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Toxigenic *Corynebacterium ulcerans* in cats

Toxigenic *Corynebacterium ulcerans* has been isolated from two domestic cats, from the same household, undergoing veterinary investigation for chronic nasal discharge, and precautionary measures have been taken by their human contacts. The organism was isolated as a pure culture from both cats by the Veterinary School in Glasgow. This prompted a more extensive microbiological investigation, with the isolates being referred for determination of toxin production to the Streptococcus and Diphtheria Reference Unit (SDRU) of the Respiratory and Systemic Infection Laboratory (RSIL) at the PHLS Central Public Health Laboratory (CPHL). The isolates were identified as toxigenic and are being genotyped. The SDRU is the PHLS reference laboratory for all corynebacteria including *C. diphtheriae* and *C. ulcerans*, and a World Health Organization collaborating centre for diphtheria.

Molecular epidemiological studies on *C. ulcerans* have demonstrated the homogeneity of human strains, but relatively few isolates from animals have been examined to determine the true genetic diversity (if any) among different species. The toxin produced by some strains of *C. ulcerans* is identical to that of *C. diphtheriae* and as a consequence human infection with toxigenic *C. ulcerans* may result in clinical diphtheria (1).

Advice was provided by RSIL and the Communicable Disease Surveillance Centre (CDSC) about the potential risk to human contacts of the cats. There are no reports in the literature of infection of small domestic animals with toxigenic *C. ulcerans*, so the implications are unclear. It would, however, seem prudent to assume that there would be a small risk of acquisition by humans from an infected domestic cat, and that this risk would be greatest in household contacts of the cats and other very close human contacts, such as the veterinary surgeon who examined them. Risk to anyone else beyond is probably negligible and would not justify further investigation. As a result of this advice throat swabs were taken from the cats' household contacts, and the veterinary staff who examined the cats, to screen for toxigenic corynebacteria. All the throat swabs from these contacts have proved to be negative. The diphtheria immunisation status of the human contacts was also checked and booster doses offered if appropriate – an incident such as this provides an opportunity to update immunisations in adults. The level of susceptibility to diphtheria among adults in the United Kingdom is known to be high, increasing with age (2).

Human infection with *C. ulcerans* is relatively rare – SDRU receives isolates from about four to six cases a year (3). Infection has classically been associated with consumption of raw milk/raw milk products and/or close association with large farm animals such as cows and horses. Although pasteurisation of milk is an important preventative measure, most cases in recent years have had no history of such exposure and questions remain about the possibility of novel reservoirs (4,5). Person-to-person transmission of *C. ulcerans* may have occasionally occurred, and for this reason guidelines recommend that the public health response to human infection with *C. ulcerans* should be the same as that for *C. diphtheriae* (6).

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Meningococcal meningitis in Africa: risk outside the meningitis belt

Meningococcal disease occurs worldwide. The disease is endemic in temperate climates causing sporadic cases or small clusters with a seasonal increase in winter or spring. Within the African meningitis belt (the area of sub-Saharan Africa from Senegal in the west, to Ethiopia in the east), epidemics normally occur in cycles, usually in the dry season. (The dry season in west Africa is usually between November and May/June, although it may vary from year-to-year – in east Africa the seasons are variable). In recent years a different pattern has been observed in sub-Saharan Africa, with epidemics flaring for two to three consecutive years.

The present African meningococcal meningitis pandemic began in 1996 with over 300,000 cases reported to the World Health Organization by the end of 1998. The most affected countries have been Cameroon, Chad, Nigeria, Burkina Faso, Mali, and Niger. In 2001, six countries within the meningitis belt experienced large epidemics: Benin, Chad, Ethiopia, Burkina Faso, Central African Republic and Niger. Benin reported 6147 cases including 265 deaths. In addition Angola, which is outside the belt, reported an outbreak between May and October.

Four countries are currently reporting outbreaks, two within the meningitis belt (Ethiopia and Burkina Faso) and two (Somalia and the Democratic Republic of Congo) outside the belt. Somalia is an eastern extension of the area normally considered as the meningitis belt, and the Democratic Republic of Congo is south of the belt. Cases in these outbreaks have been laboratory confirmed as *Neisseria meningitidis* serogroup A, which is the commonest outbreak strain in these regions. During epidemics, a smaller number of cases are usually reported to be due to serogroup C. Over the past two years, many African countries have experienced difficulty in obtaining meningococcal A + C vaccine on the commercial market during epidemics. Although cases of serogroup W135 have been identified in Africa for many years, the strain has not been implicated as contributing significantly to the epidemics. There have been small outbreaks of W135 among returning Hajj pilgrims and their close contacts over the past two years, including cases occurring towards the end of the epidemics in Burkina Faso, Central African Republic and Niger. More complete information is therefore needed on the serogroups involved in African epidemics and on the changing epidemiology of this disease.

Those advising travellers from the United Kingdom (UK), especially children travelling to Africa, should note that the meninogococcal vaccine used in the routine immunisation programme in the UK is the conjugate C vaccine. Additional vaccine containing type A will be required to provide protection for travel.

Further information

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Enteric

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General outbreaks of foodborne illness, England and Wales: laboratory reports, weeks 06-09/02*

Health authority	Organism	Place of outbreak	Month of outbreak	No. ill	Cases positive	Suspect vehicle	Evidence
Winchester	*S.* Enteritidis PT4	School	January	<1	<1	None	–
Carmarthen	*S.* Enteritidis PT4	Retailer	February	5	5	Pancakes	–
Preston	*S.* Reading	Not stated	February	3	3	None	–
Bury	*S.* Typhimurium DT12	Farm	February	5	5	Pasteurised milk	–
Lincoln	*S.* Typhimurium DT104	Hospital	February	2	2	None	–

* Preliminary data. Final information will be published in the quarterly report.
M (microbiological): identification of an organism of the same type from cases and in the suspect vehicle, or vehicle ingredient(s), or detection of toxin in faeces or food; S (statistical): a significant statistical association between consumption of the suspect vehicle(s) and being a case; D (descriptive): other evidence, usually descriptive, reported by local investigators as indicating the suspect vehicle.

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Salmonella infections (faecal specimens), England and Wales: reports to the PHLS (salmonella data set*)

Details of serotypes of the 739 salmonella infections recorded in January 2002 are given in the table below. In February 2002, 419 salmonella infections were recorded and preliminary information was received about five outbreaks.

*figures quoted from the PHLS salmonella data set are for isolates confirmed and typed by PHLS Laboratory of Enteric Pathogens (LEP)

	January 2002
Salmonella (provisional total)	739
***S.* Enteritidis** (PT4)	145
***S.* Enteritidis** (other PTs)	204
***S.* Typhimurium**	186
***S.* Virchow**	11
Other (typed)	193

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Common gastrointestinal infections, England and Wales: laboratory reports, weeks 06-09/02

	Number of reports received				Total reports	Cumulative total to	
Laboratory reports	**06/02**	**07/02**	**08/02**	**09/02**	**06-09/02**	**09/02**	**09/01**
Campylobacter	473	469	182	611	**1735**	**5497**	**8117**
Escherichia coli* O157	4	1	1	3	**9**	**23**	**54**
Salmonella	133	87	121	131	**474**	**1306**	**1215**
Shigella sonnei	3	6	4	5	**18**	**79**	**134**
Rotavirus	215	195	96	264	**770**	**2239**	**2355**
SRSV	106	41	16	82	**245**	**577**	**291**
Cryptosporidium	37	28	13	28	**106**	**445**	**537**
Giardia	42	45	26	50	**163**	**507**	**588**

* Vero cytotoxin producing isolates (data from LEP)

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Salmonella serotypes recorded in the PHLS salmonella data set: October to December 2001

All serotypes recorded in the PHLS salmonella data set in the fourth quarter of 2001 are listed below. There were more than ten reports of 22 serotypes, two to ten reports of 51 serotypes, and one report of 49 serotypes.

	October to December 2001 (provisional)
S. Agona	27
S. Anatum	13
S. Blockley	22
S. Braenderup	44
S. Brandenburg	21
S. Bredeney	13
S. Enteritidis	2917
S. Hadar	47
S. Heidelberg	13
S. Infantis	39

S. Java	33
S. Kottbus	11
S. Livingstone	13
S. Mbandaka	18
S. Montevideo	11
S. Newport	38
S. Oranienburg	11
S. Senftenberg	16
S. Stanley	16
S. Typhimurium	524
S. Unnamed	41
S. Virchow	85

Two to ten reports of each of the following serotypes were received:

S. Adelaide	5
S. Agama	8
S. Ajiobo	3
S. Alachua	2
S. Albany	6
S. Altona	2
S. Arechavaleta	2
S. Arizonae	4
S. Bareilly	6
S. Bovis-morbificans	6
S. Cerro	3
S. Chester	7
S. Coeln	3
S. Colindale	4
S. Concord	2
S. Corvallis	3
S. Derby	2
S. Drypool	3
S. Dublin	4
S. Duisburg	2
S. Durham	3
S. Give	3
S. Gold-coast	4
S. Grumpensis	3
S. Havana	4
S. Hull	2
S. Hvittingfoss	2
S. Indiana	5
S. Kedougou	7
S. Kentucky	5
S. Litchfield	3
S. London	3

S. Manhattan	2
S. Mikawasima	7
S. Mississippi	2
S. Muenchen	9
S. Nima	4
S. Ohio	6
S. Oslo	6
S. Panama	7
S. Parera	2
S. Pomona	2
S. Poona	4
S. Rissen	3
S. Saint-paul	9
S. Schwarzengrund	2
S. Stanleyville	3
S. Tel-el-kebir	2
S. Tennessee	3
S. Thompson	4
S. Weltevreden	2

One report of each of the following serotypes were received

S. Abony	*S.* Falkensee	*S.* Mesbit	*S.* Shubra
S. Adane	*S.* Fluntern	*S.* Minnesota	*S.* Stourbridge
S. Agbeni	*S.* Galiema	*S.* Muenster	*S.* Tarshyne
S. Ahuza	*S.* Godesberg	*S.* Newington	*S.* Tel- aviv
S. Angoda	*S.* Haifa	*S.* Offa	*S.* Teshie
S. Bardo	*S.* Halle	*S.* Onderstepoort	*S.* Vitkin
S. Bousso	*S.* Idikan	*S.* Oxford	*S.* Welikade
S. Carmel	*S.* Javiana	*S.* Reading	*S.* Wernigerode
S. Chailey	*S.* Kibi	*S.* Richmond	*S.* Zaiman
S. Chandans	*S.* Kintambo	*S.* Roan	*S.* Zanzibar
S. Curacao	*S.* Kisangani	*S.* Rubislaw	–
S. Degania	*S.* Lexington	*S.* Saarbruecken	–
S. Emek	*S.* Linguere	*S.* San-diego	–

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General outbreaks of foodborne illness in humans, England and Wales: quarterly report

Table 1 Final information on general outbreaks of foodborne illness: July to September 2001

Local Authority	Organism	Place of outbreak	No. ill	Cases positive	Suspect vehicle	Evidence

Powys	*S.* Enteritidis PT4	Private house	16	13	Sponge cake with dairy cream	S, D
Corby	*E. coli* O157 PT21/28	Private house	5	4	Beefburger	M
North Tyneside	Campylobacter	Restaurant	3	1	Miscellaneous foods	D
Enfield	*S.* Enteritidis PT4	Restaurant	15	6	Crispy duck, seaweed	M, D
Stafford	*S.* Enteritidis PT4	Restaurant	55	23	Haddock	S
Salford	*S.* Enteritidis PT8	Festival	6	6	None	
Wycombe	*S.* Enteritidis PT4	Public house	16	13	None	-
St Edmundsbury	*S.* Enteritidis PT4	Residential home	5	4	Soft fried eggs	D
Tameside	*S.* typhimurium DT104	Retailer	16	13	Cooked turkey, chicken, ham, beef	M, D
Test Valley	*S.* Enteritidis PT5a	Restaurant	14	14	None	-
Hertfordshire	*S.* Enteritidis PT1	Restaurant	14	14	Potato salad and egg mayonnaise	M
East Devon	*S.* Enteritidis PT4	Hotel	41	41	None	-
Wandsworth	*S.* Enteritidis PT6	Care home	8	8	Macaroni Cheese (made with eggs)	D
Birmingham	*S.* Infantis	Public house	34	18	Chicken drumsticks	M, S
Cardiff	*S.* Virchow PT8	Restaurant	9	8	Salad	D
Hart	*S.* Enteritidis PT6	Private house	51	15	Salmon, Salads, bacon rolls, chocolate souffle	M, S
Newcastle	*S.* Enteritidis PT4	Nursing home	14	12	None	-
Merton & Sutton	*S.* Enteritidis PT 4	Nursery	2	2	None	-
Swansea	*S.* Enteritidis PT4	Café	14	5	Ham sandwich, meat pasty	S
Brighton & Hove	*S.* Enteritidis PT5c	Café	8	4	Egg Mayonnaise, Chicken & mayonnaise with sweetcorn	M
Walsall	*S.* Enteritidis PT4	Restaurant	3	3	Chinese take-away	M
Wolverhampton	*E. coli* O157 PT21/28	Care home	15	9	Beef stew	S
South Somerset	*S.* Enteritidis PT6	Private house	22	8	Tiramisu	D
Torbay	*S.* Enteritidis PT8	Hotel	22	22	None	-
Hillingdon	*S.* Enteritidis PT6	Public house	15	11	None	-
Camden & Islington	*S.* Enteritidis PT5c	Retailer	11	7	Egg mayonnaise bagels	M, D
Birmingham	*E. coli* O157 PT21/28	Restaurant	5	5	-	-
Bournemouth BC	Unknown	Restaurant	6	0	Mussels	D

Rugby BC	Unknown	Public house	8	0	Tuna	-

Table 2 Outbreaks of salmonella infection: October to December 2001

Outbreak type	*S.* Enteritidis		*S.* Typhimurium	Other serotypes	Total
	Phage type 4	Other phage types			
General	2	7	4	2	15
Household	31	54	11	11	107
Acquired abroad	7	6	-	5	18
Total	40	67	15	18	140

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Rotavirus in England and Wales

A total of 16,345 cases of rotavirus were reported to the PHLS Communicable Disease Surveillance Centre in 2001 compared with 16,528 in 2000 and 14,965 in 1999 (figure 1). The number of reports received in the first ten weeks of 2002 (3138 cases) is 7% higher than in the first ten weeks of 2001 (2,914 cases).

Children aged less than 4 years accounted for 86% (14,012) of cases in 2001 and 84% (13 861) in 2000. Cases are evenly distributed across the regions (table).

Figure 1 Laboratory reports of rotavirus in England and Wales: 1988 to 2001

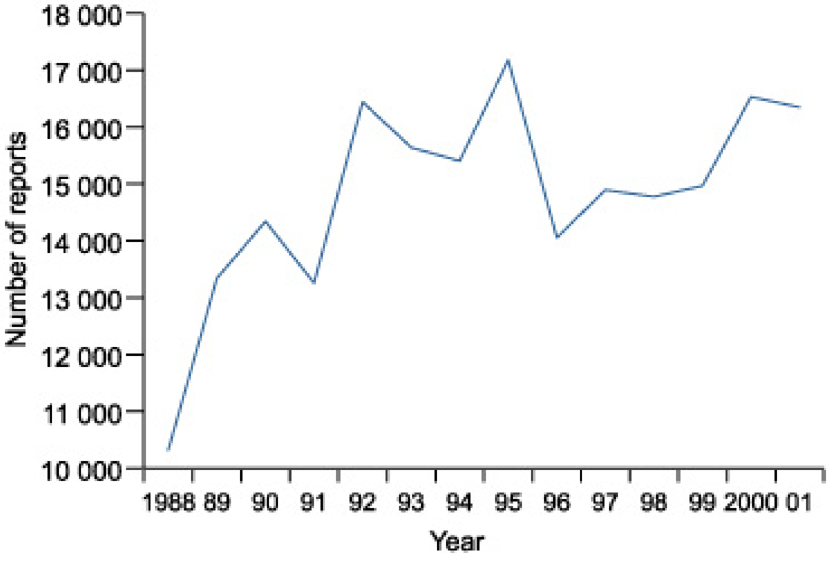

Table Regional distribution of rotavirus cases in England and Wales, 2001

Region	Number of cases
Northern & Yorkshire	2929
Trent	1656
Eastern	1896
London	1193
South East	1979
South West	1882

West Midlands	2387
North West	1020
Wales	1403
Total	**16345**

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Surveillance of waterborne disease and water quality: July to December 2001

This report is part of a twice-yearly series on the surveillance of waterborne disease and water quality. The PHLS uses a framework for assessing the strength of association between human illness and water exposure in outbreak investigations according to microbiology results from cases, microbiological examination of water samples and descriptive and analytical epidemiology (1). The data on microbiological quality of private water supplies and bathing pools were collected from Bristol, Chelmsford, Chester, Norwich, Nottingham, Preston, and Reading Public Health Laboratories, and the Wessex Environmental Microbiological Services (WEMS).

This report also contains an update on enteroviruses in water, with data on the virological contamination of wastewaters provided by the Environmental Virology Unit at Reading.

Water-related outbreaks of infection

Four water-related outbreaks of infection were reported to PHLS Communicable Disease Surveillance Centre (CDSC) between July and December 2001 (table 1).

Table 1 Outbreaks and incidents of association between human disease and water in England and Wales: July to December 2001

Outbreak reference number	Organism	New NHS Region	Month	Total affected	Positive	Association*
01/440	*Cryptosporidium*	South West	August	14	6	Possible
Cases exposed to stream water flowing through a beach. High coliform count in water sample taken. Effluent from water treatment plant enters stream. Also problem with illegal tipping into sewer, possibly from campsite chemical toilets.						
01/104	VT-producing *Escherichia coli* O157 PT 21/28	Northern and Yorkshire	October	3	4**	Strong
Residential outdoor pursuits centre supplied by a private well water supply. Pathogen isolated from cases and from private water supply. Intermittent contamination of well water suspected. Appropriate control measures and engineering improvements made to water system.						
N01/01	*Pseudomonas aeruginosa*	London	October	>50	2	Strong
Pseudomonas folliculitis contracted at spa pool leisure facility. Pathogen detected in water and from cases. Evidence of pool operating system failure prior to onset of illness. Pool closed and treated.						
01/0528	Cryptosporidium	South West	October and November	3	3	Possible
Leisure centre swimming pool. Pathogen detected in cases, but not in water.						

CDR weekly 1996; **6**(8): 65-68. **one of whom was asymptomatic

An incident involving recreational exposure to stream water flowing through a beach in south west England occurred in August. There were 14 cases of gastroenteritis, five of whom were children under 15 years of age. All had dates of onset of illness in August 2001. Five cases tested were confirmed as having *Cryptosporidium* infection. A number of possible sources of contamination were identified, including treated effluent from a water treatment works entering the stream, and illegal tipping of waste from campsite chemical toilets into a sewer. *Cryptosporidium* oocysts were not detected in the stream, although there were high faecal coliform and faecal streptococci counts.

Three symptomatic cases of *Escherichia coli* O157 infection in children aged under 15 years occurred following a residential weekend at an outdoor pursuit centre in the Northern and Yorkshire region in October 2001. The index case was admitted to hospital with bloody diarrhoea. All cases made a full recovery. Infection was microbiologically linked to consumption of well water from a private water supply. The supply to the centre was untreated except for water supplying the kitchen and washing up areas, which received minimal treatment by ultra-violet (UV) lamps. The UV lamps were supposed to be replaced annually but replacement was overdue by a month. Intermittent contamination of the well water by animal faeces or animal carcasses was thought to have occurred. Verocytotoxin-producing *E. coli* O157 PT 21/28 was isolated from the three cases, an asymptomatic child, and from samples of water from the well and kitchen tap. The isolates were microbiologically indistinguishable by pulsed field gel electrophoresis. The centre was temporarily closed, and a full engineering review of the water supply was made including arrangements for treatment, maintenance and regular monitoring. Advice was given to the centre's staff on the potential dangers of private water supplies.

Over 50 people were identified as having suffered from pseudomonas folliculutis following exposure to spa pool water at a leisure facility in London. Dates of onset were in October 2001. *P. aeruginosa* was isolated from the skin swabs of three cases and from samples of spa pool water. The spa pool had only recently been installed. The pool was closed and reopened following enhanced disinfection and improvement of the operating regime.

There was a possible association of three cases of cryptosporidiosis, with onset dates in October and November 2001, with a leisure centre swimming pool in South West region. Two cases were under 15 years of age. Although all three cases had also had contact with animals prior to illness, all isolates were genotype 1 (human type) suggesting a human reservoir. No indicator organisms were detected in water samples taken from the pool, and testing for *Cryptosporidium* oocysts was not undertaken. Advice on improved operation and maintenance was given.

Surveillance of water quality

Private water supplies

A private water supply is any water supply that is not provided by a statutorily appointed water company. Private water supplies are divided into category 1 supplies, which are used wholly for domestic purposes and category 2 supplies, which include supplies to premises such as hospitals, residential homes, holiday sites and food preparation premises (2). These categories are further sub-divided into classes depending on the volume of water or number of people supplied. About 1% of the population of England and Wales have private water supplies to their homes. Many more people may, however, be exposed transiently to private water supplies, particularly category 2 supplies when used in hospitals, holiday sites, and for food preparation. There is a statutory obligation for local authorities to monitor private water supplies and the specified frequency varies between two samples per month to one sample every five years, depending on the class of supply. Local authorities also have powers to secure improvements to private water supplies or connection to a mains supply.

Results of microbiological analysis of samples from various classes of private water supply for July to December 2001 are presented (table 2). The presence of *E. coli* indicates human or animal faecal-contamination and urgent action should be taken to eradicate the contamination. *E. coli* was isolated from 20% (281/1378) of supplies examined. In previous years the microbiological quality of private water supplies has been better in the January to June period compared with July to December (table 3) (3). For the first time since surveillance began in 1995 the microbiological quality of private water supplies has improved compared to previous years (table 3). The 1378 supplies examined yielded a total of 2471 samples, 14% (337) of which were positive for *E. coli*. This is also an improvement compared with the same period last year when more than 22% of samples were positive for *E. coli*.

Table 2 Routine, including regulatory, tests of private water supplies: July to December 2001

	Number of supplies (samples)						
	Total supplies	Category 1:domestic			Category 2: others*		Category unknown
		Class F [single dwelling]	Class D and E [<=100 people]	Class A to C [>100 people]	Class 3 to 5 [daily volume <=100m^3]	Class 1 and 2 [daily volume >100m^3]	
Number tested	1378 (2471)	120 (150)	97 (134)	5 (28)	181 (218)	21 (353)	954 (1588)
Number positive for *E. coli*	281 (337)	41 (42)	40 (49)	– (–)	57 (60)	3 (8)	140 (178)
Total coliforms (including *E. coli*)	608 (779)	71 (78)	68 (80)	2 (6)	85 (90)	9 (21)	373 (504)

*Supplies to premises such as hospitals, residential homes, holiday sites and food preparation premises.

Table 3 Percentage of private water supplies positive for *Escherichia coli*: January 1995 to December 2001

Year	**Percentage of private water supplies positive for *E. coli***	
	Jan-June	**July-Dec**
1995	19	42
1996	18	40
1997	13	31
1998	23	37
1999	20	29
2000	17	28
2001	13	20

The presence of coliforms other than *E. coli* in water does not specifically indicate faecal contamination, as they are natural inhabitants of many aquatic environments. They are, however, indicators of the efficiency of water treatment, and current legislation states that they should not be present in drinking water. Coliforms (including *E. coli*) were isolated from 44% (608/1378) of supplies, from which 779 samples out of a total of 2471 (32%) were positive. In contrast to the reduction in *E. coli* levels, coliform levels do not show a substantial reduction when compared with the same period last year when coliforms were isolated from 46% of supplies and 38% of samples.

The percentage of samples positive for *E. coli* from category 1 supplies (29%) was greater than samples from category 2 supplies (12%). This is in contrast to the same period in the previous two years when the percentage of samples positive for *E. coli* from both domestic and commercial supplies have been at around 40%.

The results of statutory testing of public water supplies in England and Wales have been compiled and published annually by the Drinking Water Inspectorate since 1992. These reports have shown that the microbiological quality of mains water supplied by the twenty-seven water companies has been continually improving. In 2000, 0.04% and 0.56% of the total samples from water supply zones were positive for *E. coli* and coliforms, respectively (4). Although private water supplies are generally of a poor microbiological quality they have shown an improvement for the first time since PHLS surveillance began in 1995.

Pool waters

Guidelines for pool water quality have been formulated and state that *E. coli* should be absent from 100mL samples from all pools and that *P. aeruginosa* should be absent from 100mL samples from spa and hydrotherapy pools (5,6). Coliforms should also be absent from 100mL. A count of <10/100mL coliforms is, however, acceptable, provided that they are not in consecutive samples, total viable count (TVC) after 24 hours incubation at 37°C is less than ten colony forming units per mL (CFU/mL), and the residual disinfection and pH are within the recommended range. A raised TVC may result from heavy pool use and microbial proliferation in the pool water, and indicates possible discrepancies in disinfection.

Results from the microbiological analysis of 3395 pool water samples from 1028 pools (73 hydrotherapy, 188 spa and 767 swimming pools) are shown in table 4. The swimming pools were in municipal, leisure and sports centres and hotels. Pools on a single site, such as learner, diving, and main pools, were counted separately. As in previous years, there was a low rate of *E. coli* isolation, with 3% (28/1028) of pools positive. The 28 positive pools yielded 37 positive samples. Coliforms (including *E. coli*) were isolated from 104 pools, which yielded 135 positive samples.

Table 4 Routine (including regulatory) tests of pool waters: July to December 2001

Organisms	**Total pools (samples)**	**Hydrotherapy pools (samples)**	**Spa pools (samples)**	**Swimming pools (samples)**
Coliform organisms				
Number tested	1028 (3395)	73 (453)	188 (504)	767 (2438)
Number positive for *E. coli*	28 (37)	2 (2)	6 (10)	20 (25)
Number positive for Total coliforms (including *E. coli*)	104 (135)	7 (9)	22 (28)	75 (98)
*Pseudomonas aeruginosa**				
Number tested	843 (2862)	73 (453)	188 (500)	582 (1909)
Number positive	228 (443)	19 (23)	64 (109)	145 (311)

* Not always tested for routinely

The presence of *P. aeruginosa* in hydrotherapy and spa pools is a potential health risk, as outbreaks of disease caused by *P. aeruginosa* have been associated with them. In conventional pools, *P. aeruginosa* is an optional quality parameter and is not always looked for. *P. aeruginosa* was isolated from 25% (145/582) of swimming pools in which it was looked for, 19/73 hydrotherapy pools and 64/188 spa pools (table 4). TVC of greater than 100 CFU/mL were found in 6% (198/ 3395) and these 198 samples were obtained from 122 pools (table 5). The microbiological results for pool waters are similar to those found in previous years.

Table 5 Highest total viable counts (CFU/mL) in all pool waters

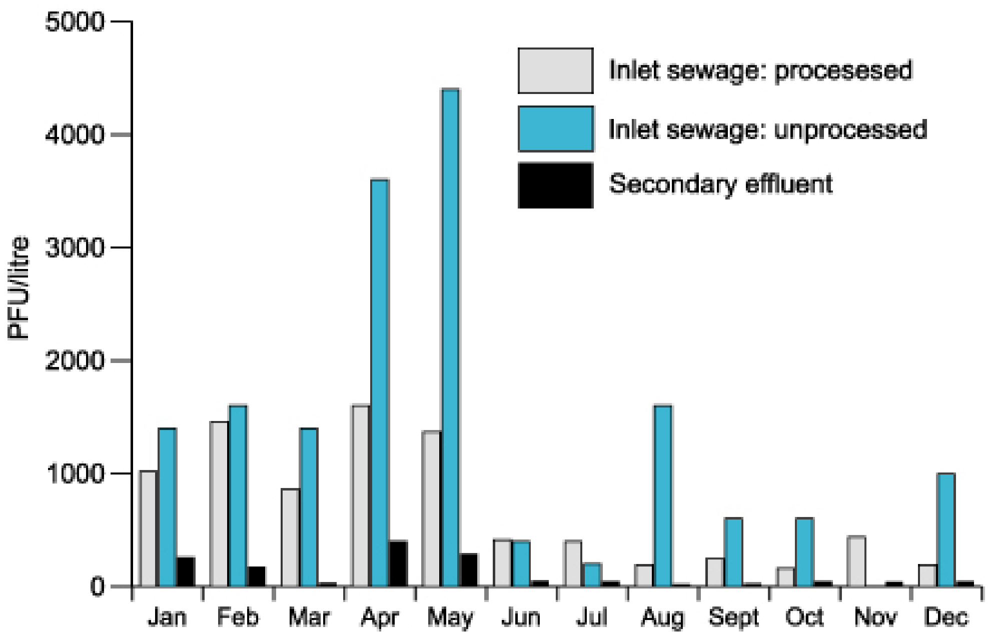
Total viable count	**Pool waters**	**Pools samples**
0 to 10	733	2805
11 to 100	173	392
>100	122	198
Total	**1028**	**3395**

Enteroviruses in water

Enteroviruses cause common infections, which may be a flu-like illness or occasionally meningitis, but the majority are without obvious symptoms. All ages may be infected and as the viruses replicate in the gastrointestinal tract they are present in sewage throughout the year. This, combined with the relative ease with which enteroviruses may be cultured in the laboratory, has made these viruses the most practical and widely used marker of human faecal viruses in the environment. The enterovirus parameter in the current European Union (EU) bathing water directive is an example of this. For monitoring purposes, a ten litre sample of recreational water is processed, usually by filtration, to a final volume of 5 to 10mL. A common method used to concentrate enteroviruses from 100mL of crude sewage is by protein precipitation to a volume of 10mL. One ml aliquots of unprocessed crude sewage may be assayed directly in the detection assay. Enteroviruses are detected and enumerated using BGM cells (monkey cells) in a suspended cell plaque assay.

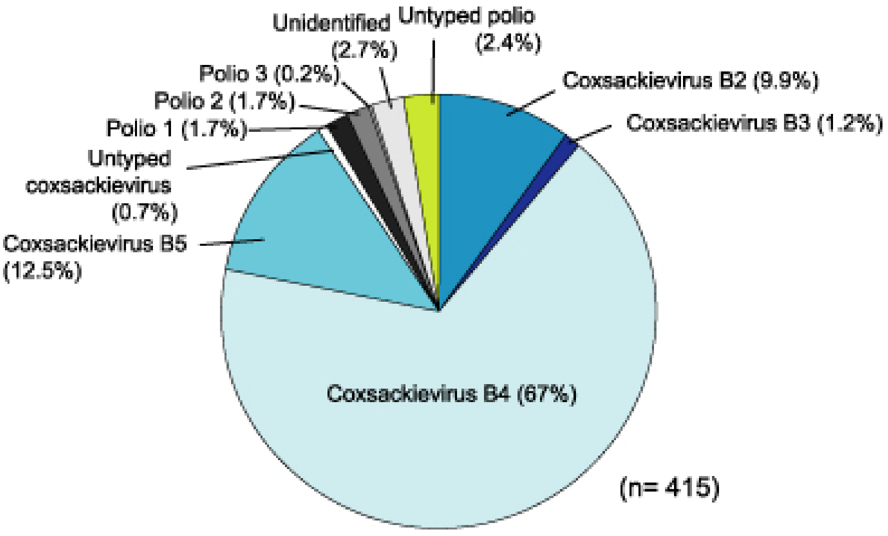
Figure 1 shows the counts of plaque forming units (pfu) found in crude sewage and secondary effluent samples collected monthly during 2001 from a single inland sewage treatment works. Each pfu is equivalent to a single infectious virus unit. More than 2500 enterovirus plaques were detected of which nearly 400 were serotyped. The highest numbers of viruses were found during the early part of the year with the usual marked increase during the autumn not seen. In most months the unprocessed crude sample contained a larger number of detectable enteroviruses than the processed sewage sample, suggesting loss of virus during the concentration steps. Since lower numbers of viruses were expected in fully treated secondary effluent, one litre volumes of effluent were processed by protein precipitation. As collection of crude and effluent samples was done at the same time, there was no direct relationship between the two. No relationship between the numbers found in the two types of sample was therefore expected or demonstrated.

Figure 1 Infectious enterovirus isolated from a sewage treatment works in 2001



The viral plaques were confirmed by passage to fresh BGM cells and the virus serotype was identified by immunofluorescence using monoclonal antibodies. Figure 2 shows the proportion of enterovirus serotypes identified in 303 samples of sewage and freshwater collected in 2001. Coxsackievirus B4 was the most common serotype identified throughout 2001. During the autumn months coxsackievirus B2 and B5 were found in similar numbers to that of B4. Coxsackievirus B5 is the most neurotropic of these strains and most commonly reported associated with clinical illness.

Figure 2 Enterovirus typing: 2001 percentage distributions



Low numbers of poliovirus were detected throughout the year and five poliovirus isolates were further characterised by RT-PCR (reverse transcriptase-polymerase chain reaction) and restriction enzyme analysis. All isolates were vaccine-like and this information has been used to support the United Kingdom surveillance for the World Health Organization poliomyelitis eradication programme.

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