* below)⁶⁹⁻⁷³.

Incubation period

The incubation period for diarrhoeal illness is one to eight days, and is usually three to four days. Incubations as long as 14 days have been reported in some outbreaks^{66,74}.

Period of excretion

Isolation from faeces is routinely successful usually only if specimens are obtained within four days of the onset of symptoms^{45,75,76}. Prolonged excretion of the organism can occur, however, notably in young children⁶⁵. In one American study of preschool childcare facilities excretion was recorded in a child 62 days after developing symptoms⁷⁷, and half of the cases were still excreting the organism 17 days after onset⁷⁷. A second study recorded shedding for a median of 29 days (range 11-57)⁷⁸.

Management of individual cases

No convincing data currently indicate that antimicrobial agents alter the natural history of VTEC infection or the duration of faecal excretion of the organism^{10,45,75,79-83}, although the isolates have usually been susceptible in vitro to the antimicrobials prescribed. Most studies have been retrospective, however, lacked adequate controls, been of small size, and have recorded dosage and duration of treatment inconsistently. Furthermore, most studies have been of co-trimoxazole, aminoglycosides, or beta-lactam antibiotics rather than the fluoroquinolones that are effective in other forms of infective enteritis. In the only prospective, randomised controlled trial five days of co-trimoxazole did not alter the clinical course or complications of VTEC infection⁸⁰, but patients in this study started antibiotic treatment relatively late (mean 7 days after the onset of diarrhoea). More recent reviews of large outbreaks of VTEC O157 infection in Japan have suggested that fosfomycin (not available in the UK) and fluoroquinolones may reduce the duration and severity of disease and the risk of progression to HUS or TTP⁸⁴⁻⁸⁶. Interpretation of these findings must be guarded as randomised controlled trials were not conducted.

A further concern about the use of antimicrobial agents in VTEC infections reflects the ability of subinhibitory concentrations of antimicrobial agents (polymyxin B, co-trimoxazole, beta-lactams, ciprofloxacin, tetracycline) in vitro to cause lysis or sub-lethal damage to VTEC with subsequent liberation of Vero cytotoxins⁸⁷⁻⁹⁰. The retrospective analyses that suggested harm might result from therapeutic use of antimicrobial agents in human infections were small, however, and difficult to interpret because various agents were used, at different stages of infection⁷⁹⁻⁸².

The general management of VTEC infections includes the correction and maintenance of fluid and electrolyte balance and regular and careful monitoring for the development of HUS. Anti-motility agents are not recommended for patients, particularly children, with bloody diarrhoea and possible VTEC infection. Retrospective analyses have suggested that these agents are a risk factor for progression of VTEC diarrhoea to HUS^{81,83,85}. Oral preparations of synthetic Vero cytotoxin receptors linked to silicon dioxide (Synsorb-Pk) which can bind Vero cytotoxin in faeces, are underway⁹¹.

Several reviews have considered the role of

conventional therapies and experimental approaches in established HUS^{19,92,93}.

Laboratory aspects

Examination of faecal specimens

All diarrhoeal faecal specimens should be examined for the presence of *E. coli* O157 regardless of the age of the patient²⁴. For routine testing, inoculate faecal specimens directly onto Sorbitol MacConkey agar (SMAC) supplemented with potassium tellurite (2.5 mg/L) and cefixime 0.05 mg/L (TC-SMAC)⁹⁴. Incubate inoculated plates at 37°C for 18h and examine for non-fermenting sorbitol colonies, which are pale yellow. Confirm suspect colonies as O157 serologically either by direct slide agglutination with anti-serum or by tests with latex agglutination reagents⁹⁵. Sorbitol fermenting VTEC O157 have been reported from Germany, Hungary, and the Czech Republic so far. All isolates of *E. coli* O157 from England, Wales, and Northern Ireland should be sent to the PHLS Laboratory of Enteric Pathogens (LEP) in Colindale for confirmation, phage typing, toxin typing, and further subtyping. In Scotland the appropriate laboratory is the Scottish *E. coli* O157 Reference Laboratory at the Department of Medical Microbiology in Aberdeen.

Isolation from faeces by direct plating may be unsuccessful if specimens are obtained four days or more after the onset of symptoms and, in particular, by the time that HUS or TTP has developed¹. Enrichment culture is of value in such circumstances and to aid the differential diagnosis of patients with suspected acute inflammatory bowel diseases and for the investigation of family contacts. Enrichment culture can increase detection of *E. coli* O157 in primary cases by about 15% and in specimens from convalescent patients and family contacts by about 30%⁹⁶. Enrichment culture, in combination with immunomagnetic separation procedures, has proved valuable in the investigation of outbreaks⁹⁶⁻⁹⁹.

Patients with suspected acute inflammatory bowel disease, patients passing bloody stools, and patients with HUS whose stools are negative for *E. coli* O157 should be investigated for infection with non-O157 VTEC. Non-O157 VTEC are usually sorbitol fermenters and therefore cannot be easily differentiated from other *E. coli* on Sorbitol MacConkey agar. For this reason, faecal specimens should be sent to LEP (Aberdeen for specimens from Scotland) for Vero cytotoxin detection and toxin gene assays. In most laboratories Vero cell tissue culture assays are not available routinely. Commercial immunoassay methods for toxin detection are now available but have not been optimised for this purpose.

Serodiagnosis

Serological diagnosis is particularly useful when investigating culture-negative cases of HUS and haemorrhagic colitis¹⁰⁰. Serum specimens collected at

least a week after the onset of symptoms can be examined for antibodies to the O157 lipopolysaccharide antigen^{100,101}. Demonstration of rising antibody titres with paired specimens or detection of antibodies to O157 LPS by immunoblotting in a single serum specimen is a good indication of recent infection. Salivary testing may also be used¹⁰². Serodiagnostic assays available at LEP and at the Scottish *E. coli* O157 Reference Laboratory may help in case ascertainment during epidemiological investigations of outbreaks¹⁰³.

Detection of VTEC O157 in food, water, environmental samples, and animals

Food products, dairy products, water, animal, and other farm-related samples may be collected during the investigation of outbreaks of *E. coli* O157 infection. In such samples *E. coli* O157 may be present in low levels, along with many contaminants, and may be sub-lethally injured. Successful detection depends on using a combination of enrichment culture and immunomagnetic separation with sub-culture on TC-SMAC. For food and water samples, methods based on those described by Eric Bolton and colleagues¹⁰⁴, established as PHLS standard methods^{94,105,106}, are appropriate. During the investigation of outbreaks spread by milk or other dairy products it is important to trace the source of the organism to the farm and to cattle or other animals. The methods developed by Peter Chapman and colleagues¹⁰⁷ using immunomagnetic separation have proved to be successful for the detection of *E. coli* O157 from cattle and farm environmental samples.

Laboratory safety

Laboratory acquired infections are uncommon, but several cases have been reported⁶⁹⁻⁷³. The Advisory Committee on Dangerous Pathogens recently reclassified Vero cytotoxin producing *E. coli* strains to Hazard Group 3¹⁰⁸, increasing the level of precautions to be taken. This is in accordance with the European Commission (EC) Directive 99/59/EEC. Low risk routine specimens may be screened in containment level 2 laboratories but high risk specimens – including those examined during outbreaks, those suspected to contain VTEC, and positive cultures for confirmation – should be handled only in level 3 facilities. Laboratories are required by law to undertake local risk assessment to ensure that high risk specimens and cultures are handled safely both in the laboratory and during transport between laboratories.

Reporting

Laboratories that identify *E. coli* O157 or VTEC infections should report cases urgently by telephone or fax to appropriate public health authorities. Clinicians should also report cases of HUS with a diarrhoeal prodrome. Public health authorities should take steps immediately to assess and prevent any risk of onward spread of the organisms.

Recommendations to prevent spread of VTEC

Note

VTEC serogroups other than O157 may also cause diarrhoea, haemorrhagic colitis, and HUS (see *Introduction*). We have no evidence that the sources and the routes of transmission differ from VTEC O157. Therefore the following measures are recommended for the control of all VTEC infections, irrespective of serogroup. Circumstances will differ for each investigation but several points should be considered in addition to a detailed food history (box 1).

Direct spread from animals – general

Those who come into contact with animals and their faeces (including slurry) through occupation or leisure activities, including living on or near farms, need to be aware that animal reservoirs of VTEC exist and that spread to man can occur readily. Such spread can be substantially prevented by adhering to well recognised hygiene practices. Hands should be washed thoroughly with soap and hot running water after animals have been handled and if soiling with animal faeces may have occurred. Hands should always be washed before eating and it is wise not to eat while attending to animals or their waste. The low infectious dose of VTEC makes soiled overalls and boots a potential hazard, particularly to children in the household. Work shoes should be kept away from main living areas and overalls should be laundered separately.

Contractors such as builders, plumbers, and electricians – who visit farms to work but do not work regularly in this environment – may need to be advised particularly. Special care should also be taken with children, particularly at the stages when they are crawling or first toddling and if they suck their thumbs or put objects in their mouths.

Direct spread from animals – farms open to the public

Open farms are an important and popular educational and leisure facility¹⁰⁹. Advice for proprietors and visitors (including teachers responsible for school parties) issued by the Health and Safety Executive⁵ and many local authorities and farming associations should be consulted. Key principles of the advice are planning and the anticipation and assessment of potential risks. Animals that may be handled should be in good health. Sufficient handwashing facilities of an adequate standard (with hot running water, soap, hand drying facilities, and cleaning and disinfection programmes) should be provided for the maximum number of visitors expected. Eating facilities should be clearly defined and situated away from areas where contact with animals, including dogs, is likely. Eating should be discouraged/prevented in other areas. Adequate signposting of attractions and facilities is very important. Signs should ideally guide visitors to handwashing areas on the way to eating areas. Staff training is crucial. Box 2 presents a list of recommendations to be considered if farm animals are thought to be the source of infection.

BOX 1 Check list for the investigation of sporadic cases

Consider these points in addition to taking a detailed food history:

- whether another household member or close contact has been suffering from diarrhoea;
- recent water supply problems or untreated water source;
- attendance of any children at a preschool nursery or similar facility;
- recent visits to premises where animals are kept, including zoos, horse riding, pet shops;
- the presence of pets in the household, particularly if the pets have access to farmland and/or farm animals;
- the occupation or hobbies of all members of the household, especially if they have close contact with farm animals or manure;
- recent contact with manure, or soil likely to contain manure, gardening;
- handling or preparing raw vegetables, particularly root vegetables with soil attached;
- whether the case bites nails or sucks thumb;
- recent foreign travel;
- recent camping;
- recent water activities, especially if head submersed and/or water swallowed (for example, swimming, canoeing, windsurfing).

Foodborne spread

Foodborne spread of VTEC disease usually results from well recognised lapses in food handling, notably failure to achieve adequate cooking temperatures^{41,45-47} or contamination of ready-to-eat products^{20,21,52-58,110,112}. VTEC O157 is susceptible to temperatures used for the pasteurisation of milk (72°C for 15 seconds)²⁴. VTEC poses an occupational risk to caterers and others who handle food, however, because of its low infective dose. VTEC's acid resistance has enabled it to cause outbreaks in North America and Australia transmitted by novel food vehicles such as unpasteurised apple juice¹¹⁰ and fermented sausages^{111,113}.

These problems may be addressed, in general terms, by the hazard analysis and critical control point (HACCP) approach^{2,114}, which makes food businesses responsible for assessing the risks in their food preparation procedures and for instituting appropriate control measures. In addition, clear and precise guidance from regulatory bodies⁶, supported by an enforcement framework for improving premises or practices that carry a risk to public health, remains important.

We recommend that the food chain is investigated thoroughly in each case for whom food may have been the vehicle of infection. If there are reasonable grounds to suspect that products from a particular herd or farm may be implicated, the Veterinary Investigation Centres should be contacted to continue investigations on-site. In particular, clusters and outbreaks of cases should be investigated fully and reports of the investigations published.

BOX 2 Procedures to consider if farm animals are believed to be the source of infection

If there is reasonable suspicion that farm animals may have been the source of VTEC O157 infection, the following procedure should be considered:

- contact the owner of the farm to discuss suspicions and to emphasise the risks posed by VTEC O157
- in farm visitor centres both the Health and Safety Executive (HSE) and the local authority may be involved in the investigations
- contact the Veterinary Investigation Centre (VIC) to discuss the possibility of carrying out an investigation, including obtaining rectal swabs and faecal specimens from animals
- in farms with dairy cattle, consider taking fore-stream milk samples from milking herd and samples from primary raw milk filters or washings, along with raw milk from the bulk milk tank
- consider taking faecal samples from fields or other areas where patient may have come into contact with animals and/or manure.

Institutions – nursing homes, schools, and children’s day nurseries – general recommendations

The importance of good hygiene practices must be stressed. We emphasise that:

- Institutions should provide toilet facilities (including toilet paper) appropriate to the age and capabilities of the people in their care. In schools and nurseries, staff should teach children to wash their hands thoroughly with soap and hot running water and to dry their hands thoroughly after using the toilets and before meals. Shared towels should be avoided as they may assist person to person spread of VTEC and other pathogens.
- Handwashing by children after using toilets and before meals should be supervised routinely in nurseries and infant schools. Supervision may also be appropriate in other settings – for example, for adults with learning difficulties. This is vital during outbreaks of VTEC infection, when children, parents, and school staff should be advised of appropriate hygiene precautions. Provide information about prevention and control measures for teachers, ancillary staff and assistants, school nurses, parents, and general practitioners.
- Formal written regimens are essential to ensure regular and frequent cleaning of toilets, cubicles, changing areas, and rooms, and for dealing with environmental contamination due to accidents. Attention should be paid to the cleaning of equipment, including children’s toys, especially during outbreaks, when suspension of play with water, sand, and clay/dough modelling material should be considered. During outbreaks especially, local authorities should ensure that schools are inspected and that there are adequate toilet facilities (as described above), and that environmental cleaning and disinfection programmes are being implemented.

Specific recommendations for the prevention of cross infection in nursing and residential homes

Residents who become ill with VTEC infection should be assessed by a medical practitioner to determine whether they require admission to hospital. If it is decided that they may stay in the nursing or residential home it is important to take adequate infection control measures to reduce the risk of cross infection. Strict isolation is very disorientating to elderly people and control measures must consider this factor.

Residents with diarrhoea should be nursed in a single room with its own washbasin. Towels and flannels should not be shared. If practicable they should have sole use of a toilet while they have diarrhoea. If their condition requires them to use a commode this should be reserved for their sole use and cleaned thoroughly with water and detergent before being returned to general service.

If available, disposable bedpans should be used and disposed of in a bedpan macerator. Non-disposable bedpans should be emptied down a toilet or a sluice, washed with detergent and hot water, and then cleaned in a bedpan washer.

All staff should wear disposable gloves and an apron when providing care to a resident with diarrhoea and when dealing with commodes and bedpans. Disposable gloves and aprons should be removed before leaving the room. Staff should wash and dry their hands thoroughly when finished.

Soiled clothing and bedlinen should be removed with care and placed in sealed plastic bags for transportation to the laundry. All soiled clothing and linen should be sluiced then machine washed at as high a temperature as the fabric can withstand.

When the resident’s diarrhoea has ceased for a period of 48h (s)he should be reminded of the importance of handwashing after visiting the toilet and may then return to normal routines within the home. The horizontal surfaces in the resident’s room should be cleaned with detergent and water. Walls need not be washed unless visibly soiled.

Visitors to residents with diarrhoea need not be restricted but the importance of infection control measures should be explained to them. Care should be exercised with regard to young children who visit a resident with profuse diarrhoea. Visitors need not wear protective clothing or gloves unless they are giving care to the resident. All visitors should wash their hands before leaving the infected resident’s room.

Specific recommendations to prevent person to person spread

Decisions about the exclusion of individuals from work or social settings can be highly dependent on specific local circumstances. Certain groups pose a particular risk of spreading infection (box 3)^{3,4}. The following guidelines are somewhat categorical, but we recognise that, in practice, this area may require the exercise of considerable judgement. In particular, household contacts of cases in group 1 (food handlers) and group 2 (care staff) may (on

occasions), if passing normal stools, be allowed to go to work without obtaining the additional reassurance of two consecutive negative faecal specimens taken at an interval of not less than 48h. All such decisions need to be justified, however, and should be made only after a careful assessment of the risk of further spread.

Group 1 (food handlers)

Food handlers with diarrhoea, whatever the cause, must be excluded from work until at least 48 h after symptoms have abated and stools have returned to normal. If they are cases of VTEC infection or household contacts of cases they should be excluded until two consecutive negative faecal specimens, taken after recovery and at least 48h apart, have been obtained. After providing two negative faecal specimens it is unlikely that an individual will still be excreting the organism, but care should always be exercised in handling unwrapped foods to be eaten raw or without further cooking.

Group 2 (care staff)

Members of this group with diarrhoea should be excluded from work until they are asymptomatic and have normal stools. If they are cases of VTEC infection or are household contacts of cases they should be excluded until two consecutive negative faecal specimens, taken after recovery and at least 48h apart, have been obtained.

Group 3 (children under 5 years)

Nurseries, play groups, or other similar groups have been the cause of significant outbreaks of VTEC (see above *Reservoir, sources, and modes of infection*^{64,65}).

General precautions There should be adequate toilet facilities with toilet paper, hot running water, soap, and hand drying facilities. Toilet and environmental cleaning and disinfection programmes should be in place.

BOX 3 Groups that pose a special risk of spreading infection

Group 1	Food handlers whose work involves touching unwrapped foods to be consumed raw or without further cooking.
Group 2	Health care, preschool nursery, or other staff who have direct contact, or contact through serving food, with highly susceptible patients or people in whom an intestinal infection would have particularly serious consequences.
Group 3	Children under 5 years of age attending nurseries, play groups, or other similar groups.
Group 4	Older children and adults who are unable to implement good standards of personal hygiene – for example those with learning disabilities or special needs; and people in circumstances where hygienic arrangements may be unreliable – for example, temporary camps housing displaced persons. Under exceptional circumstances children in infant schools may be considered to fall into this group.

Children with diarrhoea should not attend daycare or preschool nursery until they have recovered and have normal stools. Children who have diarrhoea while at a daycare facility should, if possible, be sent home. Staff in nurseries should be made aware that children in nappies pose an increased risk of transmitting of infection. Nappies should be changed in a separate area on surfaces that can be cleaned and disinfected easily. Staff must wash their hands thoroughly after changing nappies, and surfaces must be cleaned subsequently.

Children with VTEC infection Children with VTEC infection should be excluded until two consecutive negative faecal specimens, taken after recovery and at least 48h apart, have been obtained.

Household contacts Children who attend daycare or preschool nursery and who are household contacts of cases of VTEC infection may become infected at home and spread the infection to other children in the nursery. This risk will be reduced if the child household contact does not attend daycare until the household case is asymptomatic. Microbiological clearance (two consecutive negative faecal specimens at least 48h apart) of children under 5 years who are household contacts of cases is recommended to reduce the risk of outbreaks in childcare nurseries still further.

Children who are prevented from attending preschool nursery or daycare should be reviewed regularly to ensure that they do not attend other similar facilities.

Outbreaks Appropriate enquiries at the preschool nursery or daycare facility should be made to ascertain the possibility of an outbreak ('two or more linked cases'¹¹⁵). Children with recent diarrhoea should be identified and faecal specimens obtained. If an outbreak seems likely all contacts in the nursery must be screened. If an outbreak is confirmed, or very likely, the facility should be closed temporarily and undergo thorough environmental cleansing. Subsequently children may be allowed back individually when they have supplied two consecutive negative faecal specimens, taken at least 48h apart.

Group 4 (older children and adults unable to implement good personal hygiene and people in circumstances where hygiene arrangements may be unreliable)

Cases of VTEC infection and household contacts of cases should be excluded until two consecutive negative faecal specimens, taken at least 48 h apart, have been obtained. We are aware that exclusion from school or other care facilities may cause severe social problems. If exclusion is decided against, extreme care must be taken with hygiene and school staff must be advised of the potential risk and the hygiene measures necessary to avoid it.

In confirmed cases of VTEC infection we recommend that younger primary school children, whose ability to practise good personal hygiene may be limited, should be managed as preschool nursery children (above).

Household contacts of people in groups 1 to 4

The ease of spread in households means that it is wise to ensure that all cases with household contacts in groups 1 to 4 (box 3) are passing normal stools and no longer excreting the organism after clinical recovery. In the event of persistent excretion of VTEC O157, particularly in young children, both the case and household contacts may need to be kept under longer term review by appropriate public health authorities until the whole household is clear. This may involve checking on symptoms and laboratory examination of faecal specimens.

Household contacts who are not in groups 1 to 4 do not need routinely to submit faeces for examination although helpful information can be obtained if they do so. They should be advised, nevertheless, that VTEC can spread readily in households, particularly if the case is under 5 years of age⁴¹.

In a large outbreak of VTEC infection in Japan in 1997 it was shown that spread was facilitated by sharing towels or by the case helping with cooking¹¹². Spread was shown to be prevented by handwashing, particularly if disinfectant was used¹¹².

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PHLS Advisory Committee on Gastrointestinal Infections (as in January 1999)

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