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UK 2013

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Preface

This annual report on zoonoses in the United Kingdom (UK) includes a summary of reported cases of zoonotic infection in humans and animals during 2013. The data have been compiled from statutory notifiable or reportable disease reports, national scanning surveillance systems, national laboratory reporting, control programmes, research programmes and from data submitted to the European Community via the Trends and Sources Report under the Zoonoses Directive 2003/99, by agencies contributing to the Report.

This report is a collaborative publication produced by:

- Public Health England (PHE): lead organisation for this year's report
- Department for Environment, Food and Rural Affairs (Defra)
- Food Standards Agency (FSA)
- Department of Health (DH)
- Animal Health and Veterinary Laboratories Agency (AHVLA) (from 1st October 2014 re-named Animal and Plant Health Agency (APHA)
- Health Protection Scotland (HPS)
- Scottish Government (SG)
- Agri Food and Biosciences Institute (AFBI)
- Scotland's Rural College (SRUC)
- Public Health Agency (PHA), Northern Ireland
- Department of Agriculture and Rural Development (DARD), Northern Ireland
- Public Health Wales (PHW)
- Welsh Government (WG)

Occasional corrections and amendments to the data, many of which are derived from dynamic databases, may occur following publication; these will result in minor changes to subsequent annual reports.

We would very much appreciate comments and suggestions for items in future reports. Please send these to ZoonosesReport@Defra.gsi.gov.uk.


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Executive Summary

This year's UK Zoonoses report continues to include feature articles which highlight human and animal incidents and issues of public health significance which occurred during 2013, as well as a summary of reported cases of zoonotic infection in humans and animals. As usual, the report highlights significant trends in a number of infections, and whilst these will continue to be monitored, they also emphasise the need for continued surveillance and collaboration between veterinary and human health practitioners. Interpreting trends in veterinary data in particular needs to be done with care, as the number of submissions to the various Government laboratories involved in supplying data for this report may vary from year to year for a number of reasons. These may include weather conditions, concerns about disease or financial factors, and these are likely to affect both the various livestock sectors and types of submissions differently.

Campylobacter

Campylobacter continues to be the most commonly reported human gastrointestinal pathogen. After a general upward trend over the past 10 years, the number of laboratory reports of campylobacter fell across the UK during 2013. There were 66,575 reports in the UK, a decrease of 8% from 2012. Although reports fell by 9% and 3% in England and Wales and in Scotland respectively, they increased by 12% in Northern Ireland.

There were 19 foodborne outbreaks of campylobacteriosis reported in 2013, which is a significant increase on the eight reported in 2012. Fourteen outbreaks were associated with the consumption of poultry, of which nine were chicken liver parfait.

The Food Standards Agency is leading the campaign to bring together the whole food chain to tackle campylobacter, from farm to fork.

A survey of broilers at slaughter in 2013 showed a high level of contamination. This was part of a structured official monitoring programme based on Decision 2007/516/EC, and found that of 473 neck skin samples tested, 78 were positive for *C. coli* and 298 positive for *C. jejuni* and of 125 caecal contents samples which were tested, 34 were positive for *C. coli* and 66 for *C. jejuni.*

There was a significant increase in the incidence of campylobacter-associated abortion in sheep in GB, with almost twice as many cases diagnosed in 2013 compared to 2012, despite comparable submission levels. Incidences of campylobacter fetopathy recorded by AHPA appear to follow a cyclical pattern, with significant rises in infection rates observed every three years. This is thought to be due to immunity waxing and waning in the national flock. Campylobacter-associated abortion in animals is not believed to be associated with foodborne infection of people, but can result in occupationally-acquired illness.

Cryptosporidiosis

Following the large increase in the number of human cases of cryptosporidiosis reported in the UK in 2012, there were 4,111 cases reported in 2013, which represented a 38% decrease. This decrease was observed across the UK.

However, there were 21 outbreaks of cryptosporidium reported in England and Wales, compared to 14 reported in 2012. Only one of these was foodborne with transmission being associated with public drinking water. The most common outbreak settings were swimming pools and petting/open farms.

Clinical cryptosporidiosis remains relatively common in animals in the UK, with 1,870 diagnoses of clinical animal infection with cryptosporidia recorded by UK Government veterinary laboratories. Although the majority of these were in cattle (1,728 diagnoses) and sheep (126) in the UK, there were additional diagnoses in a wide range of other species in GB including goats (8), alpacas (3), hedgehogs (2), one pig, one bird and one reindeer.

There was a significant increase in the incidence of cryptosporidiosis in both calves and lambs in 2013, particularly in England and Wales. One possible explanation for this is an extended winter housing period as turn out to grazing was delayed due to poor spring grass growth in many areas.

Hepatitis E

In England and Wales the majority of hepatitis E virus (HEV) cases in people are non-travel related and present as sporadic disease. Since 2010, the numbers of confirmed hepatitis E cases have increased year on year with 691 cases reported in 2013, a 19% increase since 2012. The numbers of travel-related cases have remained relatively stable over the years. Therefore the substantial increase observed since 2010 is due to an increase in indigenously acquired cases, with 69% of cases assessed as non-travel associated or indigenous.

The substantial increase in indigenous cases in England and Wales appears to be due to the emergence of a different HEV phylotype (genotype 3, clade 2), not commonly observed in England and Wales prior to 2010. Thus there are currently two concurrent outbreaks contributing to the burden of disease nationally: clade 1 virus, which has been the cause of hepatitis E cases since 2003; and clade 2 virus which emerged more recently and accounts for around two thirds of cases in 2013.

The multi-partner collaborative pig abattoir survey, which was undertaken to better understand the possible role of infection in pigs on human disease incidence, showed that 93% of 640 pigs tested were seropositive at slaughter, with 6% actively infected with HEV, as shown by the presence of detectable plasma HEV RNA. The viral load was sufficient to identify the virus from a small number of pigs as genotype 3, clade 1. This is not the clade of virus associated with the substantial increase in indigenous cases in people since 2010 and so the cause is unlikely to be meat from UK pigs.

Bovine tuberculosis (bTB)

There were 29 human cases of *M. bovis* reported during 2013, down from 39 cases the previous year. The majority of these cases were born in the UK, and only a small minority (four people) had evidence of recent exposure, making reactivation of latent disease the most likely cause of TB in this group.

Of those with recent exposure, two cases are explained by an unusual outbreak of bTB in cats with cat-to-human transmission, which occurred during the year and this is reported in the feature articles.

During 2013, there were 79,287 cattle herds and 8.18 million cattle registered in GB and a total of 4,821 new bTB incidents were recorded. This was a 6% decrease compared to 2012.

Post-mortem evidence of bTB (characteristic lesions in test reactors and/or culture of *M. bovis*) was detected in 3,255 (68%) of the new incidents for GB. A total of 32,620 cattle in GB were slaughtered as tuberculin skin or interferon-gamma (blood) test reactors in 2013, a decrease of 14% from 2012.

Scotland, which was declared an officially bTB free region of the UK by the European Commission in 2009, also saw a fall in the number of new bTB incidents (28 in 2013, compared to 53 in 2012).

In Northern Ireland there were 24,098 cattle herds with 1.59 million cattle registered during 2013. A decrease in infection was also seen with 1,479 new TB reactor herds and 8,271 reactor animals (compared to 1,695 and 10,896 respectively in 2012).

Vero cytotoxin-producing *Escherichia coli* (VTEC)

In 2013, there were 1,017 laboratory confirmed cases of VTEC O157 reported in humans in the UK (765 in England, 28 in Wales, 167 in Scotland and 57 in Northern Ireland), an 16% decrease on the 1,217 cases reported in 2012.

The burden of disease due to serogroups other than O157 (non-O157 VTEC) in the UK is underestimated because the diagnosis of non-O157 VTEC is mainly dependent on the use of PCR based methods to detect the genes coding for the production of vero cytotoxins. Such diagnostic tests are not routinely used by most front line laboratories. However, during 2013, three hospital laboratories in England introduced a commercial PCR assay for the detection of gastrointestinal pathogens which led to a significant increase in the detection of non-O157 VTEC. In 2013 there were 151 laboratory confirmed cases of non-O157 VTEC confirmed in the UK, as compared to 60 in 2012.

Eight outbreaks of VTEC in England affecting a total of 54 cases were reported in 2013, and included two foodborne outbreaks, both linked to the consumption of watercress with

affected cases in England, Wales and Scotland. All eight outbreaks involved VTEC O157, down from 17 outbreaks of VTEC in England and Wales affecting a total of 103 cases in 2012.

Introduction

Zoonoses are defined by the World Health Organisation as “diseases and infections which are transmitted naturally between vertebrate animals and man”. Transmission may occur by a number of routes, from indirect contact through food or drink to direct contact through occupational exposure on farms, from pets or through leisure pursuits. Data on zoonotic diseases in human and animal populations are sourced from national surveillance schemes for outbreaks of infectious disease and laboratory-confirmed infections, enhanced surveillance schemes for specific zoonoses and notification of infectious diseases.

Notification and Reporting of Zoonotic Diseases

Some (but not all) zoonotic infections are statutorily notifiable or reportable under veterinary and/or human health legislation. A list of these can be seen in Appendices 1 and 2. Relevant animal legislation includes: the Animal Health Act 1981 and its subsequent amendments; the Zoonoses Order 1989; the Specified Animal Pathogens (Amendment) (England) Order 2008; the European Communities Act 1972 and the Transmissible Spongiform Encephalopathies (England) Regulations 2010. The Devolved Governments have equivalent legislation. Relevant human legislation includes the Public Health (Control of Disease) Act 1984 and the Public Health (Infectious Diseases) Regulations 1988. The Public Health (Control of Disease) Act 1984 was amended in 2010 to include a revised list of notifiable diseases, and for the first time a list of notifiable organisms (this revised list of notifiable diseases and organisms does not apply to Northern Ireland). In addition to the public health legislation, employers and the self-employed are required to report work-related incidents and diseases (including specified infections) to the Health and Safety Executive (HSE) under the Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations (RIDDOR), 1995 (www.hse.gov.uk/riddor/).

The significance of notification differs in human and veterinary contexts. In animals, there is an obligation on any person having in their possession, or under their charge, an animal affected or suspected of having a notifiable disease (as listed in Appendix 1) to immediately notify the local Animal and Plant Health Agency (APHA) Field Office in England, Wales and Scotland (http://www.defra.gov.uk/ahvla-en/) or the local Divisional Veterinary Office in Northern Ireland. Procedures for notification and control of specified diseases are outlined in the legislation detailed above.

For human cases, registered medical practitioners in England and Wales have a statutory duty to notify the proper officer of the local authority (usually the Consultant in Communicable Disease Control (CCDC) of Public Health England (PHE)[1] in England or Public Health Wales (PHW) immediately on suspected clinical diagnosis of a notifiable

[1] Formerly the Health Protection Agency (HPA) until 31st March 2013

disease. Similar processes exist in Scotland and Northern Ireland though the list of notifiable diseases varies slightly by country. A summary is provided in Appendix 2. For more detail of the specified notifiable diseases and causative organisms see:

England: www.legislation.gov.uk/uksi/2010/659/contents/made

Northern Ireland: www.legislation.gov.uk/apni/1967/36/contents

Scotland: www.legislation.gov.uk/asp/2008/5/contents

Wales: www.legislation.gov.uk/wsi/2010/1546/contents/made

Surveillance and Recording of Zoonotic Diseases

Humans

In addition to notification of specified infectious diseases, voluntary laboratory reporting (Appendix 3) and outbreak surveillance are conducted in each of the constituent countries of the United Kingdom (UK). Due to under-diagnosis and under-reporting, the cases recorded in national surveillance databases tend to be biased towards more clinically severe cases in high-risk groups, or outbreak related cases. New legislation outlined above places a statutory obligation on clinical microbiological laboratories to report specified causative agents or evidence of an infection caused by such agents.

The national surveillance centres receive and collate reports of outbreaks of foodborne gastrointestinal disease from laboratories, local health protection teams and local authority environmental health (Public Protection) departments as required under article 8 of the European Union Zoonoses Directive 2003/99/EC[2]. The minimum dataset on each outbreak is then collected through a standardised questionnaire. Surveillance provides information on specific risk factors associated with different pathogens and on trends in the importance of these factors. Enhanced surveillance schemes, either nationally or locally, provide information on specific aspects of a zoonosis.

Data from the surveillance schemes are reported on national surveillance centre websites and for England and Wales quarterly in the Health Protection Report available at https://www.gov.uk/government/publications/common-animal-associated-infections-quarterly-report-2014

Health Protection Scotland and Northern Ireland's Public Health Agency provide surveillance data on their websites:

www.hps.scot.nhs.uk/giz/index.aspx

[2] OJ L 325, 12.12.2003, p. 31. Directive 2003/99/EC of the European Parliament and of the Council of 17 November 2003 on the monitoring of zoonoses and Zoonotic agents, amending Council Decision 90/424/EEC and repealing Council Directive 92/11/EEC

www.publichealth.hscni.net/directorate-public-health/health-protection/surveillance-data.

Animals

In GB, livestock are monitored for the appearance of notifiable or novel diseases or changing trends in endemic diseases, including actual and potential zoonoses. This is done by the AHPA, Scotland's Rural College (SRUC) (Veterinary Sciences Division) and Food Standards Agency (FSA) Operations. A similar function is performed by the Agri-Food and Biosciences Institute (AFBI) and the Department of Agriculture and Rural Development (DARD) in Northern Ireland. In addition, information may be available from universities, veterinary research organisations and other private veterinary laboratories.

The AHPA undertakes scanning surveillance for new and re-emerging animal diseases on behalf of the Department for Environment, Food and Rural Affairs (Defra) and the Welsh Government (WG). The SRUC perform a similar role for the Scottish Government (SG). Surveillance is achieved primarily through the collection, collation and analysis of disease data arising from material submitted for diagnostic purposes. Clinical diagnostic samples are submitted to AHPA Regional Laboratories and post mortem examination sites and to SRUC Disease Surveillance Centres. The results are entered onto the Veterinary Investigation Diagnostic Analysis (VIDA) database and collated into reports covering GB which are published monthly, quarterly and annually. The results are available at: https://www.gov.uk/government/statistics/veterinary-investigation-diagnosis-analysis-vida-report-2013. SRUC reports can be found at: http://www.sruc.ac.uk/downloads/download/656/monthly_reports_2013. Appendix 4 also records results for notifiable zoonotic diseases.

In Northern Ireland the AFBI publish quarterly Disease Surveillance Reports on the internet http://www.afbini.gov.uk/index/services/services-diagnostic-and-analytical/adds/services-diagnostic-adds-diagnostic-report.htm. The disease summary is compiled by the veterinary services division of AFBI and is based on diagnostic submissions to AFBI's veterinary laboratories at Stormont, Belfast and Omagh, County Tyrone.

Risk assessment and control of animal associated threats to public health

The UK Zoonoses, Animal Diseases and Infections (UKZADI) group provides a high-level strategic overview and a means of ensuring overall coordination of public health action on zoonoses across the UK. The multi-agency, cross-disciplinary Human Animal Infections and Risk Surveillance (HAIRS) group acts as a forum to identify and discuss infections with potential for interspecies transfer (particularly zoonoses). In addition the Veterinary Risk Group (VRG) was established in response to the Anderson Review (Lessons Learned from the FMD outbreak in 2007) which recommended that government should establish a standardised and systematic process for identifying, assessing, characterising, prioritising and escalating unexpected animal-related threats. The VRG does this, meeting on a monthly basis to consider threats raised across government's remit, and provides transparent, auditable technical advice on options for risk management to inform decision making. The VRG is a cross-directorate and cross-administration UK-level body which reports to the four UK Chief Veterinary Officers.

Control policies have been introduced to reduce the prevalence of pathogens in the food chain and other areas. These include the implementation of legislation relating to the production of drinking water and food. The UK FSA, PHE and devolved equivalents and Local Government Regulation operate national microbiological food sampling programmes and carry out studies focusing on particular foods, food processes and the production environment. This work enables potential food safety issues to be identified, as well as establishing current levels of microbial contamination. Local authorities also carry out food sampling activities.

Under the auspices of the FSA, the Epidemiology of Foodborne Infections Group and the Advisory Committee on the Microbiological Safety of Food bring together UK surveillance data on humans, animals and food to consider foodborne risks.

Further information on the human aspects of infection is available from the PHE webpages: https://www.gov.uk/government/collections/zoonotic-diseases-zoonoses-guidance-data-and-analysis

Information on the animal aspects of infection is available from the Defra webpages:

https://www.gov.uk/government/collections/notifiable-diseases-in-animals

Feature Article 1: First report of cat-to-human transmission of *Mycobacterium bovis*

Authors: Catherine O'Connor, Amanda Walsh, Dilys Morgan (Public Health England, Colindale)

Mycobacterium bovis in cattle and other species in the United Kingdom

In the UK, *M. bovis* infection is a disease primarily of cattle. While almost eradicated in the 1960's, the disease is currently endemic mainly in areas of south west England, south Wales and in Northern Ireland. In 2013, 32,620 cattle were culled in GB, as part of bovine tuberculosis (TB) control measures, demonstrating that bovine TB remains a significant issue for cattle farmers.

In addition to cattle, *M. bovis* infection is occasionally detected in non-bovine farm animals such as goats and pigs[3]. Fortunately, the bovine TB epidemic has not significantly affected companion animals which are considered 'spill over' hosts. Each year, fewer than 30 cases of *M. bovis* infection in cats are confirmed by AHPA[3]. While this figure is believed to be an underestimation of the true incidence, *M. bovis* infection in cats is not thought to be a major issue in the UK; the vast majority of feline cases are sporadic and concentrated in regions where bovine TB is endemic.

An unusual outbreak of *M. bovis* in cats

Between December 2012 and March 2013, a single veterinary practice in Newbury (Berkshire, England) detected seven confirmed and two probable cases of *M. bovis* disease in household cats. The nine cats belonged to nine separate households, and six of the nine resided in properties close to each other. Most presented to the vet with severe systemic infection including discharging lymph nodes and pulmonary signs. Some also had non-healing or discharging infected wounds, or had a recent history of bites. At last update, six of the nine cats have been euthanized or have died. The three surviving animals received treatment and are reported to have responded well. However, one cat is known to have disappeared while undergoing treatment.

M. bovis isolates from the seven confirmed feline cases were genotyped (spoligotype and variable number tandem repeat typing) by AHPA, Weybridge. All isolates belong to a rare, distinct genotype (10:u) which was first detected in this area in cattle in 2008. It has also been found in isolates from an alpaca (in 2010) and in another cat (in 2011) from the immediate area. Whole genome sequence analysis of six of the feline isolates has shown

[3] Defra (2014) Incident of confirmed M. bovis infection in domestic and companion animals and wild deer in GB (excel spreadsheet). Accessed 08/08/2014 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/271279/bovinetb-otherspecies-14jan14.xls

them to be very similar to each other with strong similarity with sequences from infected cattle in the area[4].

This incident was recognised as an unusual occurrence since a cluster of feline *M. bovis* cases of this magnitude has not been observed in GB previously, even in historically high incidence areas. The source(s) of infection was not determined. While cattle-to-cat transmission cannot be discounted, the most plausible source of feline infection, based on known cat behaviour, is via contact with infected wildlife species or their environments. No new cases of feline *M. bovis* infection have been detected in the area since March 2013.

Public health investigation

While anecdotes of transmission existed, no confirmed cases of cat-to-human transmission of *M. bovis* had been reported in the literature. This absence of evidence resulted in the conclusion that cats infected with *M. bovis* presented a negligible risk to the health of their human contacts. Thus, public health responses to such incidents were sporadic and generally entailed informing and advising household contacts of the infected cat. Due to the unprecedented size and severity of this cluster, it was recommended that TB screening should be offered to all close contacts of the infected cats (39 people in total). Three of 24 people who accepted screening in June/July 2013 tested positive for previous TB exposure, but as none had any symptoms or signs indicative of active TB infection all were diagnosed with latent TB infection (LTBI). As a diagnosis of LTBI does not allow for the microbiological confirmation of the type of TB or the likely source of their exposure/infection, cat-to-human transmission could not be shown.

In November 2013, two people who had contact with the same cat were diagnosed with active *M. bovis* infection. One of these had been found to have LTBI on initial screening, and had declined the offer of chemoprophylaxis. The other active case had declined the initial offer of screening. Both had significant contact with the affected cat while it had signs of systemic infection. Molecular typing carried out by PHE and AHPA determined that isolates from the cats and human cases were indistinguishable. The isolates, coupled with the timeline of onset of disease in the cat (March 2013) and subsequently in its human contacts (October 2013) indicated that transmission of *M. bovis* from the infected cat was the likely source for these two individuals. This is the first documented occurrence of cat-to-human transmission of *M. bovis*[5].

Assessing the overall risk of cat-to-human transmission

The HAIRS group was informed of the incident in May 2013 and were kept informed of the situation as the investigation continued. The group decided that a qualitative assessment of the overall risk of cat-to-human transmission of *M. bovis* was required. Information gleaned from the outbreak was combined with a review of the literature to determine what

[4] Roberts, T.*et al*. (2014) An unusual cluster of Mycobacterium bovis infection in cats. Veterinary Record, 176, pp326.
[5] Public Health England (2014). *Mycobacterium bovis* and cat-to-human transmission in the UK. Health Protection Report, 8(12) https://www.gov.uk/government/publications/health-protection-report-volume-8-2014

evidence was available on the potential of cat-to-human transmission of *M. bovis*. This risk assessment was completed by the HAIRS group in collaboration with experts from PHE, Defra, AHPA and the University of Edinburgh[6].

The pathology of feline cases was consistent with the excretion of viable numbers of bacilli, which would be a source of transmission to humans. The often close human-cat contact means that the opportunity for cat-to-human transmission of *M. bovis* exists: via aerosols from cats with pulmonary signs; via the contaminated environment; or via ingestion following the handling of tuberculous lesions. As evidenced by the human cases associated with this outbreak, zoonotic transmission of *M. bovis* has been shown to occur. Despite this, there is currently no evidence to suggest that cat-to-human transmission of *M. bovis* is anything other than an infrequent event. While there are 8 million cats in the UK (in 17% of households)[7], and it is assumed that at least 30 cats are infected with *M. bovis* infection each year, more cases of *M. bovis* infection in human contacts would be observed if this was anything other than a rare transmission event. Thus, the evidence of cat-to-human transmission of *M. bovis* from the Newbury incident, coupled with the clinical presentation of the infection in cats and the absence of any previous reports of cat-to-human transmission, lead to the conclusion that the risk of transmission of *M. bovis* infection from cats to their human contacts is very low. Based on this revised risk assessment, it is now recommended that all close contacts of cats with confirmed *M. bovis* infection should be assessed by a public health professional and receive advice on how to best minimise zoonotic transmission.

[6] HAIRS (2013). Qualitative assessment of the risk that cats infected with Mycobacterium bovis present to human health http://webarchive.nationalarchives.gov.uk/20140714084352/http:/www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317140243205 Accessed 29/09/2014

[7] Pet Food Manufacturers' Association (2014) Pet population 2014. http://www.pfma.org.uk/pet-population-2014/ Accessed 18/07/2014

Feature Article 2: Hantavirus infection in people with contact with wild and pet rats in England

Author: Jackie Duggan (Public Health England, Porton)

Hantaviruses are a group of viruses present in many countries worldwide. Different species of rodents and insectivores carry specific hantaviruses, therefore, the geographic distribution of each can be worldwide, or located in one region, such as Europe, Asia or North and South America. Animals rarely show signs of disease; they are thought to become infected early in life and may shed virus in their excreta (urine, faeces and saliva) for prolonged periods.

Humans usually become infected with hantaviruses through the inhalation of aerosolised rodent excreta. Although some hantaviruses are associated with asymptomatic infections or mild disease, most can cause serious human infections, ranging from haemorrhagic fever and kidney failure (known as “haemorrhagic fever with renal syndrome” or “nephropathia epidemica”) in Europe and Asia, to a severe lung disease (known as “hantavirus pulmonary syndrome”) in North and South America. Case fatality rates can vary from 0.1% to in excess of 50%.

Symptomatic human infections with hantaviruses in the UK are rare, but a case of acute kidney injury (AKI) associated with exposure to wild rats was identified in the Humber region in 2012[8].

Infection in humans in the UK

Since 2012, there have been six cases of AKI due to hantavirus infection acquired in the UK, confirmed by laboratory diagnosis at the PHE Rare and Imported Pathogens Laboratory (RIPL). Two serologically diagnosed cases were from the Humber region and had documented exposure to wild rats. Wild rodents were trapped from the farm belonging to the second case and a Seoul strain of hantavirus was isolated from the rats[9]. The virus, named Humber virus, was likely to be the causative agent of AKI in at least one of the two patients. However, as is commonly the case in hantavirus infection, virus was not detectable by isolation or PCR.

[8] Zoonoses report UK 2012 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/236983/pb13987-zoonoses-report-2012.pdf)

[9] Jameson LJ *et al*. The continued emergence of hantaviruses: isolation of a Seoul virus implicated in human disease, United Kingdom, October 2012. Euro Surveill 2013 Jan 3;18(1):4-7.

A third case of AKI in Essex in 2010 gave serological evidence of exposure to a Sin Nombre-like hantavirus. Epidemiological investigations indicated that exposure likely occurred in Epping Forest, although the source of infection was not found.

The other cases of AKI due to hantavirus infection have been in people with exposure to pet rats. The first of these was in Wrexham in November 2012, when Seoul hantavirus was diagnosed in a man with exposure to two pet fancy rats owned by his partner. His partner's sister was a specialist breeder of fancy rats and was a member of the National Fancy Rat Society (NFRS). Epidemiological investigations determined that the two people who owned the breeding colony both had serological evidence of previous infection, with one having been hospitalised in 2011 with AKI of unknown origin[10]. The rats in the breeding colony were culled and tested and a second Seoul virus, highly similar to the Humber strain, was detected in nine animals[11] and named the Cherwell strain. Two more cases of AKI in rat owners have been identified subsequently, one in 2013 and one in 2014. Molecular evidence for the Cherwell strain was demonstrated for the 2013 patient when a partial virus sequence with 100% homology to the pet rat strain was recovered.

Epidemiological investigations and sero-prevalence studies

Yorkshire farmers study

Following the two hantavirus cases in the Humber region, a seroprevalence study was conducted amongst farmers in Yorkshire. One hundred and nineteen farmers were recruited of whom nine had demonstrable antibodies, giving an overall seroprevalence of 7.6% in farmers in this region[12].

National sero-prevalence study in at-risk groups in England

A sero-prevalence study of at-risk groups was conducted in England in 2013/14. The four study groups were:

- Study group 1: random donor blood samples purchased from the National Blood Transfusion Service (anonymised)
- Study group 2: Pet rat owners (either owners of fancy rats contacted through the NFRS or "casual" pet rat owners who acquired their pet rats from other sources e.g. pet shops)
- Study group 3: People with occupational exposure to pet rats (veterinary workers)
- Study group 4: People with occupational exposure to wild rats.

Adult volunteers were recruited based on the above criteria and asked to provide a blood sample and complete a questionnaire. All samples were tested using a hantavirus

[10] Taori SK *et al*. UK hantavirus, renal failure, and pet rats. Lancet 2013 Mar 23;381(9871):1070-6736(13)60599-1. Epub 2013 Mar 22.
[11] Jameson LJ *et al*. Pet rats as a source of hantavirus in England and Wales, 2013. Euro Surveill 2013 Feb 28;18(9):20415.
[12] Jameson LJ, *et al*. Prevalence of antibodies against hantaviruses in serum and saliva of adults living or working on farms in Yorkshire, United Kingdom. Viruses 2014 Feb 5;6(2):524-534.

immunofluorescence assay (IFA) slide (EuroImmun), which is the standard, validated test used for all hantavirus diagnosis in RIPL. Figure 1 shows hantavirus-infected cells from an IFA assay slide as seen under a fluorescence microscope. Results are shown in Table 1.

Table 1 Total number of hantavirus positive sera in each study group

Study group	Number of samples taken	Total Number of positive samples	Seroprevalence (%)
Group 1	300	10	3.3
Group 2 (NFRS)	79	26	32.9
Group 2 (Non-NFRS)	3	0	0
Group 3 (Veterinary)	170	3	1.7
Group 4 (Farmers)	120	2	1.6
Group 4 (Sewage workers)	70	1	1.4
Group 4 (Pest control workers)	106	3	2.8

The seroprevalence to hantavirus infection in group 2 was 32.9%. All positive sera showed broad cross-reactivity across the hantavirus group, with the strongest reactions against Seoul virus. All sera from this group displayed the same antibody reactivity pattern.

Three other positive sera with reactivity to other hantaviruses were seen. One pest control worker and a sample from group 1 tested positive for Dobrava antibodies, with a sero-prevalence of 0.9% and 0.3% respectively within those groups whilst one farmer tested positive for Puumala antibodies (sero-prevalence 0.8%).

Seventeen samples gave a weak positive reaction to Hantaan virus at a titre of 1:100. These came from all four study groups with the highest number from group 1. The rodent vector for Hantaan virus, which is normally associated with severe haemorrhagic fever in Asia, is not present in the UK. One possible explanation for this result is environmental exposure to an as yet unidentified hantavirus which is cross-reactive in this assay, although without a virus isolate to cross-reference the result, this cannot be confirmed.

Infection in Animals

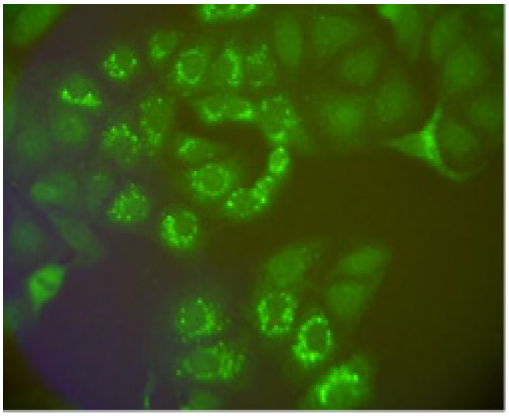
A survey of hantavirus carriage in pet rats is currently being undertaken. Volunteers recruited from group 2 were asked to collect urine samples from their rats and to send these samples for testing. In total, 450 urine collection kits were handed out to rat owners and 80 samples were subsequently returned. The samples are being tested by PCR assay at AHPA and results are currently pending.

Further Studies

Currently, we do not know whether the circulation of hantaviruses in pet rats is due to its prevalence within the specialist fancy rat group, where the rats often come into contact with each other at rat shows/meets and through breeding, or whether the virus is ubiquitous within the overall pet rat community in the UK. The project team is currently working to engage with groups who work with pet rats, such as commercial rat breeders, and those who buy/obtain their rats from commercial vendors such as pet shops. This will enable the risk of hantavirus infection in people exposed to this particular group of animals to be determined.

More targeted risk/public health advice for those who may be at risk of hantavirus through exposure to rats may be required. Meanwhile, a leaflet is available here: https://www.gov.uk/government/publications/pet-rats-mice-hamsters-reducing-the-risk-of-infection

Figure 1 IFA assay of hantavirus



Source: stock.xchng

Figure 2 Pet rat

Source: PHE Porton

Feature Article 3: Hepatitis E: enhanced surveillance in England and Wales and the emergence of a new phylotype

Authors: Bengü Said and Samreen Ijaz (Public Health England, Colindale)

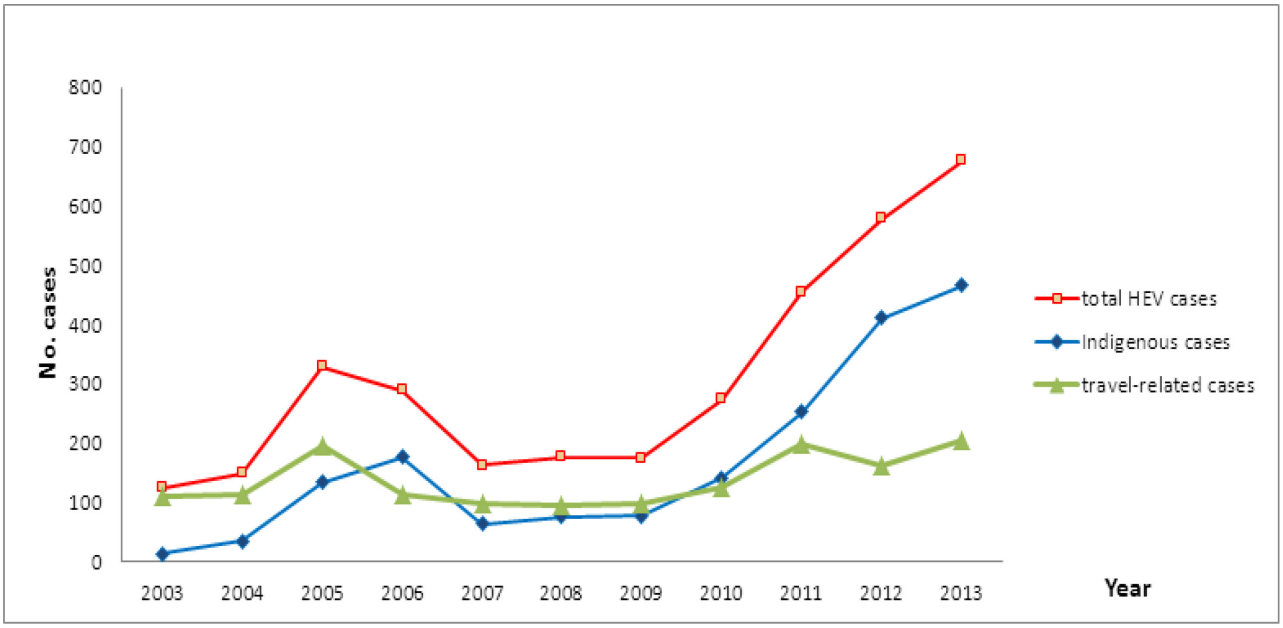
Hepatitis E virus (HEV) is an enteric virus that can infect humans and cause acute inflammation of the liver (hepatitis). The virus is endemic throughout the world and there are four main genotypes of HEV. Genotypes 1 and 2 are only found in humans, while genotypes 3 and 4 can infect humans and other animal species. Genotype 3 and 4 viruses are widespread in a number of animal species, particularly domesticated pigs and deer, although they do not appear to cause illness in these animals. HEV is transmitted mainly through ingestion of faecally-contaminated water or zoonotically through undercooked products from infected animals. In developed countries, sporadic outbreaks have followed consumption of undercooked pork or deer meat, or uncooked shellfish. Other routes of transmission include transfusion of infected blood products and vertical transmission (during pregnancy to the foetus).

HEV infection in humans

HEV infection is mainly asymptomatic with only mild liver enzyme derangement. Symptomatic infection usually presents as a mild, self-limiting illness, but immune deficiency and chronic liver disease appear to be associated with moderate to severe disease. Mortality in the general population is around 1%. In rare cases fulminant disease (rapid onset acute liver failure) develops and can prove fatal. This occurs particularly in pregnant women with mortality of up to 30%; however this is usually associated with genotype 1 virus and does not appear to be a feature of genotype 3 infections. Persistent HEV carriage (chronic hepatitis) has also been recognised particularly in immunocompromised individuals. The long-term prognosis for individuals with chronic hepatitis E is poor; infection can result in rapidly progressive liver fibrosis and cirrhosis with death due to decompensated liver disease. Chronic infections are usually linked to genotype 3 infections. If HEV infection is diagnosed in an immune-compromised individual then follow up virological testing is essential for monitoring antibody development and viral clearance. Anti-viral treatment has been effective in some cases and improved the clearance of HEV.

In England and Wales the majority of HEV cases are non-travel related and present as sporadic disease. Since 2010, the numbers of confirmed cases have increased year on year (Figure 3), with 691 cases reported in 2013, a 19.3% increase since 2012. The numbers of travel-related cases have remained relatively stable over the years. Therefore the substantial increase observed since 2010 is due to an increase in indigenously acquired cases.

Figure 3 Laboratory confirmed reports of Hepatitis E in England and Wales, 2003-2013



Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
England & Wales	124	149	329	289	162	176	175	274	456	579	691
E&W: non-travel associated cases	14	35	133	176	63	76	77	141	252	409	477

In 2013, 477 (69.0%) cases were assessed as non-travel associated or indigenous, compared with an average of 50.7% since 2003 (table). In 2013, of the indigenous cases 315 (66.0%) cases were male and 381 (79.8%) were in people over 50 years of age and 52.8% (252 cases) were both male and over 50 years of age. There was no geographical clustering. HEV genotype 3 is the prevalent virus and transmission is associated with the consumption of undercooked meat particularly processed pork products, such as sausages[13]. The substantial increase in indigenous cases in England and Wales appears to be due to the emergence of a new HEV phylotype (genotype 3, clade 2), not commonly circulating in England and Wales prior to 2010[14]. Thus there are currently two concurrent outbreaks contributing to the burden of disease nationally: clade 1 virus, which has been the cause of hepatitis E cases since 2003; and clade 2 virus which emerged more recently and accounts for around two thirds of recent cases. There is an on-going public health

[13] Said B *et al*. Hepatitis E virus in England and Wales: indigenous infection is associated with the consumption of processed pork products. *Epidemiol Infect* 2014,142, 1467-75.
[14] Ijaz S *et al*. Indigenous Hepatitis E in England and Wales from 2003 to 2012: Evidence of an Emerging Novel Phylotype of Viruses. *J Infect Dis*. 2014, 209(8):1212-8.

investigation into the causes of the increased incidence of hepatitis E in England and Wales.

Transmission of HEV through blood transfusions has also been recognised and a recent seroprevalence study in blood donors in the southeast of England showed 1:3000 donations to be HEV RNA positive indicating that asymptomatic infection amongst blood donors is widespread in England. Sequence characterisation of HEV RNA showed that all were genotype 3 and that the majority were clade 2. The study also demonstrated a 42.0% transmission rate from HEV containing blood components although there is virtually no acute disease in recipients[15].

HEV in animals

In England and Wales, HEV is primarily zoonotic. A range of animals can act as reservoirs and transmission may be direct from animals or through contaminated foods. Although HEV does not cause disease in pigs, it is endemic in pig populations worldwide. HEV genotype 3 virus is known to be found in British pigs[16] and there is evidence for HEV in the pork food chain[17]. In early 2013, as part of a multi-agency project (with PHE, Defra, FSA and AHPA), a pig abattoir survey was undertaken to better understand the possible role of infection in pigs on human disease incidence (see feature article 4) [18]. This study showed that 92.8% of 640 pigs tested were seropositive at slaughter, with 5.8% actively infected with HEV, as shown by the presence of detectable plasma HEV RNA. The viral load was sufficient to identify the virus from a small number of pigs as genotype 3, clade 1.

Future studies

Although recent studies have improved our understanding of Hepatitis E in England and Wales, certain aspects remain enigmatic and demand further study. The predominance of cases in older men, and the route and source of infection for indigenous cases, in particular the recently emerged novel phylotype (genotype 3 clade 2), remain unexplained. An understanding of the viability and persistence of the virus in blood, tissue and food matrices, as well as continuing surveillance and molecular characterisation of HEV in both humans and animals is important to inform public health advice and management of cases.

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[15] Hewitt PE *et al*. Hepatitis E virus in blood components: a prevalence and transmission study in southeast England. *Lancet* 2014 Jul 26 doi: 10.1016/S0140-6736(14)61034-5. [Epub ahead of print]
[16] Banks M *et al*. Human and porcine hepatitis E virus strains, United Kingdom. *Emerg Infect Dis* 2004; 10:953-5.
[17] Berto *et al* l. Hepatitis E in pork food chain, United Kingdom. EID 2012, 18:1358-60.
[18] http://webarchive.nationalarchives.gov.uk/20140707135733/http://www.defra.gov.uk/ahvla-en/science/bact-food-safety/2013-pig-abattoir-study/

Feature Article 4: Pig abattoir survey

Authors: Stephen Wyllie and Tanya Cheney (AHPA, Weybridge)

This article summarises from a One Health perspective the origins, development, implementation and results of a UK-wide survey of slaughter pigs for a range of zoonotic pathogens and a non-zoonotic pig virus.

The proposal originated in 2012 when, in anticipation of having to set up a UK National Control Programme for *Salmonella* (NCP) in pigs, the steering group for this project decided to carry out a baseline prevalence survey for *Salmonella* in slaughter pigs (to compare results with one that had been carried out in 2006-7). For statistical reasons the minimum sample size was deemed to be 600 pigs, sourced from across the UK.

However, various members of the project steering group also sat on other cross government groups, and through them recognised that this was an opportunity to address other data gaps relating to zoonotic pathogens carried by pigs.

Since the largest cost component of such exercises is setting up and implementing the survey rather than the subsequent analysis of the samples taken, it also represented an opportunity to carry out surveillance very cost effectively.

Representatives of the potentially interested groups across government and industry met to agree respective organisations' budgets, prioritisation of the organisms, the best samples to take, and at which laboratories they would be analysed. Funding came from Defra/SG/WG/AHPA, the pig industry, FSA, VMD and PHE.

The key policy drivers for including organisms in the survey are summarised below:

- ***Salmonella*** – Still a major foodborne pathogen. The survey provided updated baseline data and tested abattoir sampling procedures in anticipation of an EU–wide NCP in pigs.

- ***Toxoplasma gondii*** – Cause of an estimated 350,000 human infections per year in the UK, of which 10-20% are symptomatic. An ACMSF report in 2011 highlighted the lack of prevalence data in UK livestock, especially pigs.

- ***Yersinia enterocolitica*** – An EFSA report in 2011 identified *Yersinia,* along with *Salmonella*, *Trichinella* and *Toxoplasma*, as the most relevant biological hazards in pigs. The last GB survey had taken place 10 years before.

- **Hepatitis E virus (HEV)** – Year on year increases in domestically acquired human cases (see Feature Article 3) and up to 60,000 people in the UK are thought to be

infected per year[19]. The study sought to establish seroprevalence and viraemia levels at slaughter.

- **Antimicrobial resistance (AMR) in *Campylobacter* and *E. coli*** – sampling helped to meet both current and anticipated EU monitoring requirements (Decision 2013/652/EC).

- **Porcine Reproductive and Respiratory Syndrome virus (PRRSv)** – not zoonotic, but of significant economic impact to the industry.

Sampling took place from January to May 2013, and was undertaken at 14 abattoirs across the UK, which between them process 80% of the pigs slaughtered in the UK. Carcases were randomly selected and the total number sampled at each abattoir was proportional to their annual throughput. Exclusion criteria included condemned carcases, those undergoing emergency slaughter and those not reared in the UK. AHPA acted as the central co-ordination point, putting together a sampling pack for each pig, despatching them to the relevant abattoir according to an agreed schedule, and distributing the samples from the returned packs to appropriate laboratories.

Nine samples were taken from each carcase, including blood (plasma) samples, the whole caecum, tonsils, heart, tongue, and rectal and carcase swabs. Information was also collected about the origin of each carcase. In total, 648 pigs were sampled and only a small number were excluded.

Results

Salmonella – 30.5% of caecal samples, 24.0% of rectal swabs and 9.6% of carcase swabs were *Salmonella* culture positive. This represented a rise in caecal carriage, but a fall in carcase contamination compared to the 2006-7 survey (both statistically significant). The most common serovars were *S.* Typhimurium (including monophasic strains), *S.* Derby and *S.* Bovismorbificans.

Toxoplasma – Seroprevalence was 7.4%. Heart and tongue samples have also been retained at the reference laboratory in PHW for possible future analysis for tissue cysts.

Yersinia – 32.9% of the pigs carried *Yersinia* in the tonsils, but only 1.9% of the carcase swabs were positive. Most of these samples were positive for *Y. enterocolitica*, but there were small percentages of other species.

PRRSv – Seroprevalence was 58.3% (the vaccination status of each pig was unknown). Viral RNA was detected in 8.3% of tonsil samples tested.

Hepatitis E (HEV) – 92.8% of pigs were seropositive, and 5.8% were actively infected with HEV (based on detectable viral RNA in the plasma). A small number had sufficient

[19] Ijaz S *et al*. Indigenous hepatitis E virus infection in England: more common than it seems. *Journal of Clinical Virology* 2009; 44: 272–276. DOI: 10.1016/j.jcv.2009.01.005

plasma RNA for sequencing, and all were genotype 3, clade 1. Further testing on RNA from caecal samples is taking place.

Antimicrobial Resistance

Campylobacter coli – 215 caecal samples were tested for *Campylobacter* – of these 71.0% were positive for *C. coli* (plus 13.0% positive for other campylobacters). Using epidemiological cut-off values, resistance levels were as follows: Ciprofloxacin 12.4%, Erythromycin 27.5%, Nalidixic acid 17.0%, Chloramphenicol and Gentamicin both 0%, Tetracyclines 77.8%, Streptomycin 66.0%. These are generally similar to levels in other EU Member states.

ESBL (Extended Spectrum Beta-Lactamase) *E. coli* – 23.4% of pigs were ESBL positive. CTX-M genes were recovered from 22.0% and SHV-type genes from 2.2% (0.8% had both hence only 23.4% in total). The majority (85.0%) of the CTX-M type isolates were sequence type 1 (CTX-M 1), whereas the major type seen in humans in the UK is CTX-M 15 (6.4% of the CTX-M type pig isolates).

Conclusions

Overall, the project achieved its aim of filling data gaps and fulfilling statutory requirements. This was done at least cost to the participants due to sharing of "overhead" costs through taking multiple samples simultaneously from the same cohort of pigs. Acting through partner organisations (AHPA, FSA and DARD) for preparation and distribution of the sampling kits, and subsequent collection and re-distribution of samples, was logistically efficient. Sample analysis was also carried out by three different agencies (AHPA, PHE and PHW).

This project provides a model for future collaborations across government and with industry, and is an exemplar of One Health in action. Further details can be found at:

http://webarchive.nationalarchives.gov.uk/20140707135733/http://www.defra.gov.uk/ahvla-en/science/bact-food-safety/2013-pig-abattoir-study/

Feature Article 5: Outbreak of salmonellosis associated with a hog roast in North East England

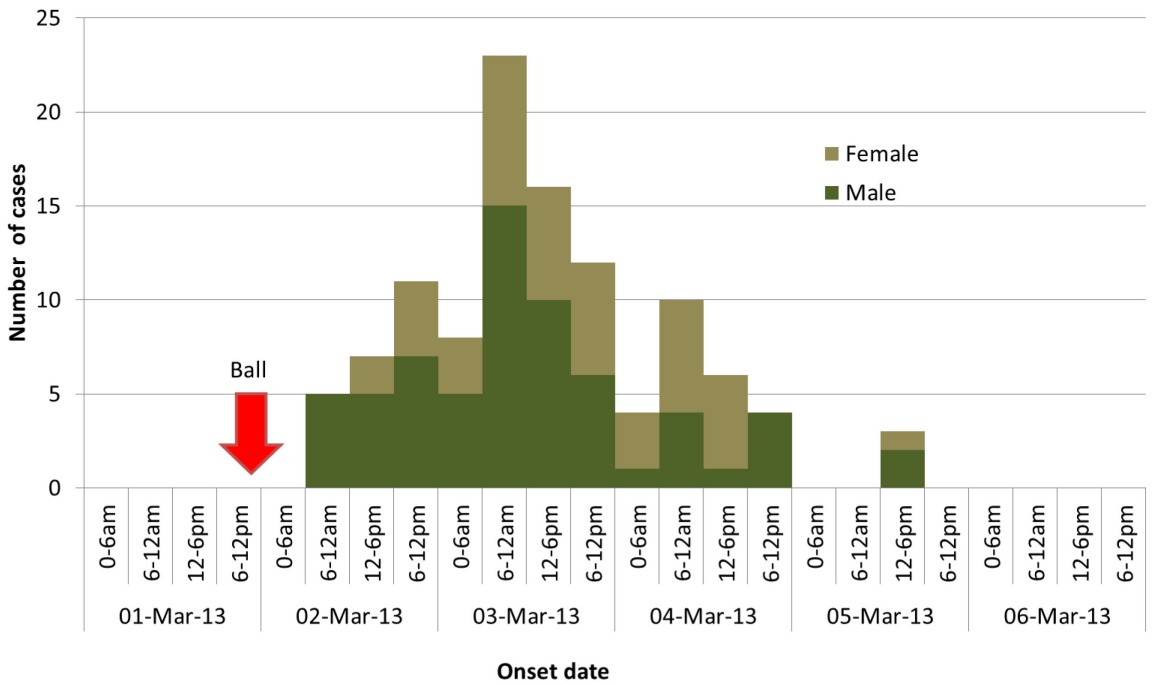
Author: Deb Wilson (North East Public Health England Centre)

Following reports of diarrhoeal illness associated with a college ball, an outbreak control team undertook microbiological, epidemiological and environmental investigations. The ball had taken place on the evening of 1st March 2013 with a formal sit-down dinner and a hog roast stall.

A cohort study was undertaken using a web-based survey. A case was defined as any individual who attended the ball and developed diarrhoea within 12-96 hours. Univariate, stratified and multivariable analyses were undertaken. Of the 550 guests, 383 (70%) completed the survey.

One hundred and thirteen people reported diarrhoea giving a clinical attack rate of 30%. Eight cases had *Salmonella* Typhimurium DT120 isolated from a faecal sample with an MLVA profile 3-11-11-0-0211. Males represented 59% of cases, 99 cases were students (mainly aged 18-21 years), eight were staff and six were other guests. The incubation period ranged from 12 to 96 hours (mean 36-42 hours). All cases had diarrhoea, 95% abdominal pain, 62% fever, 44% joint pain, 22% vomiting and 6% bloody diarrhoea. Duration of illness ranged from 2 to 7 days (mean 4 days). No cases were admitted to hospital. The epidemic curve is shown below in Figure 4.

Figure 4 Epidemic curve by date and time of onset of symptoms

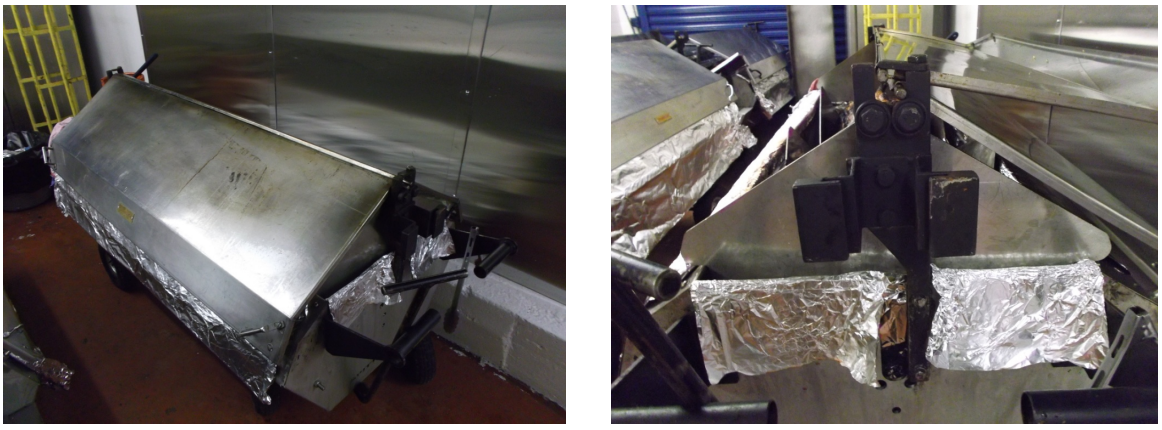


Eating hog roast meat was strongly associated with becoming a case (risk ratio 12.4 [95% confidence interval 6.7-23.0]) suggesting a causal association. All other exposures initially found to be associated with illness were found to have been confounded by hog roast meat.

The food business had been providing hog roasts since 2008 with no recent change to practices. A 60-65kg pig was cooked on 1st March from 07:30–17:30 in a special hog roast oven (Figure 5). Temperatures above 75°C were recorded during cooking. The meat juices were drained and discarded. After standing for approximately one hour, the cooked pig (still in the oven) was wheeled into a walk-in refrigerator until approximately 20:00. The oven and hog roast were then transported in a refrigerated van to the college and reheated and served from an outdoor food stall. Temperatures above 75°C were recorded at 22:00 and the hog roast was served from 00:00 to 02:00.

The description of cooking and temperature records did not explain how salmonellae survived to cause illness. Environmental health officers revisited the premises and attended other events where hog roasts were being cooked and took environmental swabs, hog roast meat samples and monitored hog roast cooking temperatures. Salmonellae were not isolated from any of the environmental swabs, faecal samples from food handlers or food samples. During these follow-up visits it was observed that triangular end-plates on the hog roast oven (Figure 5) were not always used during cooking and reheating and that this could result in uneven temperatures being achieved during the cooking (and reheating).

Figure 5 Photo of hog roast oven and close up of triangular end plate



Details of the pig supply chain were obtained from the local FSA Veterinarian. The pig came from a North Yorkshire farm via a West Yorkshire abattoir and a North East cutting plant. AHPA staff visited the North Yorkshire farm plus two other unrelated pig farms to look for salmonellae with a similar MLVA profile as the human isolates from outbreak. Twenty-seven *Salmonella* isolates were found from the three farms and nine different MLVA profiles were identified (Table 2). Two of the 27 farm isolates matched the human MLVA profile (3-11-11-0-0211), both were phage typed as *Salmonella* Typhimurium DT120 and both were from the farm that supplied the hog roast. These results provide

microbiological and molecular evidence linking the cases of human infection to consumption of pork from the supplying farm.

Table 2 MLVA profile and serology results of farm *Salmonella* isolates

MLVA profile	PHE Serology	PT VLA	No. of isolates	Origin of farm isolates with this profile
3-11-11-0-0211*	4,12:i:1,2	120	2	2 from Farm Supplying Hog Roast
3-11-6-0-0211	4,12:i:1,2	193	9	7 from Unrelated Farm C 2 from Unrelated Farm W
3-12-10-0-0211	4,5,12:i:-	193	6	4 from Farm Supplying Hog Roast 2 from Unrelated Farm C
3-7-11-0-0211	4,12:i:1,2	120	4	2 from Farm Supplying Hog Roast 2 from Unrelated Farm W
3-7-10-0-0211	4,12:i:1,2	120	2	1 from Farm Supplying Hog Roast 1 from Unrelated Farm W
3-11-6-0-0111	4,12:i:1,2	193	1	1 from Unrelated Farm W
3-10-6-0-0211	4,12:i:1,2	193	1	1 from Unrelated Farm C
3-7-6-0-0211	4,12:i:1,2	193	1	1 from Unrelated Farm W
3-11-7-0-0211	4,12:i:1,2	193	1	1 from Unrelated Farm W

*Denotes farm isolates matching human outbreak isolates

This outbreak highlights the potential of novel cooking methods to cause food poisoning and the importance of repeated observation of practice to identify food safety concerns. This can be particularly difficult for cooking processes such as hog roasting that are prolonged, only undertaken periodically and take place at event premises other than a food business premise.

The farm investigation provided additional evidence by establishing that salmonellae with the same MLVA profile as isolates from the human outbreak cases were present on the pig farm in question. This was important as food and environmental samples did not identify salmonellae. The identification of salmonellae did not imply specific inadequacies with *Salmonella* control at the farm as 44.0% of United Kingdom pig production holdings are estimated to be positive for salmonellae with 9.9% positive for *Salmonella* Typhimurium[20].

The additional costs of farm trace-back and testing must be borne in mind and not all outbreaks will warrant such on farm investigations. Effective control of *Salmonella* at pig farms is one measure with the potential to reduce the burden of human food poisoning.

[20] Analysis of the baseline survey on the prevalence of *Salmonella* in holdings with breeding pigs, in the EU, 2008, Part A: *Salmonella* prevalence estimates, EFSA Journal 2009; 7(12): [93 pp.]. doi:10.2903.1377. Available online: www.efsa.europa.eu

Feature Article 6: *Cysticercus bovis*

Author: Charlotte Featherstone (AHPA)

Reports of significant levels of *Cysticercus bovis* infection in fattened cattle from several farms in the same locality prompted an investigation into potential sources of the parasite.

Cysticercus bovis is the intermediate (larval) stage of *Taenia saginata*, the human beef tapeworm. Cattle become infected with bovine cysticercosis by ingesting materials contaminated with tapeworm eggs originating from human faeces. Humans, the definitive host, become infected via consumption of raw or undercooked beef. In people, the adult tapeworm ranges from 5m to 15m in length and whilst infection may occasionally be associated with diarrhoea or abdominal pain, it is usually asymptomatic and is mainly objectionable on aesthetic grounds.

Bovine cysticercosis is of economic importance to the beef industry due to the costs of meat inspection and control measures. Infected carcases may be condemned or downgraded and must be subjected to cold storage at temperatures not exceeding -7ºC for up to three weeks to ensure the metacestode stage of the parasite is killed.

In August 2013, levels of *C. bovis* infection in batches of cattle submitted for slaughter from a single beef producer were very high (estimated 70-80%). Collaboration with the University of Salford led to a molecular confirmation of the parasite involved. The beef producer batch reared both homebred and bought-in animals, and the majority of the affected cattle had remained housed whilst on the holding. The source of infection could not be definitively identified, but lines of enquiry focused on oil seed rape straw fed to the group of cattle in spring and potatoes which were fed in early summer, both of which had been incorporated into feed via a forage mixer. The straw had been harvested from land on which human sewage sludge had been applied in 2011. Some of the potatoes had been imported in June from Europe and were originally destined for the human food processing chain. They had been rejected by the food manufacturer reportedly after illegal immigrants had been found in the transport vehicle.

Following this outbreak, AHPA was made aware of four farms where significant levels of *C. bovis* infection in fattened cattle were reported by the same abattoir. In one case, involving a farm which purchased 21 month old store cattle to sell as finished at 24 months, 14 out of a batch of 20 animals were shown to have heavy infections. This resulted in significant disruption and economic loss to both the slaughterhouse, in the requirement to cold-store the carcases, and the farmer, whose end carcase price was only 60% of the anticipated finished price and well below the initial outlay to purchase store cattle. All affected farms purchased store cattle from different sources, and fattened the cattle over a period of approximately four months. Epidemiological investigations considered many potential sources of infection, including feed, bedding, flooding and staff sanitary conditions of the four affected farms. A common link was the feeding of potatoes from a single supplier, and this potato merchant also supplied feed potatoes for the first farm. Advice was given on reducing the exposure of cattle to potential sources of infection,

including measures to reduce any remaining environmental contamination on the affected farms.

Zoonoses A-Z

Anthrax (*Bacillus anthracis*)

Anthrax is caused by the bacterium *Bacillus anthracis*. Under certain environmental conditions *B. anthracis* can convert into a spore, which may survive in the environment for many decades in an inert state. In this form the organism shows great resistance to the effects of heat, drying, UV light and many disinfectants.

Anthrax can occur in all mammalian species, and has also been reported in some birds. The clinical presentation in animals varies between species with three forms of anthrax recognised: peracute/apoplectic, acute and chronic. Sporadic anthrax cases still rarely occur in cattle in the UK, presumably from exposure to anthrax spores present in soil and originating from cases that occurred decades earlier.

Anthrax infection in humans classically causes one of three types of disease that affect either the lungs (inhalation/ pulmonary), the digestive tract (intestinal) or the skin (cutaneous). In 95.0% of naturally-acquired human cases, the infection is cutaneous. Recent human cases of anthrax in the UK have been associated with drums made from imported animal hides, or with contaminated heroin.

Infection in humans

There were two human cases of anthrax reported in the UK in 2013 in persons who inject drugs (one case was reported in England and one in Scotland). As in previous outbreaks, these cases were thought to have been acquired from contaminated heroin. The isolates were indistinguishable from those recovered from similar cases in 2009-2012.

Genetic and genomic analyses demonstrated that anthrax strains from the 2009-10 outbreak among drug users were most closely related to isolates from Turkey[21]. Turkey is along a common route for transport of heroin from its primary source in Afghanistan into European countries, and the contamination most likely occurred from contact with animal hides.

Further molecular analyses provide evidence that a single strain of *B. anthracis* may have been responsible for the European cases of anthrax reported in 2012 and the 2009/10 outbreak[22]. This may indicate a continuing source of imported contaminated heroin which is being detected intermittently due to increased awareness, or a source of contaminated heroin that was removed from circulation in 2010 and recently re-introduced.

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[21] Price EP *et al*. Molecular epidemiologic investigation of an anthrax outbreak among heroin users, Europe. *Emerg Infect Dis* 2012;18(8):1307-13 http://dx.doi.org/10.3201/eid1808.111343

[22] Grunow R *et al*. Anthrax among heroin users in Europe possibly caused by same bacillus anthracis strain since 2000. *Euro Surveill* 2013; 18(13) :pii=20437. http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20437

Infection in animals

The last cases of anthrax in animals in GB occurred in 2006 when six cattle died on one farm in Wales (two confirmed and four suspected cases). The cause was thought to be river flooding/damage to a floodplain grazing field. In Northern Ireland the last case of anthrax was in 1990, affecting one cow on a farm in County Antrim.

There were no cases of anthrax detected in animals in the UK in 2013.

Avian and animal influenza

Influenza is a respiratory infection caused by viruses of the Orthomyxoviridae family. Animal-adapted influenza viruses do not readily infect people. However, spontaneous mutation or re-assortment of influenza virus genes between human and animal strains can occur. Some of these strains have the potential to be readily transmitted between people and can lead to pandemic spread in humans.

Avian influenza (AI), also referred to as ‘Fowl Plague’ or ‘Bird Flu’, is a disease of birds caused by type A influenza viruses. It is one of the most important poultry diseases as it is highly infectious, can produce significant mortality and can affect many species of birds. Avian influenza viruses are classified according to the severity of disease (pathogenicity) they cause in kept birds. They are either highly pathogenic or of low pathogenicity. Highly pathogenic avian influenza (HPAI) can cause severe disease in poultry, with a high death rate (up to 100% in affected flocks). HPAI disease can develop so rapidly that birds may die without showing any previous signs of disease. Low pathogenicity avian influenza (LPAI) viruses result in milder, less significant disease, but can mutate into highly pathogenic strains. Only HPAI is notifiable in birds. There are other influenza A viruses that affect other species of animals. None of these infections are notifiable and different virus strains can cause varying degrees of disease in their specific animal host. Most generally cause mild disease in comparison to the severity associated with HPAI infection in poultry.

The highly publicised H5N1 HPAI strain has been responsible for considerable poultry losses across Asia, and between 2005-2007 in Europe and other parts of the world. As a result the UK has maintained a high vigilance for avian influenza in response to the potential for westward spread of H5N1 from Asia and occasional incursion of other influenza viruses to European poultry.

Infection in humans

Human cases of avian influenza in the UK are very rare. In 2006, there was one confirmed case of H7N3 in a farm worker. In 2007, there were four cases in owners who kept birds, associated with a H7N2 poultry outbreak. All viruses were of low pathogenicity for poultry. There have been no deaths reported as a result of avian influenza in the UK.

There were no human cases reported in 2013 in the UK.

Infection in animals

There were no cases of HPAI in birds in the UK in 2013. A single case of H9N2 occurred in turkeys in April in East Anglia. Close cooperation between all stakeholders ensured the public health threat was mitigated and there were no human cases. The virus was shown by AHPA not to carry known mutations associated with increased risk for zoonoses.

The last case of HPAI in the UK was in Oxfordshire in June 2008 when H7N7 infected a single laying hen flock. Active surveillance of UK poultry stocks for viruses of H5 and H7 subtypes has been undertaken annually since 2003. Infrequently, antibodies to H5 or H7 infection subtypes have been detected in a small number of sampled birds, which is most likely indicative of prior exposure to LPAI virus strains and in ducks these are most likely to indicate non-specific reactions. During 2013, four of 377 holdings sampled in the UK had birds with antibodies to avian influenza viruses of subtypes H5 or H7. This compared with nine detections from 377 holdings sampled in 2012.

The UK undertakes EU-mandated AI wild bird surveillance activities on dead wild birds. Wild bird surveillance activities include patrols of designated reserves and wetlands around the UK and the investigation of wild bird 'mass mortalities' (defined as five or more wild birds of any species in any location in the UK). In Northern Ireland individual dead gulls, waders, ducks, geese and swans are investigated, in addition to mass mortality events. In 2013, a total of 560 wild birds were sampled in the UK. All of the birds sampled were found dead by the public or warden patrols of wetlands and reserves. H5N1 HPAI (notifiable in wild birds since 2003) was not detected. Evidence of other influenza A virus infections was found on one occasion - a herring gull collected at the London wetland reserve in June 2013 from which an H16 AI virus was isolated.

The most significant non-avian influenza associated with animals in recent years has been swine influenza. The number of diagnoses of swine influenza in respiratory disease cases in pigs remained relatively high (38/183 cases examined positive) in 2013, possibly because testing continued to be offered free of charge in some circumstances. The predominant strain of swine influenza circulating in the pig population in 2013 was the pandemic strain which emerged in 2009 (A(H1N1)pdm09), whilst H1N2 was also frequently reported. All H1N2 viruses have now acquired an internal cassette of genes from the pandemic strain thereby demonstrating the emergence and selection of second generation reassortant viruses in pigs. The genes of these viruses themselves originate from either contemporary or historical human viruses and carry unknown zoonotic risk, although perhaps significantly the viruses containing the HA gene have not circulated in humans for over 30 years. A single case with avian-like swine H1N1 was detected in 2013. Co-circulation of multiple strains continues to raise questions as to the long term dynamics of virus strain dominance or coexistence demonstrated here through the emergence and persistence of second generation reassortant viruses.

Further information:

Great Britain AI Wild Bird Surveillance data for 2013:

https://www.gov.uk/government/collections/biodiversity-and-wildlife-statistics

Northern Ireland Wild Bird Surveillance data for 2013:

http://www.dardni.gov.uk/index/animal-health-and-welfare/animal-diseases/avian-influenza/avian-influenza-questions-and-answers/wild-bird-surveillance.htm

Bovine tuberculosis (*Mycobacterium bovis*)

The *Mycobacterium tuberculosis* complex includes *M. tuberculosis, M. bovis* and *M. microti.* Bovine tuberculosis (bTB) is caused by *M. bovis*, a zoonotic organism that can give rise to a form of tuberculosis in humans that is virtually indistinguishable from the disease caused by *M. tuberculosis,* which is the major cause of human TB.

Infection with *M. bovis* most often occurs when airborne droplets of moisture (aerosols) containing the organism are inhaled, but can also occur by eating or drinking contaminated foodstuffs. The consumption of unpasteurised milk or dairy products from infected cows was an important cause of childhood tuberculosis in the UK until pasteurisation became widespread in the mid-20th century.

Bovine TB is one of the most serious animal health problems for the cattle industry in the UK. Over the last ten years the disease has cost the Government more than £500 million and could cost another £1 billion in the next ten years unless the current trends are reversed. *M. bovis* infection has also been found in many other mammal species, including other livestock, wildlife, domestic cats and dogs. However, only badgers and cattle are considered maintenance hosts for *M. bovis* in the UK, although wild deer may also act as maintenance hosts in isolated areas in some circumstances[23]. Other mammals behave as spill-over or dead-end hosts.

A compulsory eradication campaign for bTB began in GB in 1950 and in Northern Ireland in 1959. This was underpinned by routine screening of herds using the comparative tuberculin skin test, slaughter of all test reactors and cattle movement restrictions in infected herds. This programme gradually reduced the incidence infection in cattle herds to a very low level by the early 1980s. However, since then, the number and geographical distribution of new incidents of TB in cattle herds ('breakdowns'[24]) have steadily increased in England and Wales. This trend accelerated immediately after the foot and mouth disease outbreak in 2001, during which the routine TB testing and slaughter programme was suspended for almost ten months.

[23] Delahay, RJ *et al*. 2007. Bovine tuberculosis infection in wild mammals in the South-West region of England: a survey of prevalence and a semi-quantitative assessment of the relative risks to cattle. Veterinary Journal 173, 287-301

[24] Incidents of bovine TB are also known as 'breakdowns', i.e. herds in which at least one animal was identified as a reactor to the tuberculin skin test or where one or more *M. bovis* culture-positive tuberculous lesions were detected by meat inspection during commercial slaughter of a non-reactor animal.

M. bovis is currently endemic in cattle and badgers in most of Northern Ireland and large tracts of south west England and south and mid-Wales. Scotland was declared an officially bTB free region of the UK by the European Commission in 2009 (Decision 2009/761/EC) and, as such, it implements strict controls regarding the movement of cattle from the rest of the UK.

Infection in humans

In the last five years, *M. bovis* has accounted for approximately 0.7% of all culture-confirmed notified *M. tuberculosis* complex diagnoses in humans in the UK annually.

In 2013, there were 29 culture-confirmed notified cases of human TB caused by *M. bovis* in the UK, compared to 39 in 2012. Twenty-three were from England, four in Northern Ireland, two in Scotland and no cases were reported in Wales.

A country of birth was reported for 22 out of the 23 cases in England. Fifteen were UK born of which 14 were of white ethnicity and one was of unknown ethnic origin. Only a small minority (four people) had evidence of recent exposure, making reactivation of latent disease the most likely cause of TB in the majority. Of those with recent exposure, two cases are explained by an unusual outbreak of *M. bovis* in cats with cat-to-human transmission, which occurred during the year and this is reported in the first feature article.

Of the non-UK born cases reported in 2013, three were from Morocco, one from Eritrea, one from India and one from Ireland.

Infection in animals

In GB there were 79,287 cattle herds and 8.18 million cattle registered during 2013. A total of 4,821 new bTB incidents were recorded in GB in 2013, a 6.4 % decrease on the 5,151[25] new bTB incidents recorded in 2012, with 99.4% of these new incidents occurring in England and Wales. Post-mortem evidence of bTB (characteristic lesions in test reactors and/or culture of *M. bovis*) was detected in 3,255 (67.5%) of the new incidents for GB. A total of 32,620 cattle in GB were slaughtered as tuberculin skin or interferon-gamma (blood) test reactors in 2013, a decrease of 13.6% from 2012 (n=37,735 [26]).

In 2013 Wales witnessed the lowest number of new incidents recorded since 2008 with only 871 cases. The total number of TB incidents where officially TB free status was withdrawn during Jan-Dec 2013 was 445 compared with 567 for the same period in 2012. The number of animals slaughtered in Wales as TB test reactors to the tuberculin skin test or the interferon-gamma blood test during 2013 was 5,883 compared with 8,901 for the same period in 2012. The number of suspect cases of bovine TB initially identified during routine post-mortem meat inspection in abattoirs of carcases of cattle from Welsh herds in January-December 2013 was 144 (of which 74 were bacteriologically confirmed as *M.*

[25] Updated figure post publication of 2012 UK Zoonoses Report.
[26] Updated figure post publication of 2012 UK Zoonoses Report.

bovis infections), compared with 174 (97 confirmed) for the same period in 2012. In December 2013 there were 1,177 herds under movement restriction in Wales due to a TB incident or overdue TB test, compared with 1,638 in December 2012.

In Scotland, there were 28 new bTB incidents in 2013, a decrease from 53 in 2012. Of the new incidents in 2013, 10 had cattle with visible lesions of TB or positive culture results for *M. bovis*. The majority of these bTB incidents in Scotland were due to inward movements of cattle from high risk areas elsewhere in the UK and Ireland.

In Northern Ireland there were 24,098 cattle herds with 1.59 million cattle registered during 2013. There were 1,479 new TB reactor herds and 8,271 reactor animals, and at the end of the year 1,295 herds (5.4%) were still under bTB restriction.

One hundred and thirty two incidents of *M. bovis* infection in non-bovine domestic animals (mainly sheep, goats, pigs, camelids, dogs, cats and farmed deer) and wild deer in GB were confirmed by culture during 2013. This compares to 99 incidents during 2012. No cases of *M. bovis* in non-bovine domestic animals were identified in Northern Ireland.

Further information

Bovine TB leaflet for farmers:

http://webarchive.nationalarchives.gov.uk/20140714084352/

Cross Government guidance:

https://www.gov.uk/government/publications/bovine-tuberculosis-tb-public-health-management

For historical annual bTB incidence and charts:

https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs/series/bovine-tb

The GB data provided above on TB incidents in cattle were derived from the Monthly Publication of National Statistics on the Incidence of Tuberculosis in Cattle to end June 2014, issued by Defra on 10 September 2014. The bovine TB statistics are updated monthly and are available on the above link. All bovine TB data in this Defra TB database are provisional and subject to change as more data become available.

Brucellosis (*Brucella* spp.)

The cattle population of GB has been officially brucellosis free (OBF) since 1985, while Northern Ireland has not yet achieved this status. Bovine brucellosis was largely eradicated from Northern Ireland during the 1980s and only sporadic outbreaks occurred during 1990 to 1996. In 1997, three primary outbreaks resulted in secondary and tertiary spread to more than 60 farms. An eradication programme is in place in Northern Ireland,

as a result of which the prevalence of bovine brucellosis has fallen since the peak of infection in 2002. Nevertheless, the presence of *B. abortus* in cattle in Northern Ireland continues to constitute a potential risk to public health.

Infections with *B. ovis*, *B. melitensis*, *B. suis* and *B. microti* have never been detected in the animal population in the UK. The marine species *B. ceti* and *B. pinipedalis* are occasionally isolated from marine mammals washed up on the coast around the UK.

Cases of *B. abortus* in humans are occasionally acquired in Northern Ireland, and peaked in 2002 along with the peak of infection in cattle. Otherwise brucellosis is generally acquired abroad (usually *B. melitensis*). Most human cases of brucellosis are acquired through the consumption of unpasteurised milk and dairy products. However, where disease exists in cattle, infection can be as a result of occupational exposure through the handling of infected afterbirths and products of conception (e.g. in farmers, veterinarians or abattoir workers).

Infection in humans

Between 2004 and 2012 an average of 17 cases of acute brucellosis were identified in humans each year. This level of infection has remained relatively stable, with slight variation between years.

In 2013, 15 cases of brucellosis in humans were identified in the UK (Table 3): 13 in England and Wales, two in Scotland and none in Northern Ireland. Sources and countries of infection are not reported consistently, but one case was known to be of Somali origin and had consumed unpasteurised camel milk.

Table 3 Reports of *Brucella* infection in humans in the UK, 2013

	England & Wales	Scotland	Northern Ireland	UK Total
B. abortus	0	0	0	0
B. melitensis	8	1	0	9
Other *Brucella* spp.	5	1	0	6
Total	13	2	0	15

Infection in animals

The OBF status and trading rules underpin international trade and it is important to detect an incursion as quickly as possible should one occur. Therefore, a programme of surveillance is carried out in GB to ensure that the OBF status is not compromised. Cattle surveillance includes targeted post-import testing of breeding cattle, risk-based investigations of cattle abortions and premature calvings and testing of bulk milk samples from all dairy herds. An annual survey to specifically demonstrate the absence of *B.*

melitensis in sheep and goats, as required by EU Council Directive 91/68/EEC, is conducted in the UK. Evidence of absence of *B. melitensis* is also supported through the testing of submissions of abortion samples from sheep and goats.

No cases of brucellosis were detected in terrestrial animals in GB during 2013. Tests were carried out on: 40,082 bulk milk samples; 5,279 cattle abortions and premature calvings; 4,761 post importation tests of breeding cattle; and 11,478 tests of imported cows at their first calving following importation. The annual sheep and goat survey which tested 21,353 small ruminants from 1,307 sheep flocks and 642 goats from 183 herds in GB and 3,805 sheep from 220 flocks and 131 goats from 24 herds in Northern Ireland, also found no evidence of *B. melitensis*.

In Northern Ireland in 2013, 848,811 eligible animals in 19,696 cattle herds were tested for *B. abortus.* Twenty-eight herds (0.1%) were positive (the same percentage as 2012) and 26 were new herds. A total of 32 cattle were positive (0.003%, compared to 0.007% in 2012), with no herds confirmed by bacteriological culture.

Campylobacteriosis (*Campylobacter* spp.)

The species of greatest public health importance are *Campylobacter jejuni* and *C. coli* (thermophilic campylobacters) which can be found in a wide range of livestock (especially poultry) and wildlife species. They do not generally cause disease in animals, apart from occasional abortion in sheep and enteritis in young mammalian animals. *C. fetus fetus* is a common cause of abortion in sheep and may occasionally cause serious systemic disease in humans. Other *Campylobacter* species, such as *C. sputorum*, *C. hyointestinalis* and *C. lari* are present in mammals and birds in the UK, but are not generally considered of public health importance.

Campylobacter was first confirmed to cause human illness in 1972, and by 1986 it became recognised as the most commonly reported gastrointestinal pathogen in the UK, ahead of salmonella. *C. jejuni* accounts for approximately 90% of human infection. However, most laboratories do not routinely speciate strains isolated from human clinical specimens, so changes in relative incidence may not be detected.

Transmission to humans is through the faecal-oral route, usually by the consumption of contaminated foods or water.

Infection in humans

National laboratory report surveillance for campylobacter has shown an upward trend from 2008-2012. However, the provisional figures for 2013 are lower than the previous three years.

In 2013, there were 66,575 laboratory reports of campylobacter in the UK. Overall this is a decrease of 8.3% from 2012. Although reports fell by 9.3% and 2.7% in England and Wales and in Scotland respectively, they increased by 11.9% in Northern Ireland (Table 4).

Table 4 Number of *Campylobacter* reports in humans 2011-2013

Year	England & Wales	Scotland	Northern Ireland	UK
2011	64,781	6,365	1,175	72,321
2012	65,085	6,333	1,211	72,629
2013*	59,057	6,163	1,355	66,575

*These figures are provisional and may be subject to change due to delayed reporting

The Second Study of Infectious Intestinal Disease in the Community established that the ratio of unreported human campylobacter infection to reports to national surveillance is 9.3 to 1[27]. This suggests that in 2013, there were approximately 685,000 campylobacter cases[28] in the UK.

Campylobacter spp. are present in a significant proportion of animals and poultry entering slaughterhouses, resulting in potential for widespread contamination of meat (especially poultry meat) during the slaughter process and at retail. An estimated 60-80 % of *Campylobacter* infections are attributed to chicken and as a result the Food Standards Agency sees the reduction of campylobacter in poultry as a key priority. In 2013, there were 19 foodborne outbreaks of campylobacteriosis reported, which is a significant increase on the eight reported in 2012. Fourteen outbreaks were associated with the consumption of poultry, of which nine were chicken liver parfait. One outbreak was associated with red meat and another outbreak with milk and dairy products. The implicating food vehicle for three of the outbreaks is unknown. A summary of foodborne outbreaks by zoonotic pathogens, broken down by food vehicle category is given in appendix 5.

The Food Standards Agency is leading a Campaign (Acting on Campylobacter Together – ACT) to bring together the whole food chain to tackle campylobacter, from farm to fork. Further details can be found at:

www.food.gov.uk/actnow

Infection in animals

The majority of livestock derived samples were from ruminant abortion investigations. There was a significant increase in the incidence of campylobacter-associated abortion in sheep in GB, with almost twice as many cases diagnosed in 2013 compared to 2012, despite comparable submission levels. As a consequence campylobacter infection was the second most common infectious cause of ovine fetopathy incidents diagnosed by government laboratories in GB in 2013 (most common infectious cause in GB was *Chlamydophila abortus*). Incidences of campylobacter fetopathy recorded by AHPA appear

[27] Tam CC, *et al.* Longitudinal study of infectious intestinal disease in the UK (IID2 study): incidence in the community and presenting to general practice (2012) *Gut* Jan; 61(1):69-77.
[28] confirmed and estimated unconfirmed cases

to follow a cyclical pattern, with significant rises in infection rates observed every three years. This is thought to be due to immunity waxing and waning in the national flock.

Two hundred and sixty one (74.6%) of the ovine isolates were confirmed as *C. fetus fetus,* an increased percentage compared to 2012 (66.9%). Of the thirty eight bovine isolates, 20 (52.6%) were identified as *C. fetus venerealis* compared to 38.2% in 2012 and three (7.9%) were *C. fetus fetus* (10.9% in 2012) with the remaining 15 (39.5%) a mixture of unspecified and enteric (thermophilic) strains. All isolates from pet animals in Table 5 were from testing undertaken by SRUC. Campylobacter isolates may not always be considered clinically significant in a disease investigation. Therefore, discrepancies may exist between the figures reported below (which relate solely to testing of individual bacterial isolates) and those provided in Appendix 4 (which relate to clinical diagnoses of campylobacteriosis in animals).

Table 5: Number of *Campylobacter* spp. isolates identified by Government laboratories in animal derived samples in the UK in 2013

	Total units tested positive for Campylobacter	C. coli	C. jejuni	C. sputorum	C. upsaliensis	Campylobacter spp, unspecified	C. fetus subsp fetus	C. fetus subsp venerealis*	C. lari
Cattle	38		4	3		7	3	20	1
Pigs	6		2			4			
Sheep	352	10	49	1	2	28	261		1
Chickens**	478	112	365			1			
Cats***	7	1			5	1			
Dogs***	95	1	27		60	6			1
Guinea pig***	1		1						
Giraffe	1		1						
Total**	978	124	449	4	67	47	264	20	3

* Also includes C. fetus subsp venerealis intermedius (Cfvi) isolates, although not all laboratories test isolates to this level.

** The chicken data primarily reflects the results of a survey of broilers at slaughter in 2013 which was part of a structured official monitoring programme based on Decision 2007/516/EC. In the survey 473 neck skin samples were tested, with 78 positive for *C. coli* and 298 positive for *C. jejuni* and of 125 caecal contents samples were tested, 34 were positive for *C. coli* and 66 for *C. jejuni.* In

addition to these survey results there was one *C. jejuni* isolated from a chicken in England and an unspecified *Campylobacter* isolated from a chicken in Northern Ireland.

*** SRUC (formerly the Scottish Agricultural College) routinely receives and tests diagnostic samples from companion animals in Scotland (and elsewhere in the UK) and this data has been included in the above this year.

Chlamydiosis and Psittacosis

Ovine chlamydiosis (*Chlamydophila abortus*)

Infection of pregnant ewes with *Chlamydophila abortus* may result in enzootic abortion of ewes (EAE). *C. abortus* may also cause abortion in goats and cattle. The main route of transmission of this zoonosis to humans is through the inhalation of aerosols and contaminated dusts.

This infection can cause serious zoonotic disease in pregnant women, resulting in stillbirth or abortion. However, human infections appear to be rare.

Infection in humans

The number of human cases of *C. abortus* occurring annually is uncertain as routine serological testing does not distinguish between *C. abortus* and other *Chlamydophila* species. Diagnosis of *C. abortus* is dependent primarily on clinical suspicion in a person with positive serology for Chlamydophila infection and relevant exposure to sheep/lambing.

There were no human cases reported in 2013 in the UK.

Infection in animals

In 2013, there were 327 incidents of sheep or goat abortion due to *C. abortus* infection in the UK (Table 6). There was one incident of abortion due to *C. abortus* in cattle in 2013.

Table 6 Laboratory confirmed reports of *C. abortus* in animals in the UK, 2013

		GB	NI	UK Total
Sheep and goat abortions submissions*		1,978	331	2,309
C. abortus confirmed as cause of abortion	in goat abortion material	3	0	3
	in sheep abortion material	276	51	327

***** To AHPA and SRUC in GB, and AFBI in NI, where a diagnosis is reached

Psittacosis (*Chlamydophila psittaci*)

Psittacosis (also known as ornithosis or chlamydiosis) is an infection caused by *Chlamydophila psittaci*. It has been described in over 130 species of birds but is most common in psittacines (parrots and parakeets). Other birds commonly affected include pigeons and doves, whilst turkeys, ducks and geese can also be infected.

Transmission of *C. psittaci* from birds to humans most often occurs via infectious aerosols, so the presence of strong air currents may be a factor in its spread[29]. It is likely that most, if not all, cases of psittacosis are attributable to exposure to birds or bird products.

Infection in humans

In 2013, there were 34 laboratory reports of human infection with *C. psittaci* in the UK (compared with 37 cases reported in 2012), with 29 cases in England and Wales and five in Scotland. No cases were diagnosed in Northern Ireland.

A lack of specific serological testing means that reported cases could have been caused by *Chlamydophila* species other than *C. psittaci*.

Infection in animals

Two cases of avian chlamydiosis (presumed *C. psittaci*) were diagnosed by government laboratories following testing of samples from birds during 2013 in GB (the same number as 2012).

Further information

Chlamydiosis (Enzootic Abortion in Ewes) and risks in lambing season:

http://webarchive.nationalarchives.gov.uk/20140714084352/http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/ChlamydophilaAbortus/GeneralInformation/

Cryptosporidiosis (*Cryptosporidium* spp.)

Cryptosporidiosis is a disease caused by protozoan parasites of the genus *Cryptosporidium*. *C. hominis* is normally only recovered from humans and *C. parvum* is found in both animals and humans. Together, these *Cryptosporidium* species are responsible for up to 96% of cases in the UK and have different risk exposures, seasonal and geographical distributions[30].

[29] http://webarchive.nationalarchives.gov.uk/20140714084352/
[30] Chalmers RM, *et al.* Epidemiology of anthroponotic and zoonotic human cryptosporidiosis in England and Wales, 2004 to 2006. *Epidemiology and Infection* 2011; 139(5): 700-712.

Young calves (particularly those aged between 10-20 days) are considered to be the major animal reservoir for *C. parvum*, but infection can also be acquired from other species, particularly lambs and goat kids. *C. parvum* is considered to be endemic on the majority of cattle holdings in the UK, and is also common in sheep flocks and deer. Clinical disease (diarrhoea) is seen in young animals, but may not always be apparent.

Human infection is acquired through the consumption of contaminated food or water, contact with infected animals, exposure to faeces in the environment or person-to-person spread. Confirmed reports of cryptosporidiosis in humans in the UK follow a bimodal seasonal pattern, with higher incidence occurring in spring and early autumn. The spring peak consists predominantly of *C. parvum* cases, which are most likely acquired from animal sources. In contrast, the larger, early autumn peak has a greater rise in *C. hominis* cases, many of which are associated with travel outside the UK.

Infection in humans

The number of cases diagnosed and reported in the UK in 2013 was 4,111. This is a 38.2% decrease in the number of cases reported from 2012. This decrease was observed across the UK (Table 7).

Table 7 Number of *Cryptosporidium* reports in humans 2011-2013

Year	England & Wales	Scotland	Northern Ireland	UK
2011	2,990	443	140	3,573
2012	5,765	713	177	6,655
2013*	3,520	430	161	4,111

*Provisional data

The Second Study of Infectious Intestinal Disease in the Community indicated that the ratio of unreported human cryptosporidiosis in the community to reports to national surveillance is approximately 8.2 to 1[27]. This suggests that, in 2013, there were approximately 38,000 cases[28] of cryptosporidiosis in the UK.

In 2013, there were 21 outbreaks of cryptosporidium reported in England and Wales, compared to 14 reported in 2012. Only one of these was foodborne with transmission being associated with public drinking water. The most common outbreak settings in 2013 were swimming pools and petting/open farms.

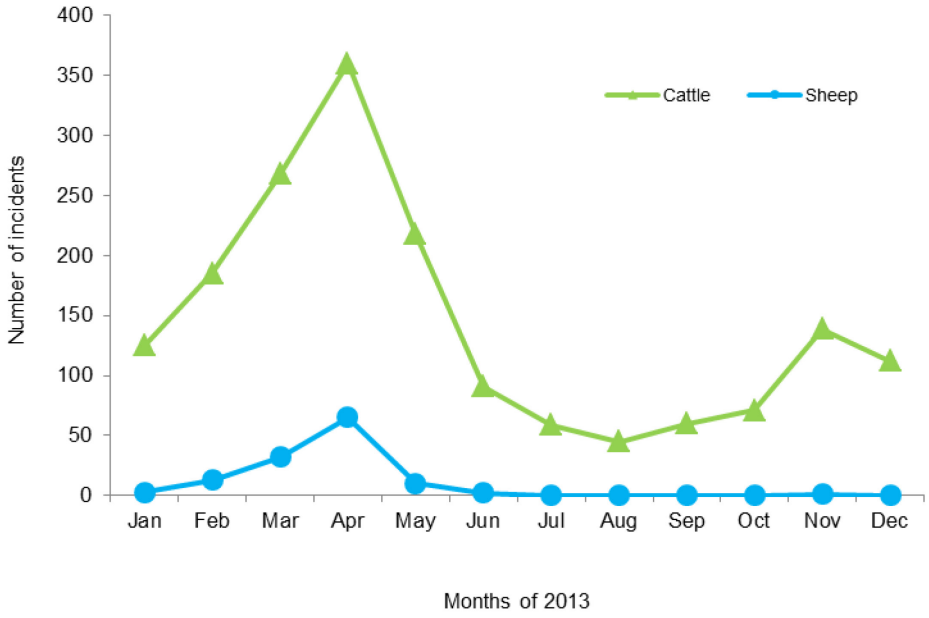
Infection in animals

Clinical cryptosporidiosis is relatively common in animals in the UK. There were 1,870 diagnoses of clinical animal infection with cryptosporidia recorded by UK Government veterinary laboratories (1,728 diagnoses in UK cattle, 126 in UK sheep [figure 6], plus additional GB diagnoses in other species: eight goats, three alpacas, two hedgehogs, one

pig, one bird and one reindeer). Examination of the VIDA data indicates that, of clinical material examined by government diagnostic laboratories in GB, clinical infection with *Cryptosporidium* spp. was diagnosed in 5.0% of cattle submissions (2.8% in 2012) and 1.3% of sheep submissions tested (0.7% in 2012).

There was a significant increase in the incidence of cryptosporidiosis in both calves and lambs in 2013, particularly in England and Wales. One possible explanation for this is an extended winter housing period as turn out to grazing was delayed due to poor spring grass growth in many areas. The three alpaca positives were eight-month-old animals investigated by AHPA. Each animal had become weak, dehydrated and subsequently died, and all were from one premise. Post-mortem examination revealed ulcerative enterotyphlocolitis and histopathology demonstrated a heavy cryptosporidial burden within the small intestine. PCR testing identified the cryptosporidia as *Cryptosporidium parvum*. This is an unusual diagnosis in eight-month-old alpacas as previous clinical cases have mostly been in young, pre-weaned crias[31].

Figure 6 Recorded diagnosis of cryptosporidiosis in cattle and sheep in UK, 2013



Echinococcosis

Alveolar echinococcosis (*Echinococcus multilocularis*)

Echinococcus multilocularis causes alveolar hydatid disease, which has a wide geographical distribution across the Northern hemisphere throughout Europe, North

[31] Wessels J, *et al* (2013). Camelid diseases: Cryptosporidiosis in eight-month old weaned alpacas. *Veterinary Records* 2013; 173 (17): 426-427.

America and Asia. Alveolar hydatid disease is a much more invasive disease in humans than cystic hydatidosis. The life-cycle normally involves foxes and raccoon dogs as definitive hosts and small rodents, particularly voles, as intermediate hosts. Dogs, cats and wolves may also act as definitive hosts to a lesser extent.

E. multilocularis is not known to be present in indigenous animals in the UK, although rarely cases have been identified in imported animals in previous years. Dogs entering the UK are required to receive treatment for *E. multilocularis*. However, there is evidence that the distribution of *E. multilocularis* is spreading in northern Europe[32,33,34]. Particular concern has been expressed in relation to the increase in the number of urban foxes should the infection enter the UK.

The European Commission adopted Regulation (EU) No 1152/2011 on 14 July 2011, as regards preventive health measures for the control of *E. multilocularis* infection in dogs[35]. It states the requirements for implementing a pathogen-specific surveillance programme regarding sampling, detection techniques and reporting which allows the UK, Ireland, Finland and Malta to maintain disease free status. Under this regulation, a programme is in place to carry out surveillance in foxes sufficient to detect not more than 1% prevalence with a confidence of 95% (at least 300 foxes sampled). As with previous surveys, the 2012-2013 surveillance of the UK fox population did not identify any *E. multilocularis.*

Cystic hydatidosis (*Echinococcus granulosus*)

Echinococcus granulosus is a tapeworm which inhabits the small intestine of canines. The *E. granulosus* complex consists of 10 *E. granulosus* genotypes,[36] two of which are present in the UK in indigenous animals: a sheep adapted strain involving a dog to sheep life-cycle (the G1 strain), and a horse adapted strain involving a dog to horse life-cycle (the G4 strain).

The main cycle of infection in GB is between farm dogs (the definitive host in the UK) and sheep (the main intermediate host). Sheep acquire hydatidosis by grazing on pastures contaminated with dog faeces containing the cestode eggs or by ingesting other contaminated feed. Cattle can also be infected with the sheep strain, but resultant cysts are usually sterile. Dogs are infected by ingesting animal viscera containing viable cysts.

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[32] Takumi K, *et al.* Evidence for an increasing presence of *Echinococcus multilocularis* in foxes in The Netherlands. *Intl J for Parasitology* 2008; 38(5):571-578.
[33] Berke O, *et al.* Emergence of *Echinococcus multilocularis* among red foxes in northern Germany 1991-2005. *Veterinary Parasitology* 2008; 155(3-4):319-322.
[34] Vervaeke M, *et al.* Spatial spreading of *Echinococcus multilocularis* in red foxes across nation borders in Western Europe. *Preventive Veterinary Med.* 2006; 76(3-4):137-150.
[35] OJ L 296, 15.11.2011, p.6.
http://eur-lex.europa.eu/JOIndex.do?year=2011&serie=L&textfield2=296&Submit=Search&_submit=Search&ihmlang=en
[36] Boubaker G, *et al.* (2013) A Multiplex PCR for the Simultaneous Detection and Genotyping of the *Echinococcus granulosus* Complex. PLoS Negl Trop Dis 7(1): e2017. doi:10.1371/journal.pntd.0002017
http://www.plosntds.org/article/info%3Adoi%2F10.1371%2Fjournal.pntd.0002017

Humans can act as an accidental intermediate host through direct contact with infected dogs or their faeces. The current incidence of human hydatid disease in the UK is considered to be very low. Over 95% of new cases identified in the UK are diagnosed in non-UK nationals and have a history of prior residence in countries around the Mediterranean Basin or Asia, or travel to countries where cystic echinococcosis is endemic.

Developing cysts may grow for 20 or more years before becoming large enough to cause a range of symptoms depending on the affected organ and the location of the cyst. This long incubation period means that new autochthonous cases may occur occasionally in people who have been exposed in the UK many years previously but who have remained asymptomatic for a substantial part of their lives.

Infection in humans

During 2013, 14 confirmed cases of hydatid disease in humans were reported in the UK (compared with six in 2012). Eleven were from England and Wales and three from Scotland, but all had an exposure history that suggested they contracted their disease outside of the UK.

Infection in animals

The following figures are reported findings of hydatid disease at post mortem inspection of sheep and cattle for human consumption at licensed abattoirs in UK during 2013. There was a throughput of 14,563,531 sheep, of which 33,050 (0.2%) were recorded as being affected with hydatid cysts (0.3% in 2012). Of a throughput of 1,844,890 cattle, 2,749 (0.1%) were recorded as affected with hydatid cysts (0.1% in 2012). In Wales, there was one bovine case of hydatid disease diagnosed by AHPA.

In Northern Ireland, there were four cases of hydatid disease in sheep reported at an abattoir in 2013. In 2012, there was one abattoir case, but prior to this; the last recorded abattoir detection in Northern Ireland was in June 2006.

In 2008, the Welsh Government launched a Wales-wide hydatid disease awareness campaign and a South Powys pilot eradication scheme, which continued throughout 2009 and finished in 2010. This was focussed in the same area as a previous dog worming campaign in South Powys, Wales, undertaken in the eighties, and was initiated following evidence[37] to suggest a rising trend of dog infestation.

Data from the South Wales pilot eradication scheme indicated an initial prevalence of 9% of farm dogs sampled. One or more dogs on 20% of farms tested positive, representing a potential human health risk. The study helped confirm that worming dogs regularly with an

[37] Buishi I, *et al*. (2005) Re-emergence of canine *Echinococcus granulosus* infection, Wales. *Emerg Infect Dis. 11*(4):568-71

appropriate treatment remains highly effective and a key personal health protection measure[38].

Further investigation by the Welsh Government has shown that *E. granulosus* is present in a wide geographical distribution across Wales and the west and south west of England. Data for other areas of England has not been collected.

Hantavirus

There are many different hantaviruses, many with defined geographical distribution. They are rodent-borne and each is specific to a different host. They are not usually associated with overt disease in rodents (although domesticated animals can develop clinical signs with some hantaviruses), and once infected, the rodent may shed infectious virus for prolonged periods.

Transmission of hantaviruses to humans occurs through the inhalation of infected animal excreta and fluids, i.e. urine, faeces and saliva. Although some hantaviruses are associated with asymptomatic infections or mild disease, most can cause serious infections in humans ('haemorrhagic fever with renal syndrome' and 'hantavirus pulmonary syndrome'). Case fatality rates vary greatly with disease syndrome and specific viruses, ranging from 0.1% to in excess of 50%. Historically, few indigenous cases of infection have been confirmed in the UK, and until recently, virological evidence was lacking.

Infection in humans

In 2013, there were three confirmed cases in England (one with exposure to wild rats and two with exposure to fancy pet rats) and one confirmed case in Wales. The first case of Seoul hantavirus infection in the UK was confirmed in 2012, with virus subsequently being isolated from wild rats at the location of exposure in north east England. See feature article 2 for more detail.

Infection in animals

Pet rats (*Rattus norvegicus*) were identified as the probable source of Seoul hantavirus infection in a male human patient from Wales, who had presented with hemorrhagic and pulmonary syndrome. Hantavirus RNA was detected in blood and tissue samples from the patient's two pet rats, and further investigations of the fancy rat breeding colony from which the rats were derived and subsequently returned, identified a hantavirus RNA in a significant number of the 21 rats tested using RT-PCR. A letter to raise awareness of the incident and provide information and advice to private veterinary surgeons was published in the Veterinary Record[39].

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[38] Mastin A, *et al* (2011) Spatial and temporal investigation of *Echinococcus granulosus* coproantigen prevalence in farm dogs in South Powys, Wales. *Veterinary Parasitology, Volume 178, Issues 1–2*: 100–107

[39] Featherstone CA, *et al*. Hantavirus and pet rodents (Letter) *Veterinary Record* (2013) 172: 370

Hepatitis E

Hepatitis E virus (HEV) is an enteric virus that can cause acute liver disease in humans. HEV infection is usually a mild, self-limiting illness however, in rare cases fulminant disease (acute liver failure) develops and can prove fatal, particularly in pregnant women. Infection can progress to chronic hepatitis in immuno-compromised individuals, mainly among solid organ transplant recipients.

Hepatitis E is found worldwide. There are four main genotypes of HEV: genotype 1 is usually found in Asia and Africa, type 2 in Mexico, type 3 in North America and Europe, and type 4 in China. Types 1 and 2 are only found in humans while types 3 and 4 can infect humans and other animal species, particularly pigs and deer, although they do not appear to cause illness in these animals. HEV is endemic throughout Europe, including the UK. The majority of hepatitis E cases in UK are non-travel related and a study in 2004 showed these cases were infected by HEV type 3 similar to that carried by British pigs[40].

HEV is transmitted mainly through ingestion of faecally-contaminated water or undercooked products from infected animals. In developed countries, sporadic outbreaks have followed consumption of undercooked pork or deer meat, or uncooked shellfish. Other routes of transmission include transfusion of infected blood products and vertical transmission (during pregnancy to the foetus). The disease usually clears within one to four weeks, but immune deficiency and chronic liver disease, along with increasing age, appear to be associated with moderate to severe disease. Mortality in the general population is usually 1-3%.

Infection in humans

Hepatitis E cases have significantly increased in recent years, with 787 cases reported in the UK in 2013, a 19.8% increase since 2012. Indigenous cases now account for the majority of cases in England and Wales and appear to be the main reason for the recent dramatic rise. In 2013, 477 (69.0%) cases in England and Wales were assessed as being non-travel associated, compared with an average of 50.7% since 2003 (Table 8). In 2013, 452 (65.4%) cases were male and 458 (66.3%) were in people over 50 years of age: 43.7% (302 cases) were both male and over 50 years of age. There was no geographical clustering.

Table 8 Laboratory confirmed reports of Hepatitis E in UK residents, 2004-2013

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
England & Wales	149	329	289	162	176	175	274	456	579	691
E&W: non travel associated cases	35	133	176	63	76	77	141	252	409	477

[40] Banks M, *et al*. Human and porcine hepatitis E virus strains, United Kingdom. *Emerg Infect Dis* 2004; 10:953-5.

Scotland	3	10	3	4	4	3	13	15	78	95
Northern Ireland*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
United Kingdom	152	339	292	166	180	178	287	471	657	787

*Northern Ireland does not routinely test for Hepatitis E.

A 2011/12 study found that indigenous cases of hepatitis E in England and Wales were associated with the consumption of processed pork products[41]. In addition, a recent study has shown that 9.5% of pork sausages sampled at point of sale from UK retailers were positive for hepatitis E virus[42], and similar findings have been reported from other European laboratories[43].

Infection in Animals

Hepatitis E does not cause disease in pigs and there are no routine surveillance systems in place.

A pig abattoir survey was undertaken in early 2013 (as part of a multi-agency project with PHE, Defra, VMD, FSA, AHPA and the British Pig Executive (BPEX) to better understand the possible role of infection in pigs on human disease incidence. See feature article 3 for further details.

Leptospirosis (*Leptospira interrogans* serovars)

Leptospirosis is a zoonotic disease caused by the bacterium *Leptospira interrogans*, of which only some strains are pathogenic. *L.* Icterohaemorrhagiae is the main serovar causing human disease.

Leptospires are widespread amongst wild and domesticated mammals. The serovars encountered most frequently in farm livestock in the UK are *L.* Hardjo (cattle), *L*. Bratislava (pigs) and *L*. Icterohaemorrhagiae (which affects a wide range of wild and domestic species). Leptospirosis is a major cause of economic loss to intensive cattle and pig industries in developed countries. Clinical disease in animals in GB is less common than in the past, although it remains a significant problem in Northern Ireland.

Humans mainly acquire infection by direct contact with the urine of chronically infected carrier animals. Infection occurs when spirochaetes in contaminated water or soil enter micro-abrasions in healthy intact skin or intact mucous membranes or conjunctiva. They

[41] Said B, *et al*. Hepatitis E virus in England and Wales: indigenous infection is associated with the consumption of processed pork products. Epidemiology & Infection (In press)
[42] Berto A *et al.* Hepatitis E virus in pork food chain, United Kingdom, 2009–10. *Emerg Infect Dis* 2012; 18(8): 1358–60. DOI: 10.3201/eid1808.111647
[43] Di Bartolo I *et al.* Hepatitis E virus in pork production chain in Czech Republic, Italy, and Spain , 2010. *Emerg Infect Dis* 2012; 18(8). DOI: 10.3201/eid1808.111783. http://wwwnc.cdc.gov/eid/article/18/8/11-1783_article.htm

may also cross the nasal mucosa and pass through the lungs (from inhalation of aerosolised body fluids). Most reported cases occur in men, probably due to greater occupational and recreational exposures.

Infection in humans

During 2013, 50 cases of leptospirosis were reported in the UK (Table 9). Forty-seven of these cases occurred in England and Wales, and the following serovars were determined by the *Leptospira* Reference Unit: *L.* Icterohaemorrhagiae (n=4) and *L.* Hardjo (n=1). The infecting serovar was not determined for the remaining cases.

Table 9 Laboratory confirmed reports of leptospirosis in UK residents, 2011-2013

Year	England & Wales	Scotland	Northern Ireland	UK
2011	44	5	3	52
2012	72	4	2	78
2013	47	1	2	50

Twenty-three cases in England and Wales were acquired indigenously, and 24 were acquired through travel (with the largest number of cases returning from South East Asia (n=16) including Borneo, Cambodia, Indonesia and Thailand). Four of the indigenous infections were likely to have been acquired through occupational activities (including a fish farmer, a livestock farmer, rubbish recycling site worker and a pet food factory worker). A further 17 cases were likely to have been acquired through recreational or non-occupational exposures to rodent-infected or contaminated environments. There was no risk factor information available for the remaining three cases. Two of the indigenous cases were fatal.

Infection in animals

Countries within the UK use different diagnostic methods, and the diagnostic criteria required for disease confirmation have also changed in recent years. It is therefore difficult to make comparisons between countries and time periods.

There was a decline in the number of incidents of leptospirosis in GB livestock diagnosed in 2013. Leptospirosis may present in a number of clinical syndromes in animals, commonly abortion or milk drop, but also as systemic infection. There were four incidents involving infection with leptospires in animals diagnosed in GB during 2013. All four of these incidents occurred in England, and were diagnosed using a range of methods.

Clinical disease in cattle can be controlled by vaccination.

In England and Wales, real-time PCR is used to test for the presence of pathogenic leptospires in animal tissues. In 2013, 243 specimens from a range of mammalian species (mainly cattle and pig foetal kidneys) in England and Wales were submitted for

examination by real-time PCR. Of the 230 samples suitable for PCR testing, none were positive, compared to 5.2% positive porcine samples and 1.7% positive bovine samples in 2012.

During 2013 the AHPA tested 10,863 serum samples from a range of species for diagnostic, monitoring and export (mainly dogs) purposes. A summary of the positive samples is given in Table 10, although it should be noted that only a few samples were examined for the full range of serovars. These data only indicate serological evidence of exposure and/or vaccination (which is widely practiced in cattle and dogs) and not clinical disease. In Northern Ireland, of 963 suitable samples (including cattle) examined by the fluorescent antibody test, there were 65 confirmed cases (6.7%).

Bulk milk testing of dairy herds in England and Wales in 2013 to monitor *L.* Hardjo status continued to show evidence of potentially active infection and/or extensive vaccination in about 54.5% of herds[44].

Table 10 Detection of antibody (possibly vaccination associated) to pathogenic leptospires in serum samples submitted to AHPA for testing using the MAT, 2013

	Dogs	Cattle	Pigs	Horses
Total samples	2,371	3,270	601	348
Positive *L.* Canicola	401*	0	0	0
Positive *L.* Icterohaemorrhagiae	190*	0	0	8
Positive *L.* Hardjo	0	693*	0	0
Positive *L.* Bratislava	6	0	193	0
Positive *L.* Copenhageni	2	0	0	0
Positive *L.* Pomona	0	0	0	0
Positive *L.* Grippotyphosa	0	0	0	0

* Serovars for which a vaccine is available in this species.

It should be noted that results only reflect the serological tests requested for each submission, and therefore significant titres to other *Leptospira* serovars could be missed.

Listeriosis (*Listeria monocytogenes*)

Listeria monocytogenes is widely distributed in the environment, including in soil, decaying vegetation and fodder such as silage in which the bacteria can multiply. In animals, listeriosis is mainly a disease of farmed ruminants, with cattle and sheep considered the

[44] Non statutory zoonoses report: http://webarchive.nationalarchives.gov.uk/20140707141401/http://www.defra.gov.uk/ahvla-en/files/pub-zoo-ann13.pdf

most important species. Infection occurs due to direct ingestion of soil or through soil-contaminated feed, notably spoilt silage.

In humans, the disease most commonly occurs in pregnant women, neonates and people over the age of 60 years with underlying medical conditions. Consumption of foods contaminated with *L. monocytogenes* is the main route of transmission to humans. Zoonotic infection acquired directly from animals is also possible, although cases reporting animal contact are rare.

Infection in humans

There were 178 cases in the UK in 2013, a decrease of 2.7% when compared with 2012. Seventeen of the cases were pregnancy-associated (Table 11).

Table 11 Laboratory reports of listeriosis in humans in the UK, 2011-2013

		2011	2012	2013
England and Wales	Pregnancy-associated cases	27	17	16
	Others	120	148	144
	Total England and Wales cases	147	165	160
Scotland	Pregnancy-associated cases	2	1	1
	Others	12	10	15
	Total Scottish cases	14	11	16
Northern Ireland	Pregnancy-associated cases	0	1	0
	Others	3	6	2
	Total Northern Irish cases	3	7	2
United Kingdom	Total	164	183	178

In 2013, there were three outbreaks of listeriosis reported in UK. Two outbreaks were reported in England and both were associated with the consumption of crab meat. A total of seven cases were affected in the two outbreaks (three cases in one and four cases in the other) and one death was reported in each outbreak. In Scotland there was one outbreak with three confirmed cases in which sandwiches were the suspected vehicle. A summary of foodborne outbreaks by zoonotic pathogens, broken down by food vehicle category, is given in appendix 5.

Infection in animals

The majority of cases in the UK occur between January and April when many animals, especially cattle, are housed. This peak in cases is considered to be linked to the feeding of soil-contaminated silage. During 2013, 201 diagnoses of listeriosis in animals were made in the UK (Table 12). Of these, 179 occurred in GB, an increase of 2.4% compared to 175 in 2012. The number of diagnoses in Northern Ireland during 2013 (22 cases, 18 of

which were *L. monocytogenes*) has decreased since 2012 (total of 45 positives, 42 of these were *L. monocytogenes)*.

Table 12 Confirmed *Listeria* cases in animals in the UK, 2011-2013

Animal	*Listeria* cases in 2011 (all species)	*Listeria* cases in 2012 (all species)	*Listeria* cases in 2013 (all species)
Birds (at farm)	3	4	3
Cattle	47	66	63
Sheep and goats	111	139	133
Other	4	11	2
Total	165	220	201

During 2013 an investigation was undertaken by AHPA following an outbreak of listerial encephalitis in a milking sheep flock, and the subsequent isolation of *Listeria* spp. from the bulk milk tank. The farm supplied milk for the production of unpasteurised hard and soft cheeses, and was also open to the public.

Between February and April 2013, 13 cases of nervous disease were reported in ewes from this flock, with clinical signs consisting variously of circling, unilateral paralysis, drooling or recumbency. Post-mortem examination of one ewe in April confirmed histopathological lesions typical of listerial encephalitis, although *Listeria* was not isolated. *Listeria* spp. was detected from bulk milk sampled by the farmer, after which milk ceased to be sold for the manufacture of unpasteurised cheese.

A farm visit was undertaken by a Veterinary Investigation Officer in June. There had been no further cases of listerial encephalitis in ewes, and no upsurge of clinical mastitis was reported. Swabs were taken from various items of dairy equipment. *Listeria monocytogenes* was yielded from cultures of a swab taken from the bulk milk tank above the milk line, raising the possibility of biofilms harbouring the bacteria. Although the possibility of clinical or subclinical listerial mastitis could not be discounted, it was considered that the most likely source of this contamination was environmental. A thorough clean of the internal workings of the bulk milk tank was recommended, in addition to a detailed expert review of cleaning processes and monitoring procedures. The farmer was also made aware of the industry Code of Practice for preventing or controlling ill health from animal contact at visitor attractions.

Listeria in food

In 2013 the European Food Safety Authority published a scientific report on '*Analysis of the baseline survey on the prevalence of Listeria monocytogenes in certain ready-to-eat foods in the EU, 2010-2011.* A copy of the report can be found at: www.efsa.europa.eu/en/efsajournal/doc/3241.pdf

This Analysis included data from the UK which had been submitted to the European Commission on 31st May 2012, but which was embargoed until after publication of the EFSA Report.

Between 1 November 2010 until 31 October 2011, 1,600 samples were taken for 3 food categories, 400 samples of ready to eat packaged hot or cold smoked or gravid (cured) fish (taken in duplicate and analysed at sampling and at use-by date), 400 samples of soft and semi soft cheese and 400 samples of heat treated meat products. A full report of this UK portion of the wider EU survey can be found at:

http://www.foodbase.org.uk/results.php?f_category_id=&f_report_id=823

Listeria species were detected in 40 (2.5%) of the 1,600 samples tested and *Listeria monocytogenes* was detected in 17 samples (1.1%). All the Listeria detected was found to be at levels below 100cfu/g (the legal limit for these types of product under the micro criteria regulations), except for one sample of sliced corned beef which was found to have a level of 900cfu/g, and enforcement action was taken in relation to this sample.

Lyme Borreliosis (*Borrelia burgdorferi*)

Lyme borreliosis, known as Lyme disease, is caused by the bacterium *Borrelia burgdorferi* and is transmitted to humans and animals through the bite of an infected tick (*Ixodes* species). It is the most common tick-borne infection in humans in the temperate northern hemisphere. The majority of UK cases are indigenously acquired, usually through recreational activities including country or hill walking, running, orienteering or gardening.

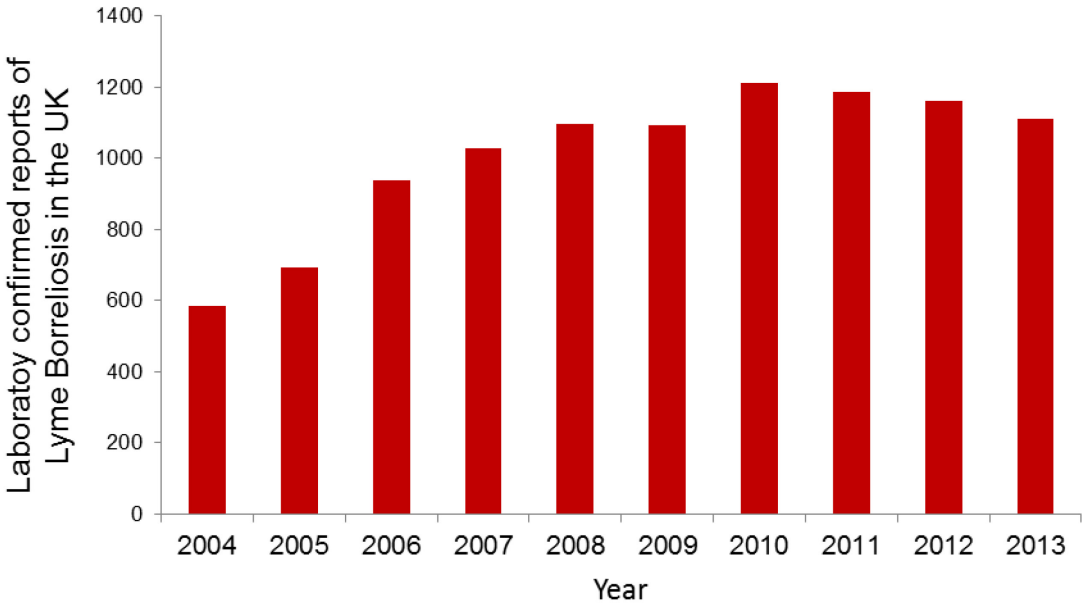
Well known regional foci of Lyme borreliosis include the New Forest, Salisbury Plain, Exmoor, the South Downs, Thetford Forest and parts of Wiltshire and Berkshire. Similar foci are known on the west coast and Highlands and Islands of Scotland.

Infection in humans

There were 1,112 serologically confirmed cases of *B. burgdorferi* infection in humans in the UK in 2013 (930 in England and Wales, 176 in Scotland, and six in Northern Ireland), an overall decrease from 2012 (n=1,163) (Figure 7).

In recent years in Scotland, efforts have been made to differentiate between recently acquired infections and identifications of infections acquired longer ago, reporting only acute infections during the reporting period. This slight change in case definition needs to be borne in mind when examining and interpreting historic trends in case numbers.

Figure 7 Number of laboratory confirmed human cases of Lyme borreliosis in the UK, 2004-2013



Of the 930 cases in England and Wales, 53 (5.7%) are known to have acquired their infections overseas (compared with 5.9% in 2012). Reported travel was primarily to northern Europe or the east coast of the USA. Since 2012 the surveillance system has changed from a system with active follow-up of exposure histories to a passive system. The seasonal pattern in 2013 was similar to previous years, with infections reported throughout the year and with a peak in the third quarter. This is consistent with the major tick feeding period which occurs in the late spring and early summer months.

In England and Wales, reports were received from all regions, with the South of England contributing around 40% of the total reports.

Pasteurellosis (*Pasteurella* spp.)

Pasteurellosis is a zoonotic bacterial disease with a worldwide distribution. *Pasteurella multocida* is found in the upper respiratory tract of many animal species including cats, dogs, chickens, turkeys, cattle, pigs, rabbits and rodents. It can cause disease in wild and domesticated animals, including 'avian cholera' in birds and poultry, respiratory disease and septicaemia in cattle, mice and rabbits, and atrophic rhinitis in pigs.

In humans, *P. multocida* is the species most commonly associated with infection. The most common mode of zoonotic transmission to humans is via dog or cat bites and scratches. These frequently lead to a cutaneous infection, which may be severe.

Infection in humans

There were 714 laboratory confirmed reports of human pasteurellosis in the UK in 2013, a 7.2% increase from the 666 cases reported in 2012 (Table 13).

In 2013, 578 cases were reported in England and Wales (386 *P. multocida)*, compared to 535 (359 *P. multocida*) in 2012. There were 133 cases reported in Scotland in 2013 (72 *P. multocida)*, compared to 129 (66 *P. multocida*) in 2012. Three cases were reported in Northern Ireland in 2013 compared to two in 2012.

Table 13 Laboratory confirmed reports of pasteurellosis in humans in the UK, 2013

Serovar	England and Wales	Scotland	Northern Ireland	UK total
P. aerogenes	1	0	0	1
P. haemolytica	3	0	0	3
P. multocida	386	72	3	461
P. pneumotropica	29	5	0	34
P. other named	12	34	0	46
Pasteurella spp	147	22	0	169
Total	578	133	3	714

Infection in animals

There were 393 cases of *P. multocida* diagnosed in animals in the UK in 2013 (Table 14).

Table 14 Laboratory confirmed reports of *P. multocida* in animals in the UK, 2012-2013

Year	2012			2013		
	GB	NI	UK	GB	NI	UK
Cattle	112	106	218	101	133	234
Sheep	68	10	78	57	6	63
Pigs	49	18	67	45	34	79
Birds	5	4	9	6	7	13
Miscellaneous / wildlife	4	2	6	1	0	1
Goats	0	0	0	2	1	3
Total	238	140	378	212	181	393

Q Fever (*Coxiella burnetii*)

Q fever is caused by the bacterium *Coxiella burnetii*. It can survive for long periods in the environment and is generally transmitted in aerosols or by fomites, including dust particles. *C. burnetii* infection occurs mainly in domesticated ruminants (cattle, sheep and goats), where it can cause abortion. Most cases of abortion due to Q fever in livestock are sporadic, although larger outbreaks can occur.

Transmission to humans mostly occurs through exposure to aerosols containing *C. burnetii*. This may arise via bacterial shedding in products of abortion or normal parturition, or result from contaminated dust particles or bedding. Most human infections are asymptomatic, but cases may present as acute or chronic disease, and relapses may occur. Since 1999, HPA/PHE data show that an average of 16.0% of annually diagnosed cases are chronic.

Infection in humans

In 2013, a total of 46 cases of Q fever were reported in the UK, a significant reduction from 127 cases in 2012 (Table 15).

Table 15 Laboratory confirmed reports of Q fever in humans in the UK, 2011-2013

Year	England & Wales*	Scotland	Northern Ireland	UK total
2011	106	7	1	114
2012	115	11	1	127
2013	44	2	0	46

*Enhanced surveillance scheme recording acute and chronic cases

Infection in animals

There were three incidents (all cattle) of Q fever abortion in England and Wales confirmed in 2013, all involved dairy herds where single or multiple abortions had been reported. There were no confirmed diagnoses of Q fever in Scotland from abortion specimens submitted to SRUC and no reported cases of Q fever in Northern Ireland.

In two of these incidents, co-infection with another abortifacient (*Neospora caninum* in one case, *Bacillus licheniformis* in the other) was demonstrated by AHPA. Additionally in a fourth submission, PCR detected the presence of *C. burnetii* in stomach content from an aborted bovine foetus, but insufficient material was submitted to confirm Q fever as the cause of abortion.

Further information

Information on Q fever infection risks during the lambing season are available at:

http://webarchive.nationalarchives.gov.uk/20140714084352/

Q fever information for farmers is available at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/322815/Q_fever_information_for_farmers.pdf

Rabies (Rhabdoviridae)

Rabies is an acute viral infection of the central nervous system, caused by a lyssavirus in the family *Rhabdoviridae*. It affects all mammals, including humans, cats, dogs, wildlife and farm animals. In animals, three forms are classically described: prodromal, excitement (furious) and paralytic (dumb). The disease is absent from land mammals in the UK. The last case of rabies in an animal outside of quarantine in GB was a dog in Newmarket in 1970[45]. In Northern Ireland the last case was reported in 1923. The last case of rabies in quarantine was reported in 2008 in England.

The virus is present in the saliva of affected animals, and the most frequent method of transmission to humans is by bites, scratches or licks to broken skin or mucous membranes. In humans, post exposure treatment with vaccine, and if indicated rabies immunoglobulin, is very effective in preventing disease. Once symptoms develop in untreated individuals, death is almost inevitable with very few documented survivors[46].

Infection in humans

The last case of human terrestrial rabies acquired in the UK was in 1902; however occasional travel-related cases do occur. Between 2000 and 2012, there were five cases of imported human rabies in the UK.

There were no human cases of rabies infection in the UK in 2013.

Infection in animals

In 2013, two cats, six dogs, a rabbit and 27 zoo bats were submitted to the AHPA for laboratory testing. None of the samples were positive for rabies.

The UK Pet Travel Scheme was launched in 2000 to allow people to bring in or travel with their pets (dogs, cats and ferrets), while ensuring the UK remains free from rabies and certain other exotic diseases. On 1st January 2012 the UK harmonised its pet movement controls with the rest of the EU. Under the EU scheme, the risk of rabies entering the UK remains very low, although these controls make it easier to travel with pets. During 2013,

[45] Pethece CK, Hopes R. A case of rabies at Newmarket. Veterinary Record, 1970 Mar 7;86(10):299.b www.ncbi.nlm.nih.gov/pubmed/5461596

[46] Jackson AC. Why does the prognosis remain so poor in human rabies? *Expert Rev. Anti Infect. Ther.* 2010; 8(6): 623-625

152,706 dogs, 13,977 cats, and 85 ferrets entered GB under the EU pet travel scheme, compared to 139,216, 14,444 and 93 respectively in 2012.

Further information

Further information on pet movement rules are at: https://www.gov.uk/take-pet-abroad

Bat rabies (European Bat Lyssavirus)

European Bat Lyssaviruses (EBLVs) 1 and 2 are commonly referred to as 'bat rabies'. EBLVs have been known to infect other animals and humans, presumably through a bite or scratch from an infected bat. Since 1977, there have been five human deaths in Europe (three confirmed, two possible) from EBLVs. In all cases the person had not received rabies vaccination either before or after the incident.

Infection in humans

In 2002, it was recognised that UK bats carry EBLV-2 when the only human case of EBLV-2 occurred in the UK. This was when a bat handler was infected following a bite from a Daubenton's bat (*Myotis daubentonii*) in Scotland[47].

There were no human cases of bat rabies infection in 2013 in the UK.

Infection in animals

A seroprevalence study conducted in England between 2003 and 2006 found EBLV-2 antibodies in 2.2% of Daubenton's bats, and EBLV-1 antibodies in <1% of Serotine bats.

Nine bats have tested positive through AHPA's passive lyssavirus surveillance scheme since 1996. In 2013, 320 dead bats from the UK were submitted to the scheme. None tested positive for EBLV-2.

Further information

Information, including guidance on post exposure prophylaxis, is available from PHE:

https://www.gov.uk/government/collections/rabies-risk-assessment-post-exposure-treatment-management

Advice for bat workers and their GPs can be found at:

http://webarchive.nationalarchives.gov.uk/20140714084352/

[47] Crowcroft N. Rabies-like infection in Scotland. *Euro Surveill*. 2002;6(50):pii=1984. Available online: www.eurosurveillance.org/ViewArticle.aspx?ArticleId=1984

Information on bats is available from the Bat Conservation Trust at: www.bats.org.uk

Results of the Scottish Natural Heritage bat lyssavirus monitoring programme:

www.snh.org.uk/press/detail.asp?id=2104

Salmonellosis *(Salmonella* species*)*

Overall, there are more than 2,600 *Salmonella* serovars, but salmonellosis in humans and animals is largely caused by the subspecies *S. enterica* subspecies *enterica.* Over 1,500 serovars belonging to this subspecies have been identified. In domestic animals, clinical cases of salmonellosis are most common in cattle. Subclinical carriage is most common in poultry, reptiles and pigs. However, reports of clinical disease in weaned pigs have increased in recent years as a result of the emergence of monophasic *S.* Typhimurium in the pig sector.

Most human salmonellosis is acquired via the foodborne route. *Salmonella* Typhi and *S.* Paratyphi A are adapted to humans and are thus not considered to be zoonoses. Illness in humans associated with other *Salmonella* serovars is known as non-typhoidal salmonellosis. Two of these serovars, *S.* Enteritidis and *S.* Typhimurium, account for over half of all human salmonellosis cases.

Infection in humans

In 2013, 8,459 cases of laboratory confirmed salmonellosis were reported in the UK. For every laboratory confirmed report of disease made to national surveillance schemes, there are estimated to be 4.7 unreported cases[27]. This means the total number of cases in the UK in 2013 was approximately 48,000[28].

Salmonella Enteritidis remained the most commonly reported serovar in 2013, accounting for 27.7% of cases. Although there was a fall in the number of cases in England and Wales (5.3%), numbers in Scotland and Northern Ireland increased (11.7% and 5.5% respectively). In the UK, reports of *S.* Enteritidis PT4 increased by 17.7% between 2012 and 2013, to 293 cases (Figure 8, Table 16). *Salmonella* Typhimurium (including monophasic strains) was the second most commonly reported serovar and fell by 15.4% from 2012. Reporting shows a consistent seasonal pattern with a distinct peak of infection observed in the third quarter of the year.

Monophasic variants accounted for 50.0% of the *S.* Typhimurium reports in England and Wales in 2013.

Figure 8 Laboratory reports of non-typhoidal human *Salmonella* cases in the UK, 1994-2013

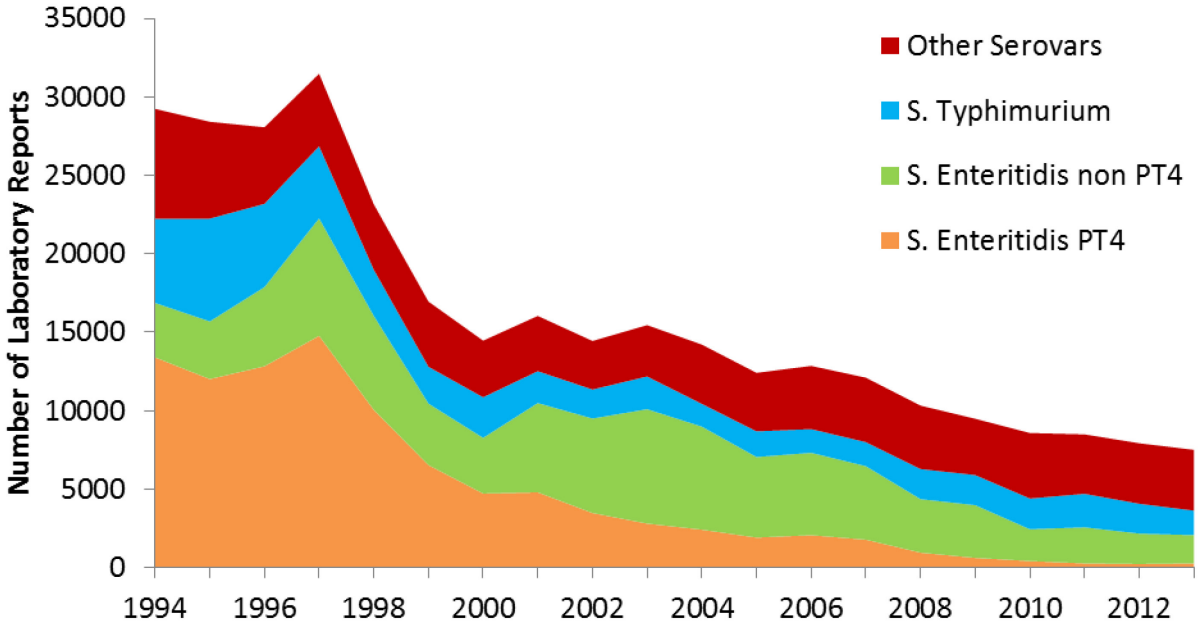


Table 16 Surveillance of non-typhoidal salmonellosis in the UK in 2013

Serotype	England & Wales	Scotland	Northern Ireland	UK	
	Cases	Cases	Cases	Total cases	Change from 2012
S. Enteritidis (TOTAL)	2,070	234	39	2,343	-4.5%
S. Enteritidis PT4	267	24	2	293	+17.7%
S. Typhimurium	1,561	163	47	1,771	-15.4%
Other serovars	3,862	416	67	4,345	+2.4%
All	7,493	813	153	8,459	-3.8%

Twelve foodborne outbreaks of *Salmonella* were reported in the UK in 2013 compared with 14 in 2012, and of these five were caused by *S.* Typhimurium, two by *S.* Enteritidis and five by other *Salmonella* spp. The most common food type associated with *Salmonella* outbreaks in 2013 was red meat. A summary of foodborne outbreaks by zoonotic pathogen, broken down by food vehicle category, is given in Appendix 5 and feature article 5 reviews a food-related incident.

Infection in animals

The majority of *Salmonella* isolations in farm livestock in the UK are detected as a result of testing diagnostic samples from clinically diseased cattle (the farmed species most commonly clinically affected by a *Salmonella* infection) or as a result of statutory surveillance under legislative programmes to control salmonella in flocks of domestic fowl

and turkeys. The poultry *Salmonella* National Control Programmes (NCPs) are required under EU regulation. The primary goal of the legislation is to reduce *Salmonella* prevalence at farm level and thereby minimise the risk of disease transmission to humans. All NCPs focus on reducing the prevalence of the most important serovars of *Salmonella* that can affect human health. Specific reduction targets are set for *S.* Enteritidis and *S.* Typhimurium (including monophasic strains). In the NCP for breeding chicken flocks, *S.* Hadar, *S.* Infantis and *S.* Virchow are also included in the reduction target. *Salmonella* NCPs have been implemented in the breeding chicken, laying chicken, broiler chicken and turkey breeding and fattening industry sectors.

For the poultry population (chickens and turkeys) subject to *Salmonella* NCPs, results are reported as the number of positive flocks detected under the programmes. Trends in the number of *Salmonella* reports in animal species not subject to an NCP also need to be treated with caution in view of the inherent biases associated with the data, e.g. the level of diagnostic and surveillance testing carried out.

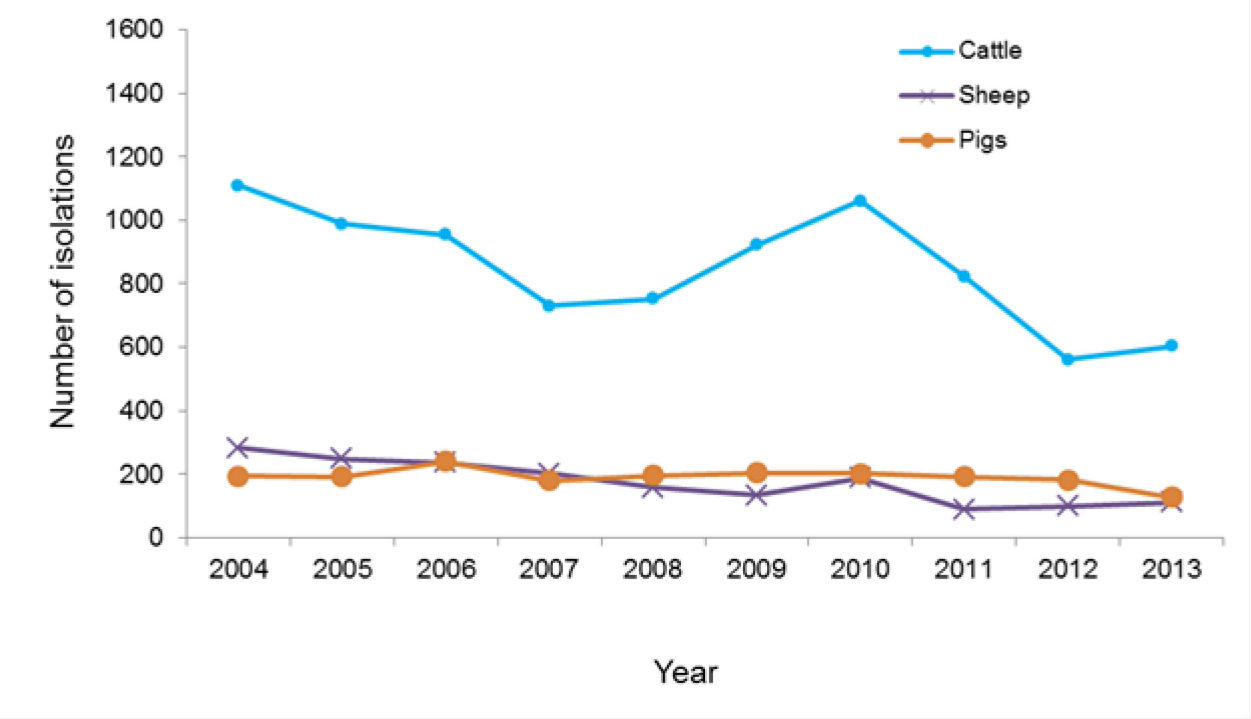
Farmed livestock (excluding species in the NCPs) and horses

Species not covered by a NCP are reported as the number of isolations rather than the number of incidents (so comparisons with data from a previous year are difficult).

There were 604 *Salmonella* isolations reported from cattle in GB during 2013, a 7.7% increase compared with 2012 (n=561) (Figure 9). There was a 12.0% increase in the number of reported isolations from sheep (112 compared to 100 in 2012), and a 30.6% decrease in the number of isolations from pigs (127 compared to 183 in 2012).

In Northern Ireland, there were 157 *Salmonella* isolates from cattle, 32 from sheep and 29 from pigs in 2013. This compares to the 2012 figures of 148 isolates from cattle, 10 from pigs and eight from sheep.

Figure 9 Number of laboratory-confirmed isolations of Salmonella in animals in GB, 2003-2013



Cattle

S. Dublin, which seldom causes disease in humans, accounts for most of the isolations in cattle. There were 565 reported isolations of *S.* Dublin in the UK in 2013 compared with 497 reports in 2012. There were also 40 isolations of *S.* Typhimurium plus 27 monophasic *S.* Typhimurium strains from cattle during 2013 plus a number of other serovars and a few untypable strains.

Sheep and goats

Isolations from sheep increased, from 108 reports during 2012 to 144 isolations during 2013. This is likely to be related to increased monitoring to identify Schmallenberg virus (SBV) and other pathogens in abortion cases. *S. enterica* subspecies *diarizonae* 61:k:1,5,(7) (not common in humans) was, as usual, the most frequently reported serovar in sheep. There was one isolation of *S.* Typhimurium and four of monophasic *Salmonella* 4,5,12:i:-.

There were no isolations of *Salmonella* from goats in 2013.

Pigs

Salmonella Typhimurium was the most commonly recorded serovar in pigs clinically affected by salmonella, accounting for 67 (46.9%) isolations (compared to 48.7% in 2012). Monophasic *S.* Typhimurium (*S.* 4,5,12:i:-) (31 isolations) represented 21.7% of isolations (compared to 38 isolates in 2012). The *S.* 4,12:i:- variant accounted for 24 isolations

(16.8% of total pig incidents in 2013, compared with 28 isolations in 2012).These results indicate the continued maintenance of monophasic *S.* Typhimurium strains in pigs. The remaining 21 isolations were of other serovars.

Further background to the pig Zoonoses NCP initiative is available at the British Pig Executive's website: www.bpex-zap.org.uk

Horses

Forty-four isolations of *Salmonella* were received from horses during 2013, which is slightly higher than in 2012 when there were 42 isolations.

Ducks and geese

There were a total of 333 isolations in ducks during 2013 in GB, which represents a 97.0% increase relative to 2012 (169 isolations). The 2013 GB isolations included 15 of *S.* Typhimurium but no *S.* Enteritidis. This apparent increase results from more frequent voluntary testing in commercial duck flocks. In Northern Ireland, there were no reports of *Salmonella* isolation from ducks during 2013 (and no reports in 2012).

There have been very few isolations of *Salmonella* from geese in recent years, with one isolation in 2013 and none in 2012.

Results from the UK Salmonella NCPs in chickens and turkeys

The different NCPs have been operating for varying time periods. The breeding chicken NCP is the longest-established and was in its seventh year in 2013 whereas the turkey NCP is the most recent addition and was only in its fourth year. Each year, the UK NCP results have been significantly below the EU reduction targets.

- The UK chicken breeding NCP reported two adult breeding flocks positive for *S.* Typhimurium but no cases of *S.* Enteritidis, representing a reported prevalence for the target serovars of 0.1% for 2013.

- In laying hen flocks during 2013, two adult flocks were positive for *S*. Enteritidis and one flock was confirmed positive for monophasic *Salmonella* strain S. 4,5,12:i:- out of the total 3,991 flocks included in the programme during the year, giving an overall prevalence of 0.1%.

- The prevalence of the target serovars in broiler flocks was 0.1% in 2013, with 12 broiler flocks detected positive for *S*. Typhimurium, four flocks for monophasic *S.* 4,12:i:- and one flock for monophasic *S.* 4,5,12:i:- out of a total of approximately 37,721 flocks tested. No broiler flocks were detected positive for *S*. Enteritidis during the year.

- No regulated serovars were isolated from breeding turkey flocks (i.e. 0% prevalence again).The 2013 prevalence of the target serovars was 0.1% (3/3,178 flocks) in

fattening turkey flocks. *Salmonella* Typhimurium was detected in two fattening flocks and a further one fattening flock tested positive for monophasic *S.* Typhimurium (*S*. 4,5,12:i:-). No UK fattening flocks were detected positive for *S*. Enteritidis.

Animal feed surveillance for *Salmonella*

Feedstuff contaminated with *Salmonella* may be a source of infection for animals. Due to the large quantity of feed that is consumed such contamination is considered to be a significant risk. In order to reduce this risk, salmonellae are monitored and controlled, according to guidelines described in Codes of Practice, at a number of points in the feed production process. The isolation rate of *Salmonella* from animal feedstuffs and feedstuff ingredients in GB has continued to remain stable. In GB in 2013, 1.3% of samples were positive (536 *Salmonella* isolates from 40,091 samples). In Northern Ireland 134 isolations of *Salmonella* were made under the animal feed surveillance programme during 2013.

Further information

A description of *Salmonella* data collection and reporting in animals in Great Britain is included in the *Salmonella* in Livestock Report:

https://www.gov.uk/government/statistics/salmonella-in-livestock-production-in-great-britain-2013

Toxoplasmosis (*Toxoplasma gondii*)

Toxoplasmosis is caused by the protozoan parasite *Toxoplasma gondii*. Cats are the definitive host for the organism although many warm-blooded animal species can be infected as intermediate hosts. The resistant oocysts excreted by cats can remain viable in the environment for many months.

Humans are infected with *T. gondii* by four routes:

- Ingesting sporulated oocysts from water, food or soil or other materials contaminated with the faeces of infected cats
- Ingesting undercooked or raw meat (mainly pork or lamb) that contains tissue cysts
- Transmission from a newly infected mother to the foetus
- Receiving organ transplants or blood products from donors with toxoplasmosis, although this is rare

Infection in humans

A total of 325 laboratory confirmed cases of toxoplasmosis were reported in the UK during 2013 (Table 17). In England and Wales, 311 cases of toxoplasmosis were reported, of which 237 cases had acute infection (76.2%). Four cases had reactivated infection (1.3%), and the remaining 70 were undetermined (22.5%).

Since 2011 in Scotland, efforts have been made to differentiate between recently acquired infections and infections that may have been acquired longer ago, reporting only acute infections during the reporting period. This slight change in case definition needs to be borne in mind when examining and interpreting historic trends in case numbers.

Table 17 UK confirmed human cases of toxoplasmosis, 2011-2013

Year	England & Wales	Scotland	Northern Ireland	UK total
2011	341	23	0	364
2012	311	16	0	327
2013	311	14	0	325

Infection in animals

In 2013 there were 215 toxoplasmosis incidents diagnosed in GB, 214 incidents involved sheep and there was one goat diagnosis. This compares to 248 GB diagnoses in 2012. However in 2013, the number of submissions to GB government laboratories for the investigation of ovine abortion returned to levels comparable to those seen in the years prior to the first incursions of Schmallenberg virus (SBV) into GB, which was considered the driver of increased submissions seen in 2012.

There was an increase in the number of *T. gondii* incidents diagnosed in NI during 2013 (229) compared to 2012 (100). This was associated with a sharp rise in the number of samples being submitted in NI for diagnostic purposes following abortions, attributed to a publicity campaign about the perceived risk of introduction of SBV.

In 2013 antibodies suggesting exposure to toxoplasma were identified in 55.9% of 1,307 sheep sera submitted (Table 18). This compares with 65.2% seropositivity in 2012. This testing does not distinguish between antibody as a result of vaccination and that produced by natural infection; therefore the vaccination status of the animal must be considered. However, as most of these samples will have been taken from sheep with a recent history of abortion it is likely that the majority of positives were associated with natural infection.

Table 18 Serological testing for toxoplasmosis in animals in the UK, 2013

Sera testing	GB	NI	UK
No. separate sheep submissions*	216	226	442
No. sheep samples sera tested	808	499	1,307
No. positives *T. gondii*	528	202	730
No. separate goat submissions*	17	2	19
No. goat samples sera tested	64	2	66
No positives *T. gondii*	32	1	33
No. separate pig submissions*	2	11	13
No. pig samples sera tested	52	11	63
No. positives *T. gondii*	0	0	0

*Each submission may contain a number of samples.

In addition to the data in the table, Northern Ireland diagnosed *T. gondii* in 26 of 41 submissions from cattle during 2013. GB also tested five dog sera (two submissions), one alpaca serum and one deer serum, which were all negative.

Trichinellosis (*Trichinella* spp.)

Trichinellosis is caused by a small parasitic nematode worm (*Trichinella* spp.) known as 'the muscle worm', which can infect many species of mammals and some birds. It is a foodborne disease that is spread primarily by the consumption of raw or undercooked meat products from horses and pigs containing trichinae, the infective, immature (larval) stage of the worm.

There are nine species of *Trichinella*, of which *T. spiralis* is the most common in Europe[48]. The ninth species was recently identified in South America[49]. In humans, European outbreaks of trichinellosis are regularly reported mainly linked to the consumption of raw or undercooked meat from wild boar, back yard pigs or horses. In contrast, there have been no human cases acquired from meat produced in the UK for over 30 years.

Infection in humans

Ten cases of trichinellosis were diagnosed in the UK between 2000 and 2013, including an outbreak of eight cases in England and Wales in 2000 associated with the consumption of

[48] Pozio E. World distribution of Trichinella spp. Infections in animals and humans. *Vet Parasitol.* 2007; 149(1-2) p3-21

[49] S. J. Kivrokapich *et al. Trichinella patagoniensis* n. sp. (Nematoda), a new encapsulated species infecting carnivorous mammals in South America (2012) *Int J Parasitol* 42(10):903-10.

imported meat products. The remaining two cases were travel related: one in England and Wales in 2001, and the other in Scotland in 2010 in a person who had eaten partially cooked meat in France.

There were no human cases in 2013 in the UK.

Infection in animals

Pigs and horses are routinely monitored for the presence of *Trichinella* at abattoir. In 2013, FSA received test results for 4,235,516 farmed pigs (tests are undertaken by food business operators and there are inconsistencies in reporting levels and detail from year to year). In addition, 3,205 horses, 985 farmed wild boar and 105 feral wild boar in the UK were tested. All samples examined were negative.

An on-going UK monitoring programme for *Trichinella* in foxes is routinely carried out, and from 2006 other susceptible wildlife have also been tested. *T. spiralis* was found in two foxes in Northern Ireland in 2007 and 2009, but Great Britain has been believed to be free of *Trichinella* since 1979. In 2013, 1,051 foxes, 458 badgers and 13 seals were tested negative and one fox in England was positive for *Trichinella pseudospiralis*. The fox could have become infected by eating a non-native wild bird. To investigate this positive, the FSA is commissioning epidemiological research along with localised enhanced monitoring of susceptible wildlife. This will provide evidence to aid the Agency in identifying the potential source of the infection and provide confidence regarding prevalence.

Variant Creutzfeldt-Jakob disease (vCJD) in humans and Bovine Spongiform Encephalopathy (BSE) in animals

Infection in humans

Creutzfeldt-Jakob disease (CJD) is a rare and fatal transmissible spongiform encephalopathy (TSE) of humans. Sporadic CJD is the most common form and was initially described in 1921. In 1996, a new variant, vCJD, was recognised and was strongly linked to BSE, which was first recognised in cattle in 1986.

There have been no cases of vCJD in people born after the 1980s in the UK. The government introduced leucodepletion of blood in 1999, and in 2004 implemented a policy that people who had received a blood transfusion in the UK since 1980 would no longer be able to give blood. There have been four probable secondary infections associated with blood transfusions in the UK.

There was just one death from definite or probable vCJD in the UK in 2013, making a total of 177 deaths recorded since 1995. The number of deaths per year peaked at 28 in 2000.

Further information

The National Creutzfeldt-Jakob Disease Research & Surveillance Unit: www.cjd.ed.ac.uk/

Report on the incidence of variant Creutzfeldt-Jakob disease diagnoses and deaths in the UK, January 1994 – December 2011: www.cjd.ed.ac.uk/documents/cjdq72.pdf

Infection in animals

BSE is a TSE disease of domestic cattle. BSE caused a major epizootic in cattle and smaller epizootics in exotic ruminants and domestic and exotic felines. Worldwide there have been two naturally occurring cases of BSE in goats: one in France and one in the UK. The transmissible agent in TSEs is widely suspected to be an abnormal form of a host-encoded protein called the 'prion protein', although some research[50,51] suggests that in some TSEs, infectivity may be associated with low levels of detectable abnormal prions, or that abnormal prion protein may not always be infectious.

The UK BSE epidemic peaked in 1992 with over 37,000 cases in cattle and has since declined steadily. The annual incidence of BSE cases in the EU has declined since targeted surveillance started in 2001. There have been a small number of cases in North America, the Middle East, and Asia.

In 2013, three cases of BSE were diagnosed in cattle in the UK, two from Wales and one from England.

Vero cytotoxin-producing *Escherichia coli* (VTEC)

Escherichia coli (E. coli) is a bacterium, which normally inhabits the intestines of animals and humans. Although many strains are considered to be harmless, there are a number of subgroups that are associated with human disease. Vero cytotoxin-producing *E. coli* are only known to cause disease in humans. VTEC O157 is the most commonly diagnosed zoonotic serogroup affecting people in the UK. However other serogroups can produce vero cytotoxin and are important causes of disease in other parts of Europe.

Many animals can carry VTEC without clinical symptoms or disease. Cattle are the main reservoir of VTEC O157 in the UK, but the organism may also be found in other ruminant species, particularly sheep, and it has been occasionally isolated from a wide range of other livestock and wildlife species.

VTEC O157 can be transmitted to people in several ways. These include:

- Consumption of contaminated food or water

[50] Barron RM, *et al.* High titres of TSE infectivity associated with extremely low levels of PrPSc in vivo. (2007) *J. Biol. Chem*. 282:35878-35886
[51] Piccardo P, *et al.* Accumulation of abnormal prion protein that is not infectious. (2007) *PNAS* 104: 4712-4717

- Direct or indirect contact with animals, their faeces or contaminated environments
- Person-to-person spread

Approximately 20% of human cases in the UK are acquired abroad. Multi-locus variable number tandem repeat analysis (MLVA), a molecular typing method, was implemented at the Gastrointestinal Bacteria Reference Unit in May 2012, for use on all VTEC O157 isolates. Compared to traditional typing methods used, this has increased the detection of related cases, concurrently reducing the proportion of sporadic cases from approximately 60% to 40%. Data analysed from the National Enhanced Surveillance System for VTEC in England and from case-control studies suggests that contact with farm animals and the rural environment is a major contributing factor to sporadic infection.

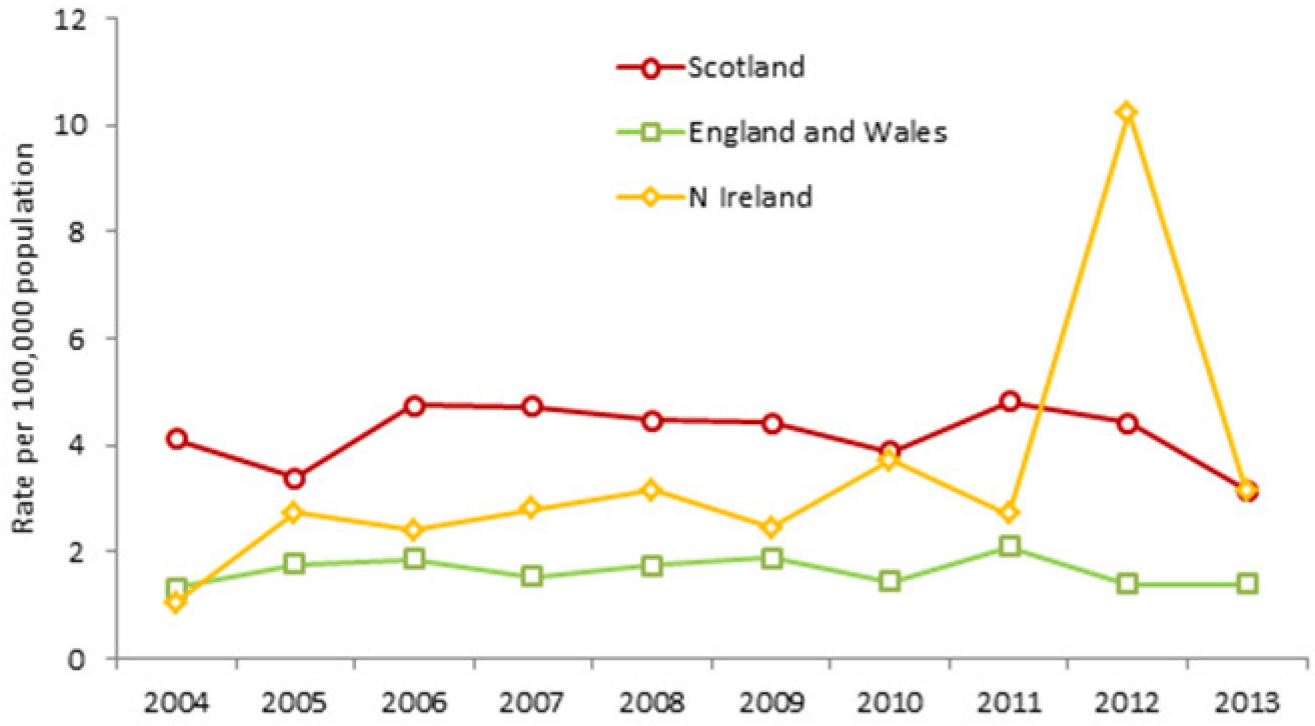
Infection in humans

In 2013, there were 1,017 laboratory confirmed cases of VTEC O157 reported in humans in the UK (765 in England, 167 in Scotland, 57 in Northern Ireland and 28 in Wales), a 16.4% decrease on the 1,217 cases reported in 2012.

The Second Study of Infectious Intestinal Disease in the Community established that the ratio of unreported human VTEC O157 infection to reports to national surveillance is 7.4 to 1[27]. This suggests that in 2013, there were likely to have been approximately 8,500 cases in the UK[28].

There are clear differences in the geographical distribution of laboratory confirmed cases within the UK, and Scotland has consistently recorded the highest rates of infection per 100,000 head of population since the late 1980s (Figure 10). The unusually high figure for 2012 for Northern Ireland was due to 140 cases associated with a single outbreak.

Figure 10 Annual rates of laboratory confirmed reports of human VTEC O157 infections in the UK, 2004–2013



The burden of disease due to serogroups other than O157 (non-O157 VTEC) in the UK is underestimated when compared to VTEC O157. This is because the diagnosis of non-O157 VTEC is mainly dependent on the use of PCR based methods to detect the genes coding for the production of vero cytotoxins. Such diagnostic tests are not routinely used by most front line laboratories. However, between December 2012 and December 2013, three front line hospital laboratories in England introduced a commercial PCR assay for the detection of gastrointestinal pathogens which led to a significant increase in the detection of non-O157 VTEC[52]. In 2013 there were 151 laboratory confirmed cases of VTEC other than serogroup O157 (non-O157 VTEC) confirmed in the UK, as compared to 60 in 2012.

Eight outbreaks of VTEC in England affecting a total of 54 cases were reported to PHE in 2013. All eight involved VTEC O157, and included:

- Five outbreaks attributed to person-to-person spread of which three were associated with schools and nurseries, one to an outdoor sports event and one involving a residential patient and their carers
- One localised outbreak in England where the source of infection was not determined

[52] Byrne L, *et al*., Jenkins C. The epidemiology and microbiology of Shiga-toxin producing Escherichia coli other than serogroup O157 in England 2009-2013. J Med Microbiol. 2014 Jun 13. pii: jmm.0.075895-0. doi: 10.1099/jmm.0.075895-0. [Epub ahead of print]

- Two national foodborne outbreaks, both linked to the consumption of watercress, occurred between September and November 2013 and affected cases in England, Wales and Scotland.
- One red meat outbreak in Scotland.

Infection in animals

VTEC O157 infection is widespread in cattle in the UK. However, because it does not cause disease in cattle and shedding of the organism is intermittent, prevalence figures are of limited help in assessing the degree of risk to humans. It is therefore assumed that all ruminants are infected with VTEC O157.

During 2013, three outbreaks of human infection with possible VTEC in England or Wales were investigated by AHPA. Two were potentially attributed to contact with animals at visitor attractions (open farms). In one of these, VTEC O157 was not cultured from any animals on the farm, despite extensive sampling. In the second, no animal sampling was undertaken. The third outbreak, linked to the consumption of watercress, VTEC O157 was not identified from cattle faecal samples collected from the adjacent field.

Further information regarding these outbreak investigations is given in the AHPA non-statutory zoonoses reports at: http://www.defra.gov.uk/ahvla-en/publication/zoo-reports/.

Further Information

Advice leaflets on minimising the risk of infection with VTEC can be found at:

- http://adlib.everysite.co.uk/resources/000/264/533/sci_vtec_leaflet.pdf
- http://www.face-online.org.uk/resources/preventing-or-controlling-ill-health-from-animal-contact-at-visitor-attractions-industry-code-of-practice
- www.scotland.gov.uk/Publications/2005/03/20839/54388
- http://www.wales.nhs.uk/sitesplus/888/page/43884

http://www.food.gov.uk/science/research/foodborneillness/ecoliresearch/fs421009/

Yersiniosis (*Yersinia* spp.)

Y. enterocolitica, *Y. pseudotuberculosis* and *Y. pestis* (which causes plague) are zoonoses. Plague does not occur in the UK.

Y. enterocolitica has been isolated from many domestic and wild mammals, birds and some cold-blooded animals. More than 50 serotypes have been identified, not all of which cause disease in animals and man. *Y. pseudotuberculosis* has been isolated from various species of wild and domestic mammals, birds and reptiles. Yersiniosis in humans is mostly

caused by *Y. enterocolitica,* and humans usually acquire infection through food contaminated with the faeces of infected animals.

Infection in humans

In 2013 there were 60 cases of human yersiniosis reported in the UK (Table 19), an 8.3% increase from 2012.

Table 19 Confirmed human cases of yersiniosis (non-pestis) in the UK, 2013

	England & Wales	Scotland	Northern Ireland	UK total
Y. enterocolitica	47	6	1	54
Y. pseudotuberculosis	3	0	0	3
Y. spp	2	1	0	3
Total	52	7	1	60

Infection in animals

During 2013, 82 cases (72 in NI and 10 in GB) of yersiniosis were diagnosed in animals in the UK (Table 20). GB cases have decreased (16 in 2012) and NI cases have increased (34 in 2012). This increase was due to a change in laboratory test procedures. Many of the recorded cases correspond to low level isolates from faecal samples.

Table 20 Laboratory confirmed cases of yersiniosis in animals in the UK, 2013

Sheep	Goats	Birds	Pigs	Wildlife & Miscellaneous	Cattle	Total
28	2	1	2	2	47	82

Further information

Reports on *Yersinia* in animals in GB are produced by the AHPA in the Non-Statutory Zoonoses Reports, which can be found at: http://www.defra.gov.uk/ahvla-en/publication/zoo-reports/

Appendix 1: Notifiable and reportable diseases in animals which are potential zoonoses in the UK

Notifiable diseases are those where there is a statutory requirement to report a suspicion of a clinical case of disease.

Reportable diseases (in animals) include those where there is a statutory requirement to report laboratory confirmed isolation of organisms of the genera *Salmonella* and *Brucella* under the Zoonoses Order 1989. In addition further diseases are included in the schedule of the Specified Animal Pathogens Order 2008. The report is to be made by the laboratory which isolated the organism from an animal derived sample.

Disease	Main species	Last Occurred in UK[53]	Notifiable to AHPA in GB, Veterinary Service in NI	Reportable (S= only reportable under SAPO)
Anthrax (*Bacillus anthracis*)	Cattle/other mammals	2006	✓	S
Avian Influenza (HPAI)	Poultry/ waterfowl	2008	✓	S
Bovine Spongiform Encephalopathy	Cattle	Present	✓	
Brucellosis (*Brucella abortus*)	Cattle[54]	2004 GB/ 2013 NI[55]	✓	✓
Brucellosis (*Brucella melitensis*)	Sheep and goats	Never	✓	✓
Brucella suis	Pigs	Never	✓	✓
Echinococcus granulosus	Sheep and dogs	Present		S
Echinococcus multilocularis	Dogs			S
Equine Viral Encephalomyelitis	Horses	Never	✓	S
Glanders & Farcy (*Burkholderia mallei*)	Horses	1928	✓	S
Newcastle disease and paramyxovirus infection	Poultry and pigeons	2006	✓	S
Psittacosis (Ornithosis)	Poultry	Present	Ornithosis (including psittacosis)	

[53] Figures taken are correct as at 8th October 2014.
[54] In the Zoonoses Order 1989 Brucella reporting relates to (a) “animal” meaning cattle (bull, cow, steer, heifer, calf), horse, deer, sheep, goat, pig or rabbit; and (b) “bird” meaning a domestic fowl, turkey, goose, duck, guinea-fowl, pheasant, partridge, quail or pigeon.
[55] Present in NI; outbreak in Scotland in 2003 and Cornwall, England in 2004.

			notifiable in Northern Ireland in poultry [56]	
Rabies (Terrestrial)	Dogs and other mammals	1970[57]	✓	S
Rabies (EBLV)	Bats	2009[58]	✓	S
Rift Valley Fever	Cattle, sheep and goats	Never	✓	S
Salmonella	All species	Present	Salmonella, when carried in animals or poultry, which the Department considers to be a risk to human health, is notifiable in Northern Ireland	✓
Trichinella	Pigs, horses and other mammals	Present in wildlife[59]		S
Tuberculosis (*Mycobacterium bovis*)	Domestic cattle, buffalo, bison and deer	Present[60]	✓[61]	✓
Vesicular stomatitis virus (VSV)	Cattle/ other mammals	Never	✓	S
West Nile Virus	Horses	Never	✓	S

[56] Legislative veterinary powers under The Psittacosis or Ornithosis Order 1953 (S.I. 1953 No. 38) give discretionary powers to serve notices to impose movement restrictions and require cleansing and disinfection of affected premises so AHPA may be involved in the control of Psittacosis, even though it is not a notifiable disease in animals or birds.

[57] A quarantine case was confirmed in 2008, however this does not affect the national disease status.

[58] European bat Lyssavirus type 2 was isolated from a Daubenton's bat in 2009.

[59] Trichinella is known to be present in wildlife in Northern Ireland and England. This follows the identification in Northern Ireland of a single fox positive for *Trichinella spiralis* in 2007 and again in 2009, and a positive fox in England in 2013 (*Trichinella pseudospiralis*) during wildlife surveillance. SAPO only refers to *T. spiralis.*

[60] Scotland has been officially free since October 2009, although sporadic incidents continue to be identified in cattle herds.

[61] In addition to any bovines and deer with suspect clinical signs of tuberculosis, under the Tuberculosis (England) Order 2007, the Tuberculosis (Wales) Order 2011, and the Tuberculosis (Scotland) Order 2007 (as amended), there is a statutory requirement in Great Britain to notify to the local AHPA office of the presence of suspect TB legions in the carcases of any bovine animals or other farmed or companion (pet) mammals. Furthermore, identification of *Mycobacterium bovis* in samples taken from any mammal (other than man) must also be reported to AHPA Weybridge unless the organism was present in the sample as a result of an agreed research procedure. Notifying the suspicion of TB in a living domestic animal in the course of clinical examination, surgery, by radiography or in biopsy material is not mandatory (except for cattle or deer), but submission of clinical samples from such cases to AHPA is encouraged.

Appendix 2: Notifiable zoonotic diseases in humans

Disease	Notifiable in humans under public health legislation in			Reportable under RIDDOR* to HSE
	England & Wales	Scotland	Northern Ireland	
Anthrax	✓	✓	✓	✓
Acute infectious hepatitis/Hepatitis unspecified: viral (e.g. Hepatitis E)	✓		✓	✓
Botulism	✓	✓		
Brucellosis	✓	✓		✓
Chlamydiosis (avian)				✓
Chlamydiosis (ovine)				✓
Diphtheria	✓	✓	✓	
Clinical syndrome due to *E. coli* O157 infection		✓		
Gastro-enteritis (under 2 years of age only)			✓	
Haemolytic uraemic syndrome	✓	✓		
Food poisoning	✓		✓	
Infectious bloody diarrhoea	✓			
Leptospirosis			✓	✓
Lyme disease				✓
Plague	✓	✓	✓	
Q fever				✓
Rabies	✓	✓	✓	✓
Clinical syndrome due to *Streptococcus suis*				✓
Tetanus	✓	✓	✓	✓
Tuberculosis (including bovine TB)	✓	✓	✓	✓
Tularaemia		✓		
Viral haemorrhagic fevers	✓	✓	✓	
West Nile Virus		✓		
Yellow fever	✓	✓	✓	

* RIDDOR: Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (not including Part II: Diseases additionally reportable in respect of offshore work places)

The table above lists notifiable zoonotic diseases only; further organisms are notifiable when isolated in laboratories. The lists of notifiable organisms can be found here:

England: www.legislation.gov.uk/uksi/2010/659/contents/made

Northern Ireland: www.legislation.gov.uk/apni/1967/36/contents

Scotland: www.legislation.gov.uk/asp/2008/5/contents

Wales: www.legislation.gov.uk/wsi/2010/1546/contents/made

Appendix 3: Laboratory-confirmed cases of zoonotic disease in humans, 2004-2013 [62]

United Kingdom

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013*
Anthrax	0	0	1	0	1	13	39	0	6	2
Avian Influenza	0	0	1	4	0	0	0	0	0	0
Mycobacterium bovis	14	26	29	24	23	29	36	39	39	29
Brucellosis	33	12	16	15	15	18	12	25	14	15
Campylobacteriosis	49,782	52,212	52,679	58,140	55,787	65,211	70,371	72,321	72,629	66,575
Cryptosporidiosis	4,222	5,413	4,728	3,668	4,937	5,647	4,604	3,573	6,655	4,111
Hantavirus	0	0	0	0	0	0	0	1	1	4
Hepatitis E	152	339	292	166	180	178	287	471	656	787
Hydatid disease	8	11	14	10	18	9	7	15	6	14
Leptospirosis	42	60	50	81	76	56	42	52	78	50
Listeriosis	230	223	208	254	207	234	179	165	185	178
Lyme disease	586	693	940	1,027	1,098	1,093	1,213	1,189	1,163	1,112
Pasteurellosis	410	425	490	457	497	559	586	668	666	714
Psittacosis	67	61	30	39	63	60	58	41	37	42
Q fever	60	61	200	71	68	31	55	114	127	46
Rabies 'classical'	0	1	0	0	1	0	0	0	1[#]	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	15,614	13,708	14,084	13,279	11,517	10,486	9,692	9,395	8,792	8,461
Streptococcus suis	0	3	4	2	7	2	4	1	3	9
Taeniasis	103	76	89	101	100	72	114	94	70	61
Toxocariasis	6	5	2	1	2	4	12	4	7	4
Toxoplasmosis	100	114	123	146	457	494	414	364	328	325
Trichinellosis	0	0	0	0	0	0	1	0	0	0
vCJD[63]‡	9	5	5	5	2	3	3	5	0	1
VTEC O157	926	958	1,286	1,120	1,247	1,315	1,052	1,484	1,260	1,017
Non-O157 VTEC	11	11	20	25	36	45	44	37	59	99
Yersiniosis	90	76	62	78	62	62	54	55	55	60

* Provisional data

‡ Data source: NCJDRSU

A UK National who visited India

[62] This is not a definitive list of zoonotic pathogens that are reported each year, but covers zoonotic diseases reported annually in the UK Zoonoses Report.
[63] Deaths

England & Wales

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013*
Anthrax	0	0	0	0	1	0	5	0	4	1
Avian Influenza	0	0	1[64]	4[65]	0	0	0	0	0	0
Mycobacterium bovis	11	18	20	22	17	21	31	30	33	23
Brucellosis	19	8	11	8	5	13	11	17	9	13
Campylobacteriosis	44,576	46,763	46,877	52,063	50,061	57,819	62,730	64,781	65,085	59,057
Cryptosporidiosis	3,621	4,540	3,982	3,073	4,162	4,831	3,901	2,990	5,765	3,520
Hantavirus	0	0	0	0	0	0	0	1[66]	1	4
Hepatitis E	149	329	289	162	176	175	274	456	578	691
Hydatid disease	8	11	14	10	18	9	6	12	6	11
Leptospirosis	39	55	44	74	62	52	39	44	72	47
Listeriosis	211	189	185	226	181	213	160	148	167	160
Lyme disease	500	595	768	797	813	863	905	959	1,040	930
Pasteurellosis	385	407	430	392	438	455	466	538	535	578
Psittacosis	62	61	30	38	62	58	53	40	27	37
Q fever**[67]	52	53	43	63	56	27	52	106	115	44
Rabies 'classical'	0	1	0	0	0	0	0	0	1#	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	14,020	12,404	12,849	12,094	10,321	9,482	8,573	8,492	7,919	7,493
Streptococcus suis	0	3	3	1	7	1	3	0	3	
Taeniasis	101	76	88	99	95	70	108	90	65	
Toxocariasis	6	5	1	1	2	1	8	0	5	
Toxoplasmosis	79	101	90	104	405**	422**	345**	341**	311**	311**
Trichinellosis	0	0	0	0	0	0	0	0	0	0
VTEC O157	699	739	1,001	828	950	1,034	773	1,182	837	793
Non-O157 VTEC	4	0	2	6	11	15	9	12	22	47
Yersiniosis (non-pestis)	32	38	33	55	39	47	47	51	44	52

* Provisional data

** Enhanced surveillance system

A UK National who visited India

[64] H7N3
[65] H7N2
[66] Indigenously acquired.
[67] Acute and chronic infections

Northern Ireland

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013*
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	3	5	3	1	2	1	1	2	0	4
Brucellosis	14	2	4	5	10	4	0	2	2	0
Campylobacteriosis	841	891	937	885	848	977	1,040	1,175	1,211	1355
Cryptosporidiosis	136	164	134	85	119	118	119	140	177	161
Hantavirus	0	0	0	0	0	0	0	0	0	0
Hepatitis E	0	0	0	0	0	0	0	0	0	1
Hydatid disease	0	0	0	0	0	0	0	0	0	0
Leptospirosis	1	1	3	1	1	0	0	3	2	2
Listeriosis	4	3	6	5	11	4	2	3	7	2
Lyme disease	0	2	1	0	0	2	0	1	2	6
Pasteurellosis	2	2	9	3	2	7	0	1	2	3
Psittacosis	1	0	0	0	0	0	0	0	0	0
Q fever	7	6	13	5	11	2	0	1	1	0
Rabies 'classical'	0	0	0	0	1[68]	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	451	177	206	155	185	158	178	166	145	155
Streptococcus suis	0	0	0	0	0	0	0	0	0	0
Taeniasis	0	0	0	0	0	0	0	0	1	0
Toxocariasis	0	0	0	0	0	0	0	0	0	0
Toxoplasmosis	1	2	0	2	4	3	2	0	0	0
Trichinellosis	0	0	0	0	0	0	0	0	0	0
VTEC O157	18	47	42	49	56	44	67	49	189[69]	57
Non-O157 VTEC	0	0	0	0	0	0	0	0	2	0
Yersiniosis	1	4	3	1	0	0	0	0	0	1

* Provisional data

[68] UK national who visited South Africa
[69] 142 of these cases were associated with one outbreak

Scotland

	2004	2005	2006	2007	2008	2009	2010	2011	2012*	2013*
Anthrax	0	0	1	0	0	13	34	0	1	1
Avian Influenza	0	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	0	3	6	1	4	7	4	7	6	2
Brucellosis	0	2	1	2	0	1	1	6	3	2
Campylobacteriosis	4,365	4,558	4,865	5,192	4,878	6,415	6,601	6,365	6,333	6,163
Cryptosporidiosis	465	709	612	510	656	698	584	443	713	430
Hantavirus	0	0	0	0	0	0	0	0	0	0
Hepatitis E	3	10	3	4	4	3	13	15	78	95
Hydatid disease	0	0	0	0	0	0	1	3	0	3
Leptospirosis	2	4	3	6	13	4	3	5	4	1
Listeriosis	15	31	17	23	15	17	17	14	11	16
Lyme disease	86	96	171	230	285	228	308	229	207	176
Pasteurellosis	23	16	51	62	57	97	120	129	129	133
Psittacosis	4	0	0	1	1	2	5	1	10	5
Q fever	1	2	144[70]	3	1	2	3	7	11	2
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	1,143	1,127	1,029	1,030	1,011	846	941	737	728	813
Streptococcus suis	0	0	1	1	0	1	1	1	0	2
Taeniasis	2	0	1	2	5	2	6	4	4	6
Toxocariasis	0	0	1	0	0	3	4	4	2	2
Toxoplasmosis	20	11	33	40	48	69	67	23	17	14
Trichinellosis	0	0	0	0	0	0	1	0	0	0
VTEC O157	209	172	243	243	241	237	212	253	234	167
Non-O157 VTEC	7	11	18	19	25	30	35	25	35	52
Yersiniosis (non-pestis)	57	34	26	22	23	15	7	4	11	7

* Provisional data

[70] 142 of these cases were associated with one outbreak

Appendix 4: Government laboratory-confirmed cases or incidents of zoonotic infection in animals, 2004-2013 [A]

United Kingdom [A]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Anthrax	0	0	2	0	0	0	0	0	0	0
Avian Influenza [A]	0	0	0	1	2	0	0	0	0	0
New TB breakdowns in cattle herds [A]	5,665	5,457	5,043	5,452	6,285	5,892	5,883	6,293	6,868	6,253
M. bovis isolates in non-bovine animals (excludes badgers)	64	72	89	77	123	156	142	142	99	132
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	39	68	186	146	107	149	144	140	16	26
Brucella abortus [A]	125	88	118	151	177	71	74	21	23	26
Brucella melitensis [A]	0	0	0	0	0	0	0	0	0	0
Brucella spp [A] (in marine mammals)	7	13	8	11	10	7	7	9	13	0
BSE	343	226	114	67	37	12	11	7	3	3
Campylobacter [A]	309	163	211	251	186	164	280	178	144	259
Chlamydiosis (*Chlamydophila abortus*) fetopathy [A]	432	548	508	553	372	406	397	447	539	331
Cryptosporidiosis [A]	1,171 Φ	1,326 Φ	1,348 Φ	1,043 Φ	1,311†	1,436	1,768	1,381	1,896	1,874
Hydatid [A]	1	0	0	0	0	0	0	0	0	1
Leptospirosis [A]	255	209	157	197	238	89	113	50	85	69
Listeriosis [A]	134	103	148	152	216	196	237	165	219	200
Orf [A]	37	26	39	48	44	38	41	36	49	56
Pasteurella multocida [A]	N/A	N/A	N/A	336†	394	540	510	464	379	428
Psittacosis (*C. psittaci*) [A]	9	3	1	2	1	3	8	0	2	2
Q fever [A]	3	6	5	4	5	3	5	8	6	3
Rabies 'classical'	0	0	0	0	1	0	0	0	0	0
Rabies EBLV	2	0	1	1	2	1	0	0	0	0
Salmonella (all types) [A]	3,324	3,218	3,119	2,352	2,311	2,672	3,513	2,961	3,344	3,321
Streptococcus suis [A]	91	96	90	100	132	115	139	124	96	133
Swine Influenza [A]	10	20	13	10	16	18	40	37	38	33
Toxoplasmosis [A]	365	417	380	424	257	232	267	189	348	444
Trichinellosis	0	0	0	1	0	1	0	0	0	1
Yersiniosis [A]	N/A	N/A	28†	24†	32†	37	23	44	50	82

[A] The key to the UK and individual nation's data in appendix 4 appears as the final table at the end of this appendix.
† GB data.
Φ Data only includes isolations from cattle and sheep in GB.

England [A]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza [A]	0	0	0	1	2	0	0	0	0	0
New TB breakdowns in cattle herds [A]	3341†	3665†	3530†	4188†	3,765	3,362	3,634	3,771	3,925	3,875
M. bovis isolates in non-bovine animals (excludes badgers) †	56	64	78	68	119	144	134	133	98	132
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	25†	55†	138†	104†	77†	122†	130†	140†	14	21
Brucella abortus [A]	0	0	0	0	0	0	0	0	0	0
Brucella melitensis [A]	0	0	0	0	0	0	0	0	0	0
Brucella spp [A] (in marine mammals)	1	1	0	0	6	4	0	1	7	0
BSE	229	153	78	39	25	9	11	5	2	1
Campylobacter [A]	182	96	117	125	94	93	148	93	73	129
Chlamydiosis (*Chlamydophila abortus*) fetopathy [A]	194	230	258	263	201	219	215	226	260	166
Cryptosporidiosis [A]	N/A	N/A	N/A	N/A	1311†	1346†	1674†	1095†	650	681
Hydatid [A]	0	0	0	0	0	0	0	0	0	0
Leptospirosis [A]	23	34	26	45	16	5	8	3	15	1
Listeriosis [A]	101†	86†	118†	132†	191†	177†	215†	146†	85	116
Orf [A]	24	18	25	29	26	26	29	20	30	35
Pasteurella multocida [A]	N/A	N/A	N/A	336†	281†	319†	368†	316†	116	115
Psittacosis (*C. psittaci*) [A]	5	0	0	1	0	1	4	0	1	1
Q fever [A]	2	4	4	4	3	3	5	3	5	3
Rabies 'classical'	0	0	0	0	1	0	0	0	0	0
Rabies EBLV	2	0	1	1	2	0	0	0	0	0
Salmonella (all types) [A]	2,703	2,689	2,658	1,948	1,729	2,198	3,044	2,392	2,739	2,685
Streptococcus suis [A]	80	69	67	67	96	83	94	94	66	69
Swine Influenza [A]	10	18	12	9	16	13	31	34	36	33
Toxoplasmosis [A]	166	174	170	166	93	115	101	84	146	132
Trichinellosis	0	0	0	0	0	0	0	0	0	1
Yersiniosis [A]	N/A	N/A	28†	24†	32†	33†	15†	22†	8	7

[A] The key to the UK and individual nation's data in appendix 4 appears as the final table at the end of this appendix.
† GB data.

Northern Ireland [A]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza [A]	0	0	0	0	0	0	0	0	0	0
New TB breakdowns in cattle herds per year and the % Herd incidence	2,324 9.17	1,792 7.22	1,513 6.23	1,264 5.35	1,274 5.58	1,293 5.61	1,160 5.12	1,386 6.00	1,695 7.32	1479 6.44
M. bovis isolates in non-bovine animals (excludes badgers)	8	8	11	9	4	12	8	9	1	0
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	14	13	48	42	30	27	14	0	0	0
Brucella abortus- number of reactor herds per year and confirmed infected herds	125	88	118	151 53	177 34	71 13	74 25	21 4	23 1	26 0
Brucella melitensis [A]	0	0	0	0	0	0	0	0	0	0
Brucella spp [A] (in marine mammals)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BSE	34	23	10	14	4	3	0	2	1	0
Campylobacter [A]	39	18	47	36	35	15	46	25	35	35
Chlamydiosis (*Chlamydophila abortus*) fetopathy [A]	52	82	61	40	36	39	55	61	68	51
Cryptosporidiosis [A]	N/A	N/A	N/A	N/A	N/A	90	94 Φ	286 Φ	736 Φ	668 Φ
Hydatid [A]	N/A	N/A	N/A	0	0	0	0	0	0	0
Leptospirosis [A]	217	161	113	106	199	84	105	46	70	65
Listeriosis [A]	33	17	30	20	25	19	22	19	45	22
Orf [A]	1	0	2	3	1	1	1	1	0	3
Pasteurella multocida [A]	N/A	N/A	N/A	N/A	113	221	142	148	140	212
Psittacosis (*C. psittaci*) [A]	0	0	0	0	0	0	0	0	0	0
Q fever [A]	0	0	0	0	0	0	0	0	0	0
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonella (all types) [A]	216	130	184	223	382	252	345	354	426	503
Streptococcus suis [A]	3	16	5	17	10	14	21	12	19	46
Swine Influenza [A]	0	0	0	0	0	5	4	0	0	0
Toxoplasmosis [A]	40	47	53	54	64	44	51	45	100	229
Trichinellosis	0	0	0	1	0	1	0	0	0	0
Yersiniosis [A]	N/A	N/A	N/A	N/A	N/A	4	8	22	34	72

[A] The key to the UK and individual nation's data in appendix 4 appears as the final table at the end of this appendix.
Φ Data only includes isolations from cattle and sheep.

Scotland [A]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza [A]	0	0	0	0	0	0	0	0	0	0
New TB breakdowns in cattle herds [A]	3341†	3665†	3530†	4188†	47	49	45	43	54	28
M. bovis isolates in non-bovine animals (excludes badgers) †	56	64	78	68	119	144	134	133	98	0
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	25†	55†	138†	104†	77†	122†	130†	140†	2	5
Brucella abortus [A]	0	0	0	0	0	0	0	0	0	0
Brucella melitensis [A]	0	0	0	0	0	0	0	0	0	0
Brucella spp [A] (in marine mammals)	6	12	8	11	4	3	7	8	6	6
BSE	37	22	12	7	1	0	0	0	0	0
Campylobacter [A]	50	40	28	44	35	39	47	34	25	55
Chlamydiosis (*Chlamydophila abortus*) fetopathy [A]	79	112	97	140	65	66	52	79	103	53
Cryptosporidiosis [A]	N/A	N/A	N/A	N/A	1311†	1346†	1674†	1095†	309	319
Hydatid [A]	1	0	0	0	0	0	0	0	0	0
Leptospirosis [A]	10	10	16	41	22	0	0	0	0	3
Listeriosis [A]	101†	86†	118†	132†	191†	177†	215†	146†	59	47
Orf [A]	6	2	10	8	10	6	8	7	8	13
Pasteurella multocida [A]	N/A	N/A	N/A	336†	281†	319†	368†	316†	99	93
Psittacosis (*C. psittaci*) [A]	4	3	1	1	1	1	4	0	1	1
Q fever [A]	0	0	0	0	0	0	0	0	0	0
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	1	0	0	0	0
Salmonella (all types) [A]	405	399	277	181	200	222	124	215	179	133
Streptococcus suis [A]	7	11	14	14	26	17	22	18	8	5
Swine Influenza [A]	0	2	1	1	0	0	5	3	2	0
Toxoplasmosis [A]	96	124	94	142	68	52	91	31	66	46
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis [A]	N/A	N/A	28†	24†	32†	33†	15†	22†	8	1

[A] The key to the UK and individual nation's data in appendix 4 appears as the final table at the end of this appendix.
† GB data.

Wales [A]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Anthrax	0	0	2	0	0	0	0	0	0	0
Avian Influenza [A]	0	0	0	0	0	0	0	0	0	0
New TB breakdowns in cattle herds [A]	3341†	3665†	3530†	4188†	1,198	1,186	1,039	1,045	1,112	871
M. bovis isolates in non-bovine animals (excludes badgers) †	56	64	78	68	119	144	134	133	98	6
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	25†	55†	138†	104†	77†	122†	130†	140†	0	0
Brucella abortus [A]	0	0	0	0	0	0	0	0	0	0
Brucella melitensis [A]	0	0	0	0	0	0	0	0	0	0
Brucella spp [A] (in marine mammals)	0	0	0	0	0	0	0	0	0	0
BSE	43	28	14	7	7	0	0	0	0	2
Campylobacter [A]	38	9	19	46	22	17	39	26	11	40
Chlamydiosis (*Chlamydophila abortus*) fetopathy**	107	124	92	110	70	82	75	81	108	61
Cryptosporidiosis [A]	N/A	N/A	N/A	N/A	1311†	1346†	1674†	1095†	201	206
Hydatid [A]	0	0	0	0	0	0	0	0	0	1
Leptospirosis [A]	5	4	2	5	1	0	0	1	0	0
Listeriosis [A]	101†	86†	118†	132†	191†	177†	215†	146†	30	15
Orf [A]	6	6	2	8	7	5	3	8	11	5
Pasteurella multocida [A]	N/A	N/A	N/A	336†	281†	319†	368†	316†	24	8
Psittacosis (*C. psittaci*) [A]	0	0	0	0	0	1	0	0	0	0
Q fever [A]	1	2	1	0	2	0	0	5	1	0
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonella (all types) [A]	2,703	2,689	2,658	1,948	1,729	2,198	3,044	2,392	2,739	2,685
Streptococcus suis [A]	1	0	4	2	0	1	2	0	3	0
Swine Influenza [A]	0	0	0	0	0	0	0	0	0	0
Toxoplasmosis [A]	63	72	63	62	32	21	24	29	36	37
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis [A]	N/A	N/A	28†	24†	32†	33†	15†	22†	0	2

[A] The key to the UK and individual nation's data in appendix 4 appears as the final table at the end of this appendix.
† GB data.

Key to all other tables in appendix 4

The tables in appendix 4 are not intended to provide a definitive list of all zoonotic pathogens, but include those for which data are available (notifiable/reportable and those recorded by VIDA system and /or AFBI systems). The VIDA data provides figures only for new incidents with relevant VIDA codes (as per FZ2100 reporting). The FSA supplied the Trichinellosis data. The species for which diagnoses may be recorded and other notes relevant in interpreting the other tables in appendix 4 are provided below.

Diagnosis	***Cattle***	***Sheep***	***Goats***	***Pigs***	***Birds*** [1]	***Misc.***	***Wildlife*** [2]
Anthrax							
Avian influenza (only highly pathogenic strains). Tables show number of HPAI incidents p.a.							
New TB breakdowns in cattle herds Data for GB countries for new TB breakdowns in cattle herds included in the relevant tables in appendix 4 is not directly comparable across the individual tables. Since 2008 the figures are based on data derived from AHPA's Sam system. Sam is an AHPA IT system that holds information on all customers, and helps manage specific work areas such as TB. Prior to 2008 a different data system was in use and the data produced is not exactly comparable with the statistics produced from Sam. In addition the overall UK totals since 2008 are not the sum of the number of new incidents in each national table as a balancing amount is included in the overall GB total for cases where the exact region is unknown, and is therefore reflected in this UK figure. This balancing amount in 2013 was 47, 60 in 2012, 54 in 2011, 5 in 2010, 2 in 2009 and 1 in 2008.							
M. bovis **isolates in non-bovine animals** (excludes badgers)							
Mycobacterium **in non-bovine animals** (excluding *M. bovis*)							
Brucella abortus	Confirmed cases are statutorily reportable under Zoonoses Order 1989.						
Brucella melitensis							
Brucella spp. *(in marine mammals)*							
BSE							
Campylobacter Confirmed cases obtained through scanning surveillance/ VIDA database (in GB). Data for GB countries included in the relevant tables in appendix 4 has been derived from the incidents recorded on AHPA's Veterinary Diagnostic Analysis (VIDA) system. This uses strict criteria and so not all isolated Campylobacter are included in the relevant tables. In NI data from diagnoses in pigs are also included.							
Chlamydiosis ***(Chlamydophila abortus)*** **fetopathy** Confirmed cases obtained through scanning surveillance/ VIDA database (in GB). NI data is only for diagnoses from sheep and goats.							
Cryptosporidiosis Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Hydatid Confirmed cases obtained through scanning surveillance/ VIDA database (in GB). Therefore tables in appendix 4 state laboratory, not abattoir, diagnoses.							

Leptospirosis Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Listeriosis Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Pasteurella multocida Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Psittacosis (*C. psittaci*) Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Q Fever (*Coxiella burnetii)* Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Rabies 'classical'							
Rabies EBLV							
Salmonella (all types) Confirmed cases statutorily reportable under Zoonoses Order 1989. Data for GB countries included in this table relates only to salmonella isolations from the statutory species (cattle, sheep, goats, pigs, horses, deer, rabbits, chickens, turkeys, ducks, geese, partridges, pheasants, guinea fowl, quail and pigeons). In NI the Zoonoses Order 1991 lists any mammal except man; any 4 footed beast which is not a mammal; snakes; birds of every species as species for which salmonella isolations must be reported. Therefore isolations from all these species are included in the NI data.							
Streptococcus suis Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Swine influenza Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Toxoplasmosis Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							
Trichinellosis							
Yersiniosis Confirmed cases obtained through scanning surveillance/ VIDA database (in GB).							

Shaded boxes indicate a diagnosis is not available for that species.

[1] Includes both domestic and wild birds, specific species included = domestic fowl (chickens), turkeys, ducks, geese, guinea fowl, pheasants, partridges, pigeons and quail. For AI any avian species to be included.

[2] Mammals only (includes rabbits and deer).

Misc. = miscellaneous exotic farmed or other species (includes horses and farmed deer).

Appendix 5: Food vehicles associated with foodborne gastrointestinal outbreaks in the UK in relation to *Campylobacter, L. monocytogenes, Salmonella*, and VTEC O157

Food vehicle category	*Campylobacter*	*L. monocytogenes*	*Salmonella*	VTEC O157
Poultry meat	14	0	2	0
Red meat	1	0	4	1
Crustacean & shellfish	0	2	1	0
Vegetables & fruits	0	0	0	2
Eggs & egg dishes	0	0	0	0
Milk & diary product	1			
Composite/Mixed foods	0	0	1	0
Potable water	0	0	0	0
Other foods	0	1	2	0
Unknown	3	0	2	1
Total*	19	3	12	4

* The total may differ from the total number of foodborne outbreaks reported as more than one food vehicle may be identified in a single outbreak.

Appendix 6: Animal population

Number of livestock in the UK in 2013

	England*	Wales**	Scotland***	N. Ireland†	UK
Cattle	5,364,000	1, 094,644	1,797,322	1,625,446	9,881,412
Sheep	14,922,000	9,460,692	6,570,611	1,968,872	32,922,175
Pigs	4,066,000	24,890	319,396	426,900	4,837,186
Poultry	120,504,000	8,736,547	14,693,992	19,128,094	163,062,633
Goats	80,000	10,475	3,966	3,133	97,574
Farmed Deer	22,000	1,007	6,234	3,064	72,305
Horses	194,000	50,381	37,117	12,007	293,505

Data sourced via the Radar Veterinary Surveillance database (Defra)

* obtained from the June 2013 England Agricultural Census

** obtained from the June 2013 Wales Agricultural Census

*** obtained from the June 2013 Scottish Agricultural Census

† Northern Ireland data provided by Department of Agriculture and Rural Development Northern Ireland, 2013 from Agriculture Survey for 2013 and APHIS records.

Note that figures in the above table are a snapshot of the population at a specific time during the year, as shown in the table footnotes. For further information on data quality including accuracy and comparability contact: vetsurveillance@defra.gov.uk

Number of pets owned in the UK in 2013[71]

PFMA research shows that in 2012 45% of UK households owned at least one pet. This would be approximately 13 million households with pets, out of approximately 27 million UK households in total. The table below shows the estimated population of UK pets, as well as a breakdown of the most popular pets, in 2013.

Species	Approximate number of pets (millions)
Dogs	8.5
Cats	8.5
Rabbits	1
Birds (indoor)	1
Guinea Pigs	0.5
Hamsters	0.5
Outdoor fish	20 - 25
Indoor fish	20 - 25
Domestic fowl	1

[71] Source: Pet Food Manufacturers' Association: www.pfma.org.uk

Appendix 7: Further reading

General further reading

Advisory Committee on the Microbiological Safety of Food: Report on microbial antibiotic resistance in relation to food safety. The Stationery Office, ISBN 0 11 322283 1.

http://acmsf.food.gov.uk/acmsfreps/acmsfreports

Defra - Zoonoses web pages

https://www.gov.uk/government/collections/zoonoses-reports

Defra Publications - Zoonoses Reports UK

https://www.gov.uk/government/collections/zoonoses-reports

Food Standards Agency: A report on the study of Infectious Intestinal Disease in England, The Stationery Office, ISBN 0 11 322308 0

www.food.gov.uk/science/research/foodborneillness/microfunders/intestinal

Food Standard Agency – Measuring foodborne Illnesses levels

http://www.food.gov.uk/science/microbiology/fds/58736

Public Health England - Zoonoses web pages

https://www.gov.uk/government/collections/zoonotic-diseases-zoonoses-guidance-data-and-analysis

Public Health England - Zoonoses newsletters

http://webarchive.nationalarchives.gov.uk/20130502110159/

Health Protection Scotland – Outbreaks in Scotland in 2013

http://www.hps.scot.nhs.uk/outbreaks/

HSE zoonoses guidance:

http://www.hse.gov.uk/agriculture/topics/zoonoses.htm

Joint Agency Guidelines for the Investigation of Zoonotic Disease (England and Wales)
http://webarchive.nationalarchives.gov.uk/20140714084352/

Guidelines for the investigation of zoonotic disease in Scotland

http://www.documents.hps.scot.nhs.uk/about-hps/hpn/zoonoses-guidelines.pdf

AHPA - Non-Statutory Zoonoses Reports
https://www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2014

Oxford Textbook of Zoonoses: Biology, Clinical Practice and Public Health Control, 2nd Ed. (Palmer, Soulsby, Torgerson and Brown) OUP ISBN 9780198570028

Disease specific further information:

Useful links can also be found at the end of each A-Z section.

Appendix 8: List of Abbreviations/ Acronyms

ACMSF	Advisory Committee on Microbiological Safety of Food
AFBI	Agri-Food and Biosciences Institute
AHVLA	Animal Health and Veterinary Laboratories Agency (Animal and Plant Health Agency from 1st October 2014)
AI	Avian Influenza
AMR	Antimicrobial Resistance
APHA	Animal and Plant Health Agency (new agency formed on 1st October 2014 that incorporated AHVLA)
BSE	Bovine Spongiform Encephalopathy
bTB	Bovine Tuberculosis
CCDC	Consultant in Communicable Disease Control
CCHF	Crimean Congo Haemorrhagic Fever
CJD	Creutzfeldt-Jakob Disease
CMO	Chief Medical Officer
CTX-M	Genes having cefotaxime hydrolysing capabilities (conferring antimicrobial resistance). See 'ESBL' for a fuller explanation.
DARC	Defra Antimicrobial Resistance Coordination group
DARD	Department of Agriculture and Rural Development (Northern Ireland)
Defra	Department for Environment, Food and Rural Affairs
DH	Department of Health
EAE	Enzootic Abortion of Ewes
EBLV	European Bat Lyssavirus
EM	*Echinococcus multilocularis*
ESBL	Extended spectrum β-lactamases (ESBLs) are enzymes produced by bacteria that can confer resistance to some of the most commonly used antibiotics in hospitals e.g. penicillins, cephalosporins, monobactams. There are various types encoded by different genes, including a group of genes termed CTX-M and a separate set known as SHV.
EU	European Union
FSA	Food Standards Agency
GB	Great Britain (England, Wales, Scotland)
GP	General Practitioner
HAIRS	Human, Animal Infections and Risk Surveillance Group

HEV	Hepatitis E Virus
HPA	Health Protection Agency (now Public Health England since April 1, 2013)
HPAI	Highly Pathogenic Avian Influenza
HPS	Health Protection Scotland
HSE	Health and Safety Executive
IgG	Immunoglobulin type G
LPAI	Low Pathogenic Avian Influenza
NCP	National Control Programme for *Salmonella* in Poultry
NHS	National Health Service
OBF	Officially Brucellosis Free
PCR	Polymerase Chain Reaction
PHA	Public Health Agency (Northern Ireland)
PHE	Public Health England (formerly HPA)
PHW	Public Health Wales
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (HSE)
SG	Scottish Government
SHV	Genes having sulfhydryl variable (conferring antimicrobial resistance). See 'ESBL' for a fuller explanation.
SitRep	Situation Report
SRUC	Scotland's Rural Colleges (created on 1st October 2012, formally SAC)
TB	Tuberculosis
TSE	Transmissible Spongiform Encephalopathy
UK	United Kingdom (England, Wales, Scotland, Northern Ireland)
UKZADI	United Kingdom Zoonoses, Animal Diseases and Infections Group
vCJD	Variant Creutzfeldt-Jakob disease
VIDA	Veterinary Investigation Diagnosis Analysis Database
VMD	Veterinary Medicines Directorate
VRG	Veterinary Risk Group
VTEC	Verocytotoxigenic *Escherichia coli*
WG	Welsh Government
WHO	World Health Organisation

Appendix 9: Acknowledgements

This report was produced by a group under the Chairmanship of Dilys Morgan. The group contained representatives of, or received assistance from, the following organisations:

Agri Food and Biosciences Institute

Veterinary Sciences Division, Stoney Road, Stormont, Belfast, BT4 3SD

www.afbini.gov.uk

Animal and Plant Health Agency (APHA)

New Haw, Addlestone, Surrey, KT15 3NB

https://www.gov.uk/government/organisations/animal-and-plant-health-agency

Brucella reference unit (BRU)

Royal Liverpool and Broadgreen University Hospital, Prescott Street, Liverpool, L9 8XP

https://www.gov.uk/government/collections/brucella-reference-unit-bru

***Cryptosporidium* Reference Unit** (PHE Collaborating Laboratory)

Public Health Wales, Microbiology Swansea, Singleton Hospital, Swansea, SA2 8QA

www.wales.nhs.uk/sites3/page.cfm?orgId=457&pid=25284

Department for Environment, Food and Rural Affairs (Defra)

Area 5B, Nobel House, 17 Smith Square, London, SW1P 3JR

https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs

Department of Agriculture and Rural Development (Northern Ireland) (DARD)

Dundonald House, Upper Newtownards Road, Belfast, BT4 3SB

www.dardni.gov.uk

Department of Health

Richmond House 79 Whitehall, London, SW1A 2NS

www.dh.gov.uk

Department of Health, Social Services & Public Safety (Northern Ireland)

Castle Buildings, Stormont, Belfast, BT4 3SJ

www.dhsspsni.gov.uk

Food Standards Agency (FSA)

Aviation House, 125 Kingsway, London, WC2B 6NH

www.food.gov.uk

Health Protection Scotland (HPS)

Meridian Court, 5 Cadogan Street, Glasgow, G2 6QE

www.hps.scot.nhs.uk

Hospital for Tropical Diseases

3rd floor Mortimer Market Centre, Mortimer Market, London, WC1E 6JB

https://www.gov.uk/government/collections/national-parasitology-reference-laboratory-nprl

***Leptospira* Reference Unit** (PHE Collaborating Laboratory)

Department of Microbiology and Immunology, County Hospital, Hereford, HR1 2ER

https://www.gov.uk/government/collections/leptospira-reference-unit-lru

National Lyme Disease Testing Service (Scotland)

Microbiology department, Raigmore Hospital, Inverness, IV2 3UJ

Public Health Agency (Northern Ireland)

18 Ormeau Avenue, Belfast, BT2 8HS

www.publichealth.hscni.net/

Public Health England (PHE) (formerly HPA)

PHE Colindale, 61 Colindale Avenue, London, NW9 5EQ

www.phe.gov.uk

Public Health Wales

Communicable Disease Surveillance Centre, Health Protection Division, The Temple of Peace and Health, Cathays Park, Cardiff, CF10 3NW

www.wales.nhs.uk/sitesplus/888

Rare and Imported Pathogens Laboratory, Porton

Public Health England Porton Down, Salisbury, Wiltshire, SP4 0JG

https://www.gov.uk/government/collections/rare-and-imported-pathogens-laboratory-ripl

Scotland's Rural College

West Mains Road, Edinburgh, EH9 3JG

http://www.sruc.ac.uk/

Scottish *E. coli* O157/VTEC Reference Laboratory (SERL)

Department of Clinical Microbiology, Western General Hospital, Edinburgh, EH4 2XU

www.hps.scot.nhs.uk/reflab/RefLabDetail.aspx?id=13

Scottish Government, Rural Directorate

Saughton House, Broom House Drive, Edinburgh, EH11 3XD

www.scotland.gov.uk

Scottish Parasite Diagnostic and Reference Laboratory

House-on-the-Hill, Stobhill Hospital, 133 Balornock Road, Glasgow, G21 3UW

http://www.nhsgg.org.uk/content/default.asp?page=s201

Scottish *Salmonella* Reference Laboratory

North Glasgow University Hospitals NHS Trust, 133 Balornock Road, Glasgow, G21 3UW

http://www.hps.scot.nhs.uk/reflab/RefLabDetail.aspx?id=18

Scottish Toxoplasma Reference Laboratory

Microbiology department, Raigmore Hospital, Inverness, IV2 3UJ

***Toxoplasma* Reference Unit** (PHE Collaborating Laboratory)

Public Health Wales, Microbiology Swansea, Singleton Hospital, Swansea, SA2 8QA

www.wales.nhs.uk/sites3/page.cfm?orgId=457&pid=25359

Welsh Government (WG)

Cathays Park, Cardiff, CF10 3NQ

www.wales.gov.uk