HM Government

Zoonoses Report
UK 2017

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Contents

Preface

This annual report on zoonoses in the United Kingdom (UK) includes cases of zoonotic infection in humans and animals reported during 2017. The data has been compiled from statutory notifiable or reportable disease reports, national scanning surveillance systems, national laboratory reporting, control programmes and research activities. Some of the data has been submitted to the European Commission 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 and Social Care (DHSC)
- Animal and Plant Health Agency (APHA)
- Health Protection Scotland (HPS)
- Scottish Government (SG)
- Scotland's Rural College (SRUC)
- Food Standards Scotland (FSS)
- Agri-Food and Biosciences Institute (AFBI)
- Public Health Agency (PHA), Northern Ireland
- Department of Agriculture, Environment and Rural Affairs (DAERA, Northern Ireland)
- Public Health Wales (PHW)
- Welsh Government (WG)

Occasional corrections and amendments to the data, a lot of which is derived from dynamic databases, may occur following publication and will result in minor changes to subsequent annual reports.


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Executive summary

This year's UK Zoonoses Report continues to include the numbers of reported cases of zoonotic infection in humans and animals and a selection of feature articles which highlight human and animal incidents and issues of public health significance which occurred during 2017. Many of the featured incidents are on-going and emphasise the need for continued surveillance and collaboration between veterinary and human health practitioners. The identification of human and animal infections associated with the increased popularity of feeding raw pet food is an example of where taking a collaborative, 'One Health' approach can produce an effective response. In this case, collaboration both within government and with the Pet Food Manufacturers' Association (PFMA) led to an improved understanding of the potential risks inherent in raw food, the publication of specific guidelines by the PFMA, and consequent changes within the UK production and supply network. These changes will help reduce future incidents.

The report highlights significant trends in a number of infections which will continue to be monitored. However, 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, test charges and so on, and are likely to affect the various livestock sectors and types of submissions in different ways.

Campylobacter continues to be the most commonly reported human gastrointestinal pathogen and cases increased again in 2017 after a decline over the previous 2 years. Outbreaks of campylobacter infections associated with the consumption of chicken or duck liver parfait or pate continue to be reported, with 9 incidents during 2017.

The burden of disease due to non-O157 shiga toxin producing strains of *E. coli* (STEC) is underestimated, but frontline laboratories introducing a PCR to directly detect shiga toxin genes has improved the detection of serogroups other than O157. In 2017, there were 589 laboratory confirmed cases of non-O157 STEC identified in the UK, and this represents a steady increase from the 59 cases reported in 2012. Three outbreaks of non-O157 (O26, O145 and O55) STEC infection were reported during 2017, although the sources of the outbreaks proved difficult to identify.

The number of cases of Lyme disease also showed a significant increase in England and Wales during 2017, although not in Scotland or Northern Ireland. Reports of human hepatitis E infections which have increased steadily for over 10 years, finally dropped in 2017, although reasons for this are not known.

The UK outbreak of H5N8 highly pathogenic avian influenza (HPAI) began in late 2016 and affected commercially kept poultry, backyard flocks and wild birds. Heightened biosecurity measures including housing of poultry and captive birds were pursued as means to reduce the likelihood of disease transmission from wild birds to poultry. The UK situation was part of a much larger outbreak affecting many other European countries as well as neighbouring countries in the Middle East and North Africa. Internationally, over a thousand poultry outbreaks were reported and nearly 1,500 wild-bird findings. This was an unprecedented level of highly pathogenic avian influenza, even more so than the epizootic of H5N1 HPAI in 2005 to 2006. The public health risk from this particular strain of AI was assessed to be very low.

Another incursion of a possible zoonotic pathogen was identified in 2017, when 4 cases of *Brucella canis* were identified in dogs. All the affected dogs had entered the UK from other European countries. It is believed all were infected prior to arrival, although most did not become clinically affected until some months later. Although human infection with *Brucella canis* is exceptionally rare, it is important dog owners are aware of the potential risk.

Both these disease incursions required proactive communication by government with stakeholders to help highlight the specific threat and enhance the response.

Thank you to the many contributors to this report and as ever, we would very much appreciate comments and suggestions for items in future reports. Please send these to zoonoses@phe.gov.uk.

Introduction

Zoonoses are defined by the World Health Organization 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 is sourced from laboratory-confirmed infections, enhanced surveillance schemes for specific zoonoses and statutory 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 (see 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, the Public Health (Infectious Diseases) Regulations 1988, the Public Health etc. (Scotland) Act 2008 and the Public Health Act (Northern Ireland) 1967. 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 in England and Wales. Similar lists for Scotland and Northern Ireland are included in the legislation cited above. 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. 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) in England or Public Health Wales (PHW)) immediately on suspected clinical diagnosis of a notifiable disease. All laboratories in England and Wales performing a primary diagnostic role must notify PHE/PHW on the confirmation of a notifiable organism. Similar processes exist in Scotland and Northern Ireland though the list of notifiable diseases varies slightly by

country. A summary is provided in Appendix 1. 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

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 2) to immediately notify the local Animal and Plant Health Agency (APHA) Field Office in England, Wales and Scotland[1] or the local Divisional Veterinary Office in Northern Ireland. Procedures for notification and control of specified diseases are outlined in the legislation detailed above.

Surveillance and recording of zoonotic diseases

Humans

In addition to statutory notification of specified infectious diseases (as above), 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 or outbreak related cases.

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. The minimum dataset on each outbreak is then collected through a standardised questionnaire. Each year a summary report of the results of the investigations are reported as required under article 8 of the European Union Zoonoses Directive 2003/99/EC[2]. Surveillance provides information on specific risk factors associated with different pathogens and their trends. Enhanced surveillance schemes, either nationally or locally, provide information on specific aspects of a zoonosis.

Data from the zoonoses surveillance schemes is reported on national surveillance centre websites and for England and Wales quarterly in the Health Protection Report

[1] https://www.gov.uk/government/organisations/animal-and-plant-health-agency/about/access-and-opening
[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

available at www.gov.uk/government/publications/common-animal-associated-infections-quarterly-reports-2018

Health Protection Scotland (HPS) and Northern Ireland's Public Health Agency (PHA) provide surveillance data on their websites:
www.hps.scot.nhs.uk/giz/index.aspx
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 APHA, Scotland's Rural College (SRUC), Food Standards Agency (FSA) Operations and Food Standards Scotland (FSS) Operations. A similar function is performed by the Agri-Food and Biosciences Institute (AFBI) and the Department of Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland. In addition, information may be available from universities, veterinary research organisations and other private veterinary laboratories.

The APHA 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 performs 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. Diagnostic samples are submitted to APHA 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.

Reports for 2017 are available at www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2017

SRUC reports can be found at www.sruc.ac.uk/downloads/120613/monthly_reports

In Northern Ireland the AFBI publish quarterly Disease Surveillance Reports at www.afbini.gov.uk/publications/animal-disease-surveillance-reports-2017

Appendix 4 records results for zoonotic diseases identified via testing undertaken by Government veterinary laboratories. However many veterinary samples are submitted to private laboratories for diagnosis and so may not be included in the data in this report.

Risk assessment and control of animal associated threats to public health

The UK Zoonoses, Animal Diseases and Infections (UKZADI) is an executive group that enables effective join-up at a strategic level across UK Government and devolved administrations' public health interests and co-ordinates cross-departmental and intergovernmental action. The Human Animal Infections and Risk Surveillance (HAIRS) group is a multi-agency, cross-disciplinary horizon scanning and risk assessment group for infections with potential for interspecies transfer (particularly zoonoses) both nationally and internationally (if there is the potential to impact the UK). In addition the Veterinary Risk Group (VRG) was established in response to the Anderson Review (Lessons Learned from the Foot and Mouth Disease outbreak in 2007) which recommended that the government should establish a standardised and systematic process for identifying, assessing, characterising, prioritising and escalating unexpected animal-related threats. The VRG is a cross-directorate and cross-administration UK-level body which reports to the 4 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 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 (EFIG) and the Advisory Committee on the Microbiological Safety of Food (ACMSF) bring together UK surveillance data on humans, animals and food to consider foodborne risks.

Further information

Human aspects of zoonotic infections
www.gov.uk/government/collections/zoonotic-diseases-zoonoses-guidance-data-and-analysis

Animal aspects of zoonotic diseases
www.gov.uk/government/collections/notifiable-diseases-in-animals
www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2017

Feature article 1: First UK outbreak of *Mycobacterium bovis* in a working foxhound kennel

Authors: Cat O'Connor and Katherine Russell, Emerging Infections and Zoonoses, National Infections Service, Public Health England

The vast majority of confirmed *Mycobacterium bovis* infections are reported in bovine species [1]. Infections in non-farm animals, including companion animals, are rarely reported but are known to present a risk, albeit a very low risk, to the health of their human contacts [2]. In 2017, Defra, APHA and PHE, in collaboration with the University of Edinburgh, worked together on the first reported outbreak of *M. bovis* in a working foxhound kennel in the UK [3, 4].

Animal health investigation

In early 2017, a suspected outbreak of *M. bovis* infection in a working foxhound kennel of approximately 180 hounds in Buckinghamshire, England was reported. The kennel is located within the Edge Area of TB control in England, which is a buffer zone of intermediate bovine TB incidence separating the High and Low bovine TB Risk Areas. These areas are subject to additional surveillance and controls for bovine TB. Since late 2016, a small number of hounds had displayed non-specific clinical signs such as weight loss and deterioration of condition. To complement traditional testing techniques (culture confirmation), a combination of experimental ante-mortem immunological tests including an interferon gamma release assay (IGRA) and a serological assay were used as part of this investigation [3]. Of the 164 hounds tested, 85 (52%) were diagnosed using the above methods [3]. Test positive and/or clinically unwell hounds were euthanised. Three hounds had lesions suggestive of mycobacterial infection in kidney and heart tissue at post mortem examination. *M. bovis* infection was culture confirmed by APHA in 14 cases and identified as genotype 10:a [3].

The source of infection for the hunting pack was not identified. One hypothesis was that the hounds may have been infected by contaminated meat or offal. Hounds in hunting kennels are permitted under Article 18 of the Animal By-Products regulation (EC1069/2009) to be fed meat or offal from fallen stock animals (animals that have died or were euthanised on a farm) that have not gone through meat inspection but did not show signs of diseases communicable to humans or animals at the time of their death. Since this incident, additional measures have been put in place to strengthen controls on meat or offal fed to dogs in recognised kennels or packs of hounds [5].

Public health investigation

Two PHE Health Protection Teams (Thames Valley and East of England HPT) carried out risk assessments for all individuals with reported close contact with the affected hounds, including hunt kennel and veterinary staff, a total of 17 people [4]. Tuberculosis screening was offered to 11 individuals with significant contact with affected hounds, but no cases of active disease were found. One asymptomatic exposed person tested positive for TB on initial screening by immunological assay (IGRA test). Following CT scanning and culture of tissue samples, no evidence of active TB infection was identified and the individual was diagnosed with latent TB. This individual had not been previously tested for TB and did not have other known risk factors for TB outside of the workplace. However, they were involved in many high-risk exposure activities at the hunt kennels including post-mortem examination of hounds without personal protective equipment, preparation of meat from fallen stock carcases for feeding, cleaning of kennels using a pressure washer and care of open wounds on infected animals. In latent TB infection speciation of the causative agent cannot be undertaken so it is not possible to state whether this individual was infected with *M. bovis* or if the infected hounds were the source [4].

Although no confirmed human cases were associated with this outbreak, risk assessments performed by local HPTs highlighted the many practices commonly undertaken in foxhound kennels where potential exposure could occur. In future outbreaks of *M. bovis* infection in foxhounds or other kennels, public health actions should be considered as part of the initial response.

References

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5 Defra. Derogations from Animal By-Product controls under Regulation (EC) 1069/2009 and Commission Regulation (EU) 142/2011. Oct 2017. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/650731/abp-exemptions-201710.pdf

Feature article 2: Risks associated with raw pet food

Authors: Jennifer Wilburn, Emerging Infections and Zoonoses, National Infections Service, Public Health England and Stephen Wyllie, Veterinary Advice Services Team, Animal and Plant Health Agency

The use of raw pet food, particularly raw meat, has become an increasingly popular trend amongst pet owners [1]. The composition of feed includes a range of meats and offal, commonly from chicken, turkey, lamb, beef, pork, but also hare, rabbit, horse, venison, kangaroo and wild boar [2]. The perception is that such diets may be beneficial for companion animals. However, there are significant concerns that such practices can pose a health risk of serious illness in both pets and their owners, as raw pet food may contain a wide range of pathogens [3]. Raw pet food is not considered directly to be a food safety issue, however it can be a potential source of zoonotic infection via unhygienic or inappropriate handling in domestic environments through cross-contamination, especially during handling in the kitchen [3]. Contact with infected pets, which may or may not show symptoms, also serves as a potential route of exposure. In addition, raw pet food may have the potential to increase animal and human exposure to antimicrobial resistant (AMR) bacteria [3]. The risk of microbiological contamination is of particular concern for immuno-compromised individuals.

While animal by-products regulations are in place to reduce the risk associated with raw pet food, 9 microbiological incidents were associated with raw meat-based pet food in 2017 (details on 3 of the incidents are included below) [2].

Requirements of the regulations include [2]:

- operators may only manufacture raw pet food from certain Category 3 (low risk) material
- raw pet food must be packed in new packaging preventing any leakage
- effective steps must be taken to ensure that the product is not exposed to contamination throughout the production chain and up to the point of sale
- materials must be collected and transported under conditions which exclude risks to public and animal health
- no unacceptable risks to public or animal health from source material
- random samples must be taken weekly from each product line during production or storage (before dispatch) to verify compliance with microbiological standards

While samples are only required to be tested for *Salmonella* and Enterobacteriaceae, there is also a risk from other bacterial and parasitic pathogens [2].

Salmonella Kentucky

In 2017, official testing of raw pet food from a large UK raw pet food producer identified 3 *S.* Kentucky positive samples, with resistance to ciprofloxacin, naladixic acid and ampicillin. 70% of the company's raw materials came from UK sources, with 30% of material imported from the EU. EU-sourced ingredients were imported from the Netherlands and included turkey, rabbit and chicken. No pre-export testing was conducted as the Dutch company do not claim that the material is microbiologically sterile. Following detection, the product was recalled, destroyed and cleaning and disinfection conducted by the UK producer. There were no associated human or animal cases in the UK known to be linked to the incident.

As an outcome, the industry requested clearer guidelines on when a public recall of a product is required as this can often be damaging to the reputation of the company and potentially the sector as a whole. APHA and other Government Departments have worked with the Pet Food Manufacturers Association to create a Code of Practice [4], and to inform the public that such products should be handled appropriately with the same level of caution as handling any raw meat.

Salmonella Infantis

The presence of *S.* Infantis in a frozen raw pet-food product was reported by Belgian authorities, with the product originating from the Netherlands. This frozen pet-food was exported to Spain, France, UK and Italy. Within the UK, the contaminated batch was supplied to a single importer who used the product at their kennels as well as selling to customers. The strain was found to be resistant to 5 antibiotics which were:

- ciprofloxacin
- nalidixic acid
- sulfamethoxazole
- tetracycline
- trimethoprim

This AMR profile is consistent with the type of *Salmonella* Infantis that is epidemic in broiler chickens in much of Europe and the Middle East. The strain of *S.* Infantis was assessed as posing a low level risk (medium uncertainty) to public health. There were no associated human or animal cases in the UK arising from the incident.

Brucella suis

An ill dog in the Netherlands was diagnosed with *B. suis* (pig Brucella) infection, identified as biovar 1. This organism is not thought to be endemic in the Netherlands. Alternative sources of contamination were sought and the infection was traced to raw, frozen pet food made from hare meat imported from Argentina which had been fed to the infected dog. The Dutch authorities then notified the 5 other Member States which had received batches of this pet food product from the Dutch distributor. The UK distributor had received an alert from the Dutch supplier and issued a recall notice to their customers 2 weeks earlier, but had not informed the UK authorities. Although it was not certain that the batches imported to the UK were contaminated, in view of the pathogenicity of the organism strain, UK authorities decided to take a precautionary approach. Communications included a joint “Warn and Inform” letter from PHE and APHA to owners and pet shops who had purchased the pet food, and an APHA letter to the Veterinary Record to alert private vets to the potential risk from biovar 1. APHA offered to test blood samples from dogs fed the pet food at no charge. There were no associated human or animal cases in the UK arising from the incident.

Although there were no animal or human cases from the first 2 incidents, highly antibiotic resistant organisms that pose a risk to public health were recovered. While the third incident was not related to antimicrobial resistance, it illustrates the wide range of meats and sources that can contain and potentially transmit a highly pathogenic organism. By following good hygiene and proper handling, some of the risks associated with feeding raw pet food diets to animals can be mitigated.

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Feature article 3: Shiga-toxin producing *Escherichia coli* O157 outbreak associated with consumption of raw dairy milk

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An outbreak of Shiga-toxin producing *Escherichia coli* (STEC) O157 PT 21/28 stx2 occurred in Autumn 2017 in the South of England. Investigations identified 7 confirmed cases, 3 of whom developed Haemolytic Uraemic Syndrome (HUS). All but one case had either consumed raw milk from, or been exposed directly to the environment, of a farm which was a raw milk producer and was also open to the public. During investigations, control measures put in place to prevent further transmission included cessation of sale and recall of raw milk supplied by the farm, and actions to limit public exposure to associated environmental sources such as preventing access to animals on the farm by closing the petting activities. Despite this, a further 3 cases were notified following the recall, 2 of whom had drunk raw milk from the farm after the recall had been put in place. This was the first STEC outbreak associated with raw dairy milk (RDM) in England and Wales since an outbreak in 2014 affecting 9 cases [1].

During 2017, a number of other incidents related to RDM also occurred. In Wales, a child infected with STEC who had consumed RDM died, a rare consequence of STEC infection. Meanwhile, there have been 3 separate outbreaks of *Campylobacter* spp affecting 27 individuals in total, and an incident of *Salmonella* Dublin, in which 1 human was infected.

Products made from RDM have also caused illness. In 2016, unpasteurised cheese made from RDM caused 3 incidents, including a relatively large STEC O157 outbreak, predominantly affecting Scotland [2]. In addition, a listeriosis death was reported in 2017 where the same strain was detected in a cheese product and the patient, and a *Campylobacter jejuni* outbreak occurred, affecting 69 cases in England.

Prior to the above incidents, the last reported outbreaks associated with RDM were 2 STEC O157 outbreaks occurring in 2000 [3]. A previous publication on foodborne outbreaks in England and Wales, indicated 14 RDM outbreaks between 1992 and 2000, with STEC O157 (n=5), *S.* Typhimurium (n=5) and *Campylobacter* (n=4) as the infecting pathogens.

The recent increased occurrence of RDM and RDM-product related gastrointestinal infection incidents in 2016 and 2017 is noteworthy and of concern, and highlights the continued role of RDM as a cause of human illness. This has corresponded with an increase in popularity among consumers and in registered RDM producers in the UK. In January 2018, there were 168 RDM producers compared to 108 in April 2014 [4].

In July 2015, controls governing the sale and marketing of RDM were reviewed by the FSA and at that time no changes were recommended to existing control measures. In England and Wales, RDM must be labelled with a warning and can only be sold directly to the customer at the farm gate or farmhouse catering operation, by farmers at farmers' markets, distributors using a vehicle as a shop (such as a milk round), direct online sales or vending machines at farms. In Scotland, the sale of RDM is banned.

However, in May 2018 following the recent evidence, the Advisory Committee on the Microbiological Safety of Food (ACMSF) recognised that the microbiological risk associated with consumption of RDM in the UK had increased reflecting greater levels of exposure due to increased numbers of producers and rising consumption. The FSA have subsequently set out recommendations to enhance existing controls around registration and hygiene of RDM producers.

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Feature article 4: Shiga-toxin producing *Escherichia coli* O157 outbreak associated with green tripe

Authors: Jennifer Wilburn, Emerging Infections and Zoonoses, National Infections Service, Public Health England and Lisa Byrne, Gastrointestinal Infections, National Infections Service, Public Health England

Shiga toxin-producing *Escherichia coli* (STEC) are zoonotic and healthy ruminants, particularly cattle and sheep, are the main reservoir of infection [1]. STEC has a very low infectious dose and transmission to humans occurs through consumption of contaminated food or water, direct or indirect contact with infected animals or their environment and through person to person spread. Each transmission route can cause sporadic infection as well as outbreaks.

In August 2017, a cluster of 4 human cases infected with genetically related strains of STEC O157 was identified [2]. The strains possessed the toxin subtype stx2a, known to be associated with more severe disease. One person died following development of HUS. A multi-agency investigation was undertaken and included re-interviewing cases and sampling and testing implicated products. No clear common exposures were apparent, except for contact with dogs. One case specified feeding their dogs raw tripe. A second case reported contact with dog(s) also fed on raw tripe purchased from the same shop. Another case had close contact with a dog, including brushing its teeth with their own toothbrush, and this dog was also fed a raw meat based diet.

A second trawling interview was undertaken with each case (or a family member) with the aim of refining a hypothesis for investigation. The trawling questionnaires indicated that the only exposures common amongst the 4 cases were that each had contact with dogs and had eaten carrots. Feeding of raw tripe (n=2) and a raw meat based diet (n=1) was reconfirmed in the interviews. The fourth case reported contact with a dog fed on bulk frozen pet food sourced from an online company that also supplied raw pet food 4 weeks prior to onset of symptoms.

While 1 case was not linked to raw pet food, exposure to the same strain of STEC may have occurred through a different route including indirect or direct exposure to infected animals which entered the pet feed supply chain. Alternatively, the case may have been exposed to an animal fed a raw meat based diet without being aware of, or being able to recall, that exposure.

Tripe is the edible lining of cow stomach and as such raw tripe can plausibly contain pathogens including STEC. While tripe is cleaned and treated for human consumption, many raw pet foods contain green tripe, a raw product which hasn't been cleaned and contains the untreated contents of the cow's stomach.

Sampling and microbiological screening of raw pet food was undertaken and indicated the presence of STEC in the products. STEC was isolated from 1 sample of raw tripe but it was a different strain to that responsible for the outbreak. Nevertheless, isolation of STEC did provide evidence for microbiological contamination of tripe and its pathogenic risk to human health, making it a plausible transmission route. As phylogenetic analyses indicated the strain of STEC in this outbreak clustered most closely with other strains isolated from cases without a travel history, the source of infection was therefore likely to be of domestic (UK) origin.

This adds to the evidence of raw pet food as a risk factor for zoonotic transmission of gastrointestinal pathogens [3]. It is widely accepted that raw meat, including animal by-products used in pet feeds, can contain pathogens which are harmful to health. The Incident Management Team concluded the best approach to reduce the risk of infection is to improve awareness of risk and promote good hygiene practices when handling raw pet food. Subsequently, PHE have developed guidance on the topic and a series of infographics to promote awareness of good hygiene when handling raw pet food. They can be found here at www.gov.uk/guidance/raw-pet-foods-handling-and-preventing-infection.

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Feature article 5: Enhanced surveillance for leptospirosis

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Leptospirosis is a zoonotic disease caused by the spiral-shaped bacteria *Leptospira* and is more common in tropical areas of the world [1,2]. Nearly all mammals can carry the bacteria and may spread the disease via urine. Common animal reservoirs include rodents, cattle and pigs.

Case definition for confirmed cases of human leptospirosis

A confirmed case of leptospirosis included confirmation on either Microscopic Agglutination Test (MAT) and/or PCR.

Confirmation on MAT defined as:

- a single MAT titre of ≥ 320
- a rising MAT titre, rising to 320 or greater
- any 4 fold rise in MAT titre

Confirmation on PCR defined as:

- 16S rRNA PCR positive on any sample

In England and Wales, enhanced surveillance for laboratory confirmed cases of human leptospirosis was undertaken between 29 December 2016 and 28 December 2017. The local Health Protection Teams (HPT) were asked to complete an Enhanced Surveillance Questionnaires (ESQs), either online using SelectSurvey or via secure email, for all laboratory confirmed leptospirosis cases in their area. The ESQ collected clinical and epidemiological information about the cases. Additional diagnostic information was provided by the National Leptospirosis Service.

The objectives of the enhanced surveillance study were to:

- understand the clinical and epidemiological characteristics of laboratory-confirmed cases of leptospirosis
- obtain information on risk factors to inform development of public health advice
- provide information to improve laboratory diagnostics

A total of 87 laboratory confirmed cases of leptospirosis were reported during the study period. The majority of cases were confirmed by PCR (n=63), of which 7 cases were also positive by MAT. The remaining 24 cases were confirmed by MAT titres alone.

Of the 31 MAT positive results the serogroup could be assigned in 25 (81%) cases. The most frequently identified serogroup was Serjoe (see table below). Although leptospirosis is traditionally diagnosed by the presence of reacting leptospira serovar(s) in blood [3], cross-reactivity has been observed in pathogenic and non-pathogenic serovars between different serogroups [4,5].Therefore to reduce this variation and improve consistency of reporting, serogroup designation is reported in place of serovar designation.

The ages of cases ranged from 10-82 years (median=38 years), and the majority were male (86%, n=75). The gender difference observed in this study has been reported elsewhere and is frequently attributed to men being more likely to undertake occupations or activities that bring them into contact with the pathogen [6-10].

Table: Identified serogroup corresponding to the highest MAT titre

Serogroup		No. of cases	%
Serjoe	(MAT 13,14)	11	36%
Icterohaemorrhagiae	(MAT 7, 8)	5	16%
Australis	(MAT 1)	3	10%
Semaranga	(MAT 16)	3	10%
Andaman	(MAT 17)	1	3%
Bataviae	(MAT 20)	1	3%
Pyrogenes	(MAT 25)	1	3%
Unknown	-	6	19%
Total		**31**	

ESQs were completed for 78 cases (90%). The majority of cases reported that they were admitted to hospital (n=69, 88%) and 74 cases (95%) had at least 1 occupational, animal or water exposure identified which may have been the source of infection. Recent history of travel outside of the UK (returning within 30 days of symptom onset) was reported for 36 cases (46%); with Central America, the Caribbean and Asia the most frequently travelled locations. An increase of leptospirosis observed in international travellers from less developed countries, particularly those in adventure tourism, has previously been recognised [11]. A recent history of travel within the UK was reported for 16 cases (21%). Two cases reported travel both within and outside of the UK and 28 cases (36%) reported no recent travel history. The figure below summarises the number of reported exposures comparing UK and abroad.

Occupational risks included working in rivers and agricultural work with animals.The most frequent occupational exposure (n=13 in UK, n=4 abroad) was working in rivers, floodwater or other surface water; followed by agricultural workers (n=10 in UK, n=1 abroad).

The most frequent animal exposure was to dogs (n=26 UK, n=9 abroad) although this may be an indicator of environmental exposure. As expected, contact with animals and occupational risks for leptospirosis were more common amongst UK acquired cases compared to those acquired abroad.

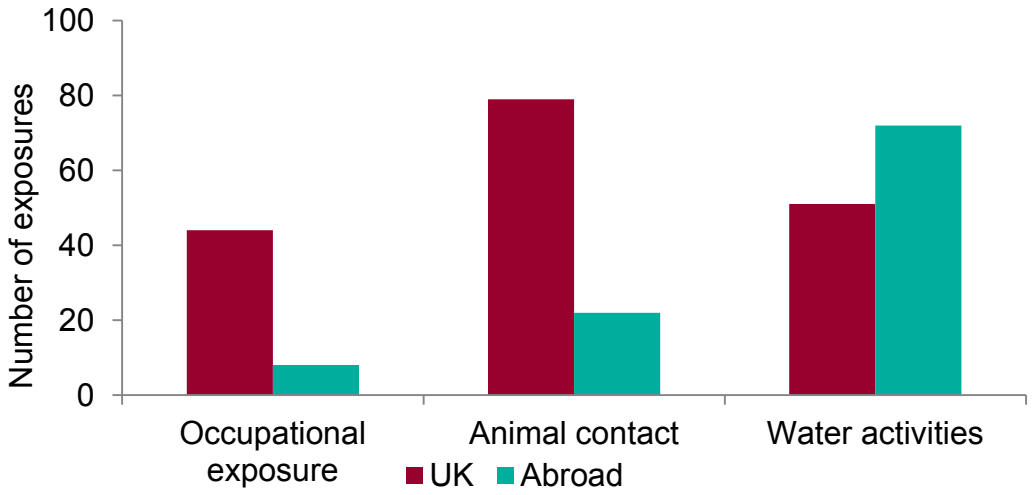

Figure: Number of cases with exposures in the UK compared to abroad

Overall water activities accounted for the greatest number of potential exposures. The risk of acquiring leptospirosis may be increased in certain water-based and adventure sports where the risk of skin abrasions is high. Water activity includes swimming, kayaking, canoeing and rafting. Swimming in untreated water was the most frequently reported exposure (n=15 in UK, n=24 abroad). Given that many cases had different types of exposure it can be difficult to determine the specific activity that led to infection.

Two clusters of leptospirosis were reported in 2017. The first cluster occurred in May 2017 involving 3 cases who had been travelling together in the Caribbean region and went swimming in untreated water. The second cluster occurred in the UK in October 2017 with 4 cases who had participated in a military exercise reporting exposure to untreated water. Three of the 4 cases were confirmed as having the same serogroup (Serjoe).

Symptom onset was highest in the summer months in those who travelled abroad; most likely reflecting the holiday season during which more people travel overseas. However, symptom onset was highest in the autumn months in those who remained in the UK. Further investigation to establish whether there is seasonality of leptospirosis in the UK would be beneficial as currently data is limited for the UK as most cases are imported and this can skew seasonality.

This enhanced surveillance study provides an important insight into the epidemiology of *Leptospira* infections diagnosed in the UK. Although leptospirosis is not a common infection, it can cause severe disease requiring hospitalisation. Those whose occupation or recreational activities may put them at increased risk should be advised to seek medical attention if they feel unwell following a possible exposure.

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Zoonoses A-Z

Anthrax (*Bacillus anthracis*)

Anthrax is caused by the bacterium *Bacillus anthracis*. Under aerobic conditions *B. anthracis* converts into spores which may survive in the environment for many decades in an inert state and show great resistance to the effects of heat, drying, ultra-violet light and many disinfectants.

Anthrax infection in humans mainly causes 1 of 3 main types of disease that affect either the lungs (inhalation/ pulmonary), the digestive tract (intestinal) or the skin (cutaneous). In 95% 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 in persons who use drugs.

Anthrax can occur in all mammalian species, and has also been reported in some birds. The clinical presentation in animals varies between species with 3 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.

Infection in humans

There were no human cases of anthrax reported in the UK in 2017.

Infection in animals

There were no anthrax incidents detected in animals in the UK in 2017. The last outbreak of anthrax in animals in the UK occurred in 2015 when anthrax was confirmed in 2 cows at a farm in Wiltshire.

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. AI viruses are classified according to the severity of disease (pathogenicity) they cause in kept birds as either highly pathogenic or of low pathogenicity. Highly pathogenic AI (HPAI) viruses 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. All HPAI and LPAI strains of H5 or H7 subtypes are 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 virus infection in poultry.

The H5N1 HPAI virus strains have been responsible for considerable poultry losses across Asia and other parts of the world. In addition, other H5 and H7 strains have been observed in wild birds and poultry worldwide including H5N8 HPAI and H5N6 HPAI. As a result the UK has maintained a high vigilance for AI with established surveillance systems, in response to the potential for sporadic incursions of influenza A (H5) viruses.

Infection in humans

Human cases of AI in the UK are very rare. There were no human cases reported in 2017.

In 2006, there was 1 confirmed case of H7N3 in a farm worker. In 2007, there were 4 cases of AI 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 AI viruses in the UK.

Avian influenza surveillance

Active surveillance of UK poultry for viruses of H5 and H7 subtypes has been undertaken annually since 2003. During 2017, 3 of the 328 holdings sampled in the UK had birds with antibodies to AI viruses of subtypes H5 or H7, (5 of the 320 holdings sampled in 2016 had birds with antibodies to AI viruses of subtypes H5 or H7).

Twelve cases of AI in poultry were confirmed between January and June 2017 in GB. The H5N8 strain of HPAI was confirmed at farms in Suffolk, Lancashire and Lincolnshire, and in backyard flocks in Lancashire, Norfolk, North Yorkshire, Northumberland, and Carmarthenshire. These viruses were closely analysed to assess

the possible threat they posed to public health. They were strains with retention of strong avian affinity and therefore of very low risk for public health. Full details of these cases are on the links below:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/630442/ai-epi-report-may-2017.pdf

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/626641/ai-epid-report-july17.pdf

The same strain of virus was also found in wild birds in England and Wales in 2017. 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 5 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 2017, a total of 1,131 wild birds were sampled in the UK. All of these were found dead/injured by the public or warden patrols of wetlands and reserves. Twenty-seven were positive for H5N8 with a range of species represented, but the majority in Great Britain (GB) were waterfowl, including 12 mute swans (*Cygnus olor*). In GB, 1 whooper swan (*Cygnus cygnus*), 1 barnacle goose (*Branta leucopsis*), 1 mute swan and a mallard duck (*Anas platyrhynchos*) were influenza A-positive, H5-negative. In Northern Ireland, 1 mute swan, 2 whooper swans and a Chinese goose were positive.

To increase the sensitivity of surveillance in GB, in March 2017, the surveillance threshold for certain target species (wild geese, wild ducks including mallards, swans, gulls and birds of prey) was reduced to the finding of a single dead bird. Despite a reduction in the number of H5N8-positive birds, the decreased threshold remained during the second and third quarters of 2017 to increase surveillance sensitivity.

Infection via the food chain

In 2015, the FSA carried out an updated assessment of the risk to consumers from AI viruses via the food chain.[3] The assessment concluded that for thoroughly cooked and hygienically handled and stored food, the risk of infection with AI viruses via handling and consumption is considered to be very low.

[3] ACMSF. Assessment of the risk of avian influenza viruses via the food chain. https://acmsf.food.gov.uk/sites/default/files/acm_1192_avian%20influenza.pdf

Non-avian influenza

The most significant non-AI virus associated with animals in recent years has been swine influenza pandemic H1N1 virus which emerged in 2009 (termed A(H1N1)pdm09). There were 16 cases, from 133 case investigations of respiratory disease in pigs (12%), of swine influenza reported in GB in 2017, compared with 25 in 2016. This relatively high number of investigations may be influenced by testing continuing to be offered free of charge through the Defra programme under certain circumstances.

There were no cases of swine influenza from 46 case investigations of respiratory disease in pigs reported in Northern Ireland in 2017, compared with no cases from 70 investigations in 2016.

The predominant strain of swine influenza virus circulating in the pig population in 2017 was H1N2, which included some H1N2-pdmH1N1 reassortant viruses. Co-circulation of multiple strains raised questions as to the long term dynamics of virus strain dominance or coexistence, particularly the potential for further genetic reassortment and consequent risk for public health. Close liaison is maintained with public health colleagues for timely dissemination of such results. Swine influenza diversity across the globe is being driven by reassortment between the endemics and the pdmH1N1 strain.

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 tuberculosis in humans that is virtually indistinguishable from the disease caused by *M. tuberculosis,* the major cause of human tuberculosis (TB).

Bovine TB is one of the most serious animal health problems for the cattle industry in the UK. In England alone, the government spends about £70 million a year on disease control with the cost to industry estimated to be a further £50 million. *M. bovis* infection has also been reported in many mammalian species, including other livestock, wildlife and domestic animals. In the UK, cattle and badgers are considered the main maintenance hosts, with other mammals regarded as spill-over or dead-end hosts.

A compulsory area 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 of infection in cattle herds to a very low level by the early 1980s. However, since then, the

incidence and geographical distribution of bTB in cattle herds ('breakdowns'[4]) has increased in England, Wales and Northern Ireland. This increasing trend accelerated immediately after the foot and mouth disease outbreak in 2001, during which the routine bTB testing and slaughter programme was suspended for almost 10 months.

The overall aim of the government's current bTB strategy for England is to secure official bTB free (OTF) status for the whole of the country by 2039[5]. The longer-term figures for England indicate that herd prevalence and herd incidence have levelled off since 2012, reversing the historical increasing trend that began in the late 1980s and early 1990s. This is the case for England as a whole, but also for the high risk area (HRA), which accounts for the majority of TB breakdowns. The disease is not uniformly distributed across the country. In the low risk areas (LRA) herd incidence and prevalence remained very low and stable in 2017. In contrast with the LRA and HRA, the herd incidence and prevalence continued to increase in the Edge Area of England in 2017.

The number of new bTB herd breakdowns in Wales peaked during 2008 and 2009. Subsequently, there were substantial decreases in 2010, 2013 and 2016. There was an 11% increase in the number of new herd incidents in 2017, though the total was still the second lowest annual figure recorded since 2006. The trajectory over this period is far from stable, with short-term fluctuations, up and down. It is also important to note that apparent short-term increases in incidence may be at least partly attributable to intensified surveillance.

NI is epidemiologically and geographically distinct from GB and has developed and implemented a separate programme since controls began. Measures of disease in NI are not directly comparable with those in GB. Herd incidence has fluctuated considerably since 2007 and reached a peak in November 2017 (9.73%). Changes in annual animal incidence show a similar trend reaching a peak (0.920%) in November 2017.

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 also implements strict controls regarding the movement of cattle from the rest of the UK.

[4] Incidents of bovine TB are also known as 'breakdowns', that is herds in which at least 1 animal was identified as a reactor to the tuberculin skin test or where 1 or more *M. bovis* culture-positive tuberculous lesions were detected by post-mortem meat inspection during commercial slaughter of a non-reactor animal.

[5] www.gov.uk/government/publications/a-strategy-for-achieving-officially-bovinetuberculosis-free-status-for-england

Infection in humans

In 2017, there were 40 UK cases, a slight increase from 38 in 2016. The majority (n= 35) of *M. bovis* cases were reported from England, with a smaller number in Wales (n=2), Scotland (n=2) and Northern Ireland (n=1). Over the last 5 years, *M. bovis* has accounted for 0.9% (183/20,288) of culture confirmed *M. tuberculosis* complex human cases notified in the UK.

In 2017, approximately half of all *M. bovis* cases were male (n=21). By age, case numbers were highest in the 15-44 age group (n=16), followed by the 65 and over age group (n=15). There were 9 cases in the 45-64 age group and no cases in children aged under 15.

Place of birth was known in nearly all cases (n=37/40), with the majority born in the UK (n=30/37). Of the 7 non-UK born cases, 3 were aged 15-44 years, 3 were aged 45-64, and 1 was aged over 65 years. Almost half (13/30) of the UK-born cases were aged 15-44, while 6 were aged 45-64 and 11 were aged 65 years or over.

Infection in animals

In 2017, the UK registered cattle population comprised nearly 100,000 herds and 10 million cattle. Key data is shown in table 1.

Post-mortem evidence of bTB (characteristic lesions in test reactors and/or culture of *M. bovis*) was detected in 53.7% of the new GB incidents (598 confirmed slaughterhouse cases out of 1,114 slaughterhouse cases reported to APHA). The majority of individual cattle herds in the UK have OTF status at any given time (93% of all herds in GB at the end of 2017).

Table 1: Bovine TB herd incidents, 2017

	England	Wales	Scotland	GB	GB % change from 2016	N Ireland
New bTB herd incidents	3,824	789	40	4657 (+2)6	+3%	2,208
Number of cattle slaughtered as bTB test reactors	32,416	7,882	268	40,566	+11%	15,949

In England there was an increase of less than 2% in the total number of new herd incidents detected in 2017 relative to the previous year. Compared with 2016, the

[6] A 'balancing amount' refers to any cases that are known to have occurred in GB, but which cannot be allocated to a specific nation

number of new TB herd breakdowns increased by 25 (less than 1%) in the HRA, from 3,236 to 3,261. The number of breakdowns in the Edge Area increased by 44 (11%), from 393 to 437. By contrast, in the LRA there were 7 (5%) fewer breakdowns in 2017 than in 2016 (a drop from 133 to 126). The overall herd incidence rate in England, expressed as new herd breakdowns per 100 herd-years at risk, increased from 10.0 in 2016 to 11.0 in 2017. At 31 December 2017, there were 3,221 herds in England with OTF status suspended or withdrawn (that is under movement restrictions) due to a bTB breakdown, compared with 2,971 in 2016. This was the highest figure since 2012 and it means that the herd point prevalence increased slightly from 5.8% at the end of 2016 to 6.4% at the end of 2017. Again, herd point prevalence was highest in the HRA at 12.4% (11.7% at December 2016) and lowest in the LRA at 0.3% in 2017 (0.2% at December 2016).

In Wales, there was an 11% increase in the number of new herd incidents in 2017 compared to 2016, though the total was still the second lowest annual figure recorded since 2006 (Appendix 4). Officially bTB free status was withdrawn from 412 Welsh herds during 2017 compared with 409 in 2016, but the number of animals slaughtered in Wales as bTB test reactors[7] during 2017 was down 10% compared with 8,718 in 2016. The number of suspect bTB cases from Welsh herds identified in the slaughterhouse in 2017 was 109 (of which 55 were bacteriologically confirmed as *M. bovis* infections), compared with 102 (44 confirmed) in 2016. In December 2017 there were 912 herds under movement restriction in Wales due to a bTB incident or overdue bTB test, compared with 749 in December 2016.

In Scotland, there were 40 new bTB herd incidents in 2017, compared to 36 in 2016. There were 13 incidents where OTF herd status was withdrawn. Animals with either visible tuberculous lesions at slaughter or positive *M. bovis* culture were only detected in 8 of the 40 new herd incidents (20%) in 2017.

In 2017, the Northern Irish registered cattle population comprised 23,300 herds and 1.75 million cattle. During 2017, 2,208 new bTB reactor herds and 15,949 reactor animals were identified, and at the end of the year 3,617 herds were under movement restriction due to either a bTB incident or overdue bTB test, compared with 3,236 in December 2016.

During 2017 *M. bovis* infection was confirmed by laboratory culture in tissue samples from 105 non-bovine domestic animals (mainly camelids and pigs) as well as captive and wild deer in GB. In Northern Ireland, 1 sample, from farmed red deer, was confirmed as *M. bovis* positive.

[7] TB reactors to the tuberculin skin test or the interferon-gamma blood test

Further information

Epidemiology of *M. bovis* in humans in England, Wales and Northern Ireland (2002 to 2014) wwwnc.cdc.gov/eid/article/23/3/pdfs/16-1408.pdf

Bovine TB infection status in cattle in GB in 2017 www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2017

Cross Government guidance www.gov.uk/government/publications/bovine-tuberculosis-tb-public-health-management

The latest and historical statistics about TB in cattle in GB www.gov.uk/government/collections/bovine-tb

The GB data provided in the above link on TB incidents in cattle was derived from the TB in cattle in Great Britain National Statistics, as issued by Defra on 1 June 2018[8].

The bTB statistics are updated monthly and are available on the above link. All bTB data in this Defra TB database is provisional and subject to change as more data becomes available.

Brucellosis (*Brucella* spp.)

Cases of *B. abortus* in humans have occasionally been acquired in Northern Ireland, and peaked in 2002 along with the peak of infection in cattle. Human infections can be as a result of occupational exposure through the handling of infected afterbirths and products of conception (such as in farmers, veterinarians or abattoir workers), but this is now very rare in the UK. Otherwise, human cases of brucellosis are generally acquired outside the UK (usually *B. melitensis*) through the consumption of unpasteurised milk and dairy products in endemic countries.

The cattle population of GB has been officially brucellosis free (OBF) since 1985. Northern Ireland was declared OBF on 6 October 2015[9].

Infections with *Brucella 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.

[8] https://www.gov.uk/government/statistical-data-sets/tuberculosis-tb-in-cattle-in-great-britain
[9] Commission Implementing Decision (EU) 2015/1784

Infection in humans

In 2017, 5 cases of brucellosis in humans were identified in the UK (Table 2). Four were thought to have been acquired abroad, 1 is unknown and was lost to follow-up. This compares with 17 cases in 2016.

Table 2: Reports of Brucella infection in humans in the UK, 2017

	England & Wales	Scotland	Northern Ireland	United Kingdom
B. abortus	--	--	--	--
B. melitensis	4	--	--	4
***Brucella* spp. unknown**	1	--	--	1
Total	5	--	--	5

Infection in animals

The OBF status and trading rules underpin international trade and it is important to detect an incursion as quickly as possible. A programme of surveillance is therefore carried out in GB to ensure 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 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.

There were 4 cases of *B. canis* in terrestrial animals in GB during 2017, all imported dogs. The annual sheep and goat survey in GB tested 13,865 sheep from 752 flocks and 266 goats from 48 herds, and 4,948 sheep from 280 flocks and in Northern Ireland, 198 goats from 35 herds. No evidence of *B. melitensis* was found.

In Northern Ireland in 2017, 245,222 eligible animals in 10,896 cattle herds were tested for *B. abortus* on-farm and 57,523 individual animals were tested at point of slaughter as part of disease surveillance. In addition, 7,399 individual animals were tested on-farm as part of a specific check test, a re-test of inconclusive reactor animals or following the report of abortion. One herd in 2017 and 2 in 2016 gave seropositive results but this was not subsequently confirmed as brucellosis.

There were 8 diagnoses of *Brucella* spp. in marine mammals in 2017, all 8 identified following positive culture results in Scotland. In 2016 there were 9 diagnoses of *Brucella* spp. in marine mammals, all from Scotland.

Campylobacteriosis (*Campylobacter* spp.)

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. Transmission to humans is through the faecal-oral route, usually by the consumption of contaminated food or water. *C. jejuni* accounts for approximately 90% of campylobacter infections in humans. However, most laboratories do not routinely speciate strains isolated from human clinical specimens, so changes in relative incidence may not be detected.

The *Campylobacter* species of greatest public health importance are *C. jejuni* and *C. coli* (thermophilic campylobacters) which can be found in a wide range of livestock, poultry, and wildlife species. They do not generally cause disease in animals, apart from occasional abortion in sheep and enteritis in young mammals. *C. fetus* is a common cause of abortion in sheep and may occasionally cause serious systemic disease in humans. Other *Campylobacter* spp., 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.

Infection in humans

The reporting rate for campylobacter increased in the UK from 89.8 per 100,000 population in 2016 to 96.8 per 100,000 in 2017. This increase was observed in each of the UK countries. Northern Ireland continues to report rates lower than the rest of the United Kingdom (76.0 cases per 100,000 population). The reasons for this are unknown (Table 3 and Figure 1).

Table 3: Number of *Campylobacter* reports in humans 2015 to 2017

Year	England & Wales	Scotland	Northern Ireland	United Kingdom
2015	55,697	6,184	1,320	63,201
2016	52,382	5,298	1,258	58,938
2017*	56,729	5,796	1,421	63,946

*These figures are provisional

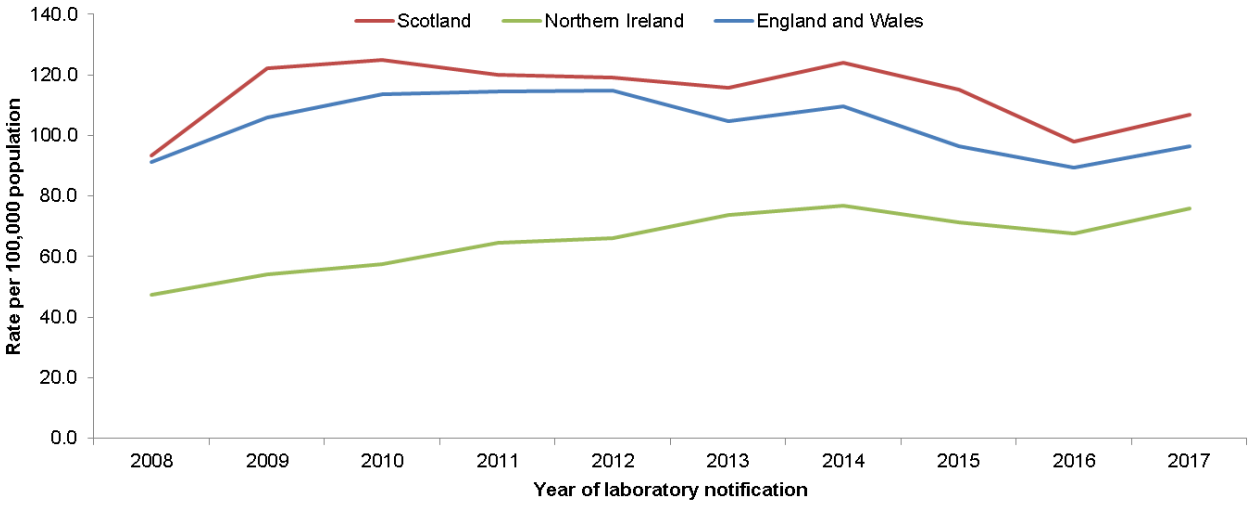

Figure 1: Rate of reported *Campylobacter* infections by region per 100,000 population, 2008 to 2017

The Second Study of Infectious Intestinal Disease in the Community established that the ratio of unreported human campylobacter disease to reports to national surveillance is 9.3 to 1 (95% CI 6-14.4) [10]. This suggests that, in 2017, there were almost 600,000 (with 95% CI, 383,676 – 920,822) cases in the UK. Since this is a population estimate, the confidence intervals need to be taken into consideration, but nevertheless, this is the most accurate measure we have of the unavoidable under-reporting to laboratory surveillance systems.

In 2017, there were 9 foodborne outbreaks of campylobacteriosis reported in the UK, compared to 8 recorded in 2016. Seven outbreaks were associated with the consumption of poultry meat products, of which 6 were chicken or duck liver parfait or pate. Two outbreaks were associated with the consumption of raw drinking milk. A summary of foodborne outbreaks by zoonotic pathogens, broken down by food vehicle category, is given in Appendix 5.

Infection in animals

There were 189 confirmed cases of campylobacter identified in animals in the UK in 2017 (129 England and Wales; 25 Scotland; 35 Northern Ireland). This compares with 158 cases in 2016, an increase of 20%. These cases were identified by Government laboratories from material submitted for diagnostic reasons.

Campylobacter isolates may not always be considered clinically significant in a disease investigation. Therefore, discrepancies may exist between the figures reported below

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

(which relate solely to testing of individual bacterial isolates) and those provided above and in Appendix 4 (which relate to clinical diagnoses of campylobacteriosis in animals).

The majority of livestock derived samples are from ruminant abortion investigations. Incidences of campylobacter fetopathy recorded by APHA appear to follow a cyclical pattern, with significant rises in infection rates observed every 3 years. This is thought to be due to immunity waxing and waning in the national flock.

Of the 144 ovine isolates from GB, 125 (87%) were confirmed as *C. fetus fetus (*a similar proportion to that seen in 2016), and 17 (12%) as a mixture of enteric strains (10 *C. jejuni*, 3 *C. coli* and 2 *C. sputorum,* 2 *C. mucosalis* of those that have been typed). The remaining 2 were unspecified. Of the 19 bovine isolates from GB, 9 (47%) were identified as *C. fetus venerealis intermedius* and 9 (47.4%) were *C. fetus fetus*. One (5%) was the enteric (thermophilic) strain *C. jejuni*.

In Northern Ireland, there were 4 bovine isolates and 31 ovine isolates.

Campylobacter contamination of food

A UK-wide microbiological survey of campylobacter contamination in chickens at retail sale carried out during August 2016 to July 2017 as part of the Food Standards Agency's Strategic Plan to reduce campylobacter contamination in whole raw chicken to a specified target. The aim was to determine the prevalence and levels of *Campylobacter* spp. contamination on fresh whole chilled chickens produced in the UK and sold at UK retail outlets. Based on the series of months for which comparisons can be made between year 2 (2015/16) and year 3 (2016/17) of the survey, there was a significant decrease in the percentage of chickens with highest levels of campylobacter (over 1000 cfu/g), from 11% during Aug 2015 – Mar 2016 to 7% over the same period a year later (Aug 2016 - Mar 2017). There was a significant decrease in the percentage of chickens positive for campylobacter, from 60% during Aug 2015 – Mar 2016 to 53% over the same period a year later. Standard produce chickens were sampled as well as a smaller number of free range and organic chickens (reflecting market share) and tested using method EN/ISO/TS 10272-2:2006[11]. The survey protocol had previously involved the collection and testing of a 25 gram sample, but following a new widespread industry practice of shortening neck skins prior to marketing, a testing protocol using a sample size of 10-25 gram neck skin was validated and this method was used from August 2016[12].

[11] 'Microbiology of food and animal feeding stuffs – Horizontal method for detection and enumeration of Campylobacter spp. Part 2: Colony-count technique'
[12] https://www.food.gov.uk/sites/default/files/media/document/retail_survey_protocol_year3_0.pdf

In November 2017, after a series of discussions with the top 9 retailers, an agreement was reached where these retailers will publish their campylobacter testing data online for consumers[13]. This has meant that the FSA has now stopped sampling these retailers and is instead focusing on small retailers and the independent market to try and tackle campylobacter levels in that sector.

As per its strategic plan 2015-2020, the FSA continues to work to reduce the incidence of foodborne disease, with a particular focus on campylobacter and established an Industry-Government campaign (Acting on Campylobacter Together (ACT)), that aims to reduce the prevalence of campylobacter at all points across the food chain. Further details can be found at: www.food.gov.uk/safety-hygiene/campylobacter

To measure progress on the effectiveness of this work, a joint government and industry target to 'reduce campylobacter in UK produced chickens by 2015' had been set, to reduce the most contaminated carcases (>1,000 cfu/g) in UK poultry houses from 27% to 10% by 2015[14]. The target was not achieved, but due to the measurable progress being made by the industry, it was agreed to roll the target over.

Chlamydiosis[15] and psittacosis

Ovine chlamydiosis (*Chlamydia abortus*)

Human infections appear to be rare but can cause serious disease in pregnant women, resulting in stillbirth or abortion. The main route of transmission to humans is through the inhalation of aerosols and contaminated dusts.

Infection of pregnant ewes with *Chlamydia abortus* may result in enzootic abortion of ewes. *C. abortus* may also cause abortion in goats and cattle.

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 *Chlamydia* species. Diagnosis of *C. abortus* is dependent primarily on clinical suspicion in a person with positive serology for *Chlamydia* infection and relevant exposure to sheep/ lambing.

There were no human cases reported in 2017 in the UK.

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[13] http://webarchive.nationalarchives.gov.uk/20180411163053/https://www.food.gov.uk/news-updates/news/2017/16736/retailers-publish-campylobacter-results
[14] http://www.food.gov.uk/science/microbiology/campylobacterevidenceprogramme/
[15] The nomenclature has reverted from chlamydophila back to chlamydia

Infection in animals

In 2017, there were 267 incidents of abortion in animals due to *C. abortus* infection in the UK, 266 in sheep, 1 in goats and none in cattle.

Psittacosis (*Chlamydia psittaci*)

Psittacosis (also known as ornithosis or chlamydiosis) is an infection caused by *Chlamydia psittaci*. Transmission of *C. psittaci* from birds to humans most often occurs via infectious aerosols, although it is not always possible to attribute individual cases to a particular source.

It has been described in over 130 species of birds but is most common in psittacines (parrots and parakeets). Bird species of the economically important poultry industries, for example turkeys, geese and ducks, are also natural hosts.

Infection in humans

Psittacosis data for 2017 is not available for England and Wales due to an ongoing reporting issue that is being investigated. Two cases were reported in Scotland.

A lack of specific serological testing means that reported cases could have been caused by *Chlamydia* 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 UK birds during 2017 (compared to 1 case in 2016). Of the 2 isolations, 1 was from a budgerigar carcass and 1 from a faecal sample of a lorikeet in a zoological park, but neither involved any human cases.

Further information

Chlamydiosis (Enzootic Abortion in Ewes) and risks in lambing season
www.gov.uk/guidance/chlamydophila-abortus

Cryptosporidiosis (*Cryptosporidium* spp.)

Cryptosporidiosis is a disease caused by protozoan parasites of the genus *Cryptosporidium*. *C. hominis* is normally only detected in humans, whilst *C. parvum* is found in both animals and humans. Together, these *Cryptosporidium* species are

responsible for up to 96% of diagnosed cases in people in the UK and have different risk exposures and seasonal and geographical distributions[16].

Human infection is acquired through the consumption of contaminated food or water, contact with infected animals, exposure to faeces (human or animal) in the environment or through 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 comprises a rise in *C. hominis* cases, many of which are associated with travel outside the UK.

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.

Infection in humans

The number of cryptosporidiosis cases reported in the UK in 2017 was 5,052 (Table 4), a decrease of 25% (n=1,670) compared to 2016.

However, case numbers were elevated in 2015 and 2016 due to an increase in *C. hominis* cases reporting travel to Spain and an outbreak of *C. parvum* linked to food items purchased from coffee shops. A general increase also occurred in 2016, seen most acutely in reports of *C. hominis* from mid to late August.

Table 4: Number of Cryptosporidium reports in humans 2013 to 2017

Year	England & Wales	Scotland	Northern Ireland	United Kingdom
2013	3,520	430	161	4,111
2014	4,023	432	143	4,598
2015	5,222	723	204	6,149
2016	5,654	786	282	6,722
2017	4,292	509	251	5,052

The Second Study of Infectious Intestinal Disease in the Community indicated that the ratio of human cryptosporidiosis disease in the community to reports to national

[16] Chalmers RM, *et al*. Epidemiology of anthroponotic and zoonotic human cryptosporidiosis in England and Wales, 2004 to 2006. *Epidemiol Infect,* 2011; 139(5): 700-712

surveillance is approximately 8.2 to 1 (95% CI 2.1 – 31.7). This suggests that during 2017, there were over 41,000 cases (with 95% CI 10,609 – 160,148) cases of cryptosporidiosis in the UK. Since this is a population estimate, the confidence intervals need to be taken into consideration, but nevertheless, this is the most accurate measure we have of the unavoidable under-reporting to laboratory surveillance systems.

During 2016 and 2017, there were a total of 10 non-foodborne outbreaks of cryptosporidiosis in England and Wales. Of these, 6 (60%) were linked to petting zoos or farms and 4 (40%) were associated with swimming pools. No foodborne outbreaks were reported.

Infection in animals

Clinical cryptosporidiosis is relatively common in animals in the UK. In 2017, there were 731 (384 in GB and 347 in Northern Ireland) diagnoses of infection with cryptosporidia recorded by UK Government veterinary laboratories. Of these, 639 (317 in GB and 322 in Northern Ireland) were diagnosed in cattle; 78 (53 in GB and 25 in Northern Ireland) were diagnosed in sheep (Figure 2); and 14 GB diagnoses were made in other species, mostly in goats.

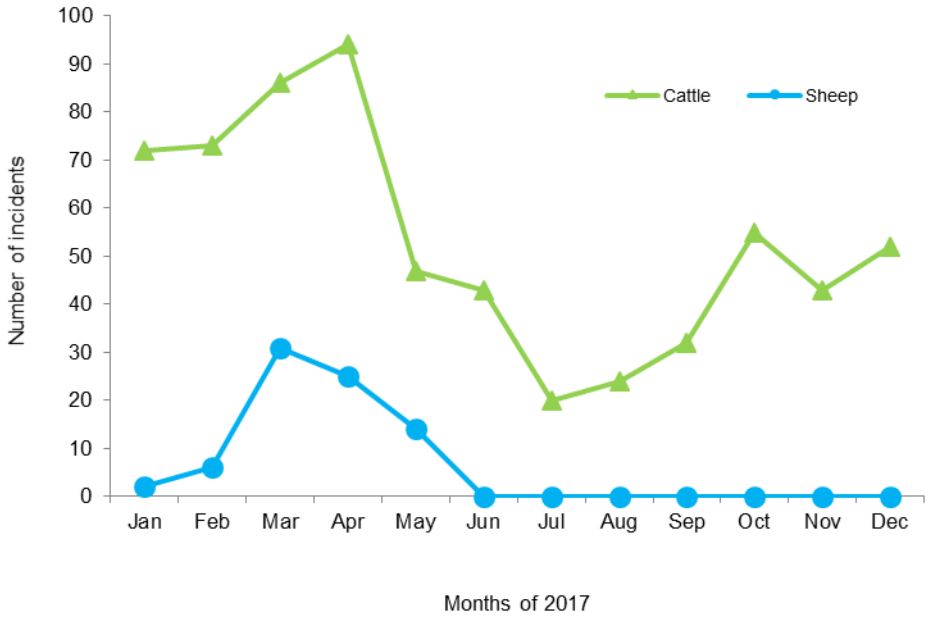

Figure 2: Recorded incidents of cryptosporidiosis in cattle and sheep in UK, 2017

During 2017 APHA were involved in 2 outbreak investigations relating to human cases of cryptosporidiosis in the period January to December 2017.

(1) APHA was contacted by PHE following 7 confirmed human cases of cryptosporidiosis in individuals who had visited an open farm between 18 and 26

February and were reported to have been involved in the feeding of 3 orphan lambs. The Outbreak Control Team meeting indicated that there were issues over the required biosecurity measures during lamb feeding. The interim control measures included feeding the lambs through a barrier, and the importance of hand washing with hot water and soap was reiterated. Veterinary Investigation Officers from the local Veterinary Investigation Centre visited the farm with the local Environmental Health Officer and collected faecal samples on 23 March 2017. Faecal samples from 3 lambs and from a number of other animals that the public had contact with were sampled and all were negative on FAT. Excretion of cryptosporidium oocysts may be intermittent and decreases with age as immunity develops.

(2) A visit was made to an open farm at the request of PHW following the diagnosis of cryptosporidiosis in children who had recently visited the farm. The visiting Veterinary Investigation Officer collected 76 samples, 75 animal faeces samples and 1 sample from a sandpit on site. Ten out of the 76 samples were positive for *Cryptosporidium* spp, including 3 samples from lambs and calves used for bottle-feeding by the general public. The positive samples were sent to the Cryptosporidium Reference Unit for genotyping. One sample confirmed *as C. parvum* had a GP60 subtype identical to that found in 4 of the 5 human cases which indicates a very probable link between the animal isolate and the human cases.

Further information

An industry Code of Practice (CoP) on preventing or controlling ill health from animal contact at visitor attractions is available: www.face-online.org.uk/CodeofPractice

Echinococcosis

Echinococcus multilocularis (Alveolar echinococcosis)

Echinococcus multilocularis is a tapeworm that causes alveolar hydatid disease. Its 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 has a wide geographical distribution across the northern hemisphere throughout Europe, North America and Asia, but is not present in indigenous animals in the UK (rarely cases have been identified in imported animals). Dogs entering the UK are required to receive treatment for *E. multilocularis*. There is evidence that the

distribution of *E. multilocularis* is spreading in northern Europe[17,18,19]. Given the large number of urban foxes in the UK[20], trends within Europe are of interest and are being closely monitored.

The European Commission adopted Regulation (EU) No 1152/2011 on 14 July 2011, as preventive health measures for the control of *E. multilocularis* infection in dogs[21]. It lays out 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 2017 surveillance of the UK fox population (665 foxes tested) did not identify any *E. multilocularis.*

Cystic hydatidosis (*Echinococcus granulosus*)

Echinococcus granulosus is a tapeworm that inhabits the small intestine of canines and causes cystic hydatidosis (also known as echinococcosis), a less invasive disease than alveolar hydatid disease. The *E. granulosus* complex consists of 10 *E. granulosus* genotypes,[22] . Two genotypes are present in the UK in indigenous animals: a sheep adapted strain involving a dog to sheep life-cycle; and a horse adapted strain involving a dog to horse life-cycle.

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 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.

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

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17 Takumi K, et al. Evidence for an increasing presence of Echinococcus multilocularis in foxes in The Netherlands. Intl J Parasitol, 2008; 38(5):571-578

18 Berke O, et al. Emergence of Echinococcus multilocularis among red foxes in northern Germany 1991-2005. Vet Parasitol, 2008; 155(3-4):319-322

19 Vervaeke M, et al. Spatial spreading of Echinococcus multilocularis in red foxes across nation borders in Western Europe. Prev Vet Med, 2006; 76(3-4):137-150

20 Irwin, A. There are 5 times more urban foxes in England than we thought. New Scientist, 4 January 2017. https://www.newscientist.com/article/2116583-there-are-5-times-more-urban-foxes-in-england-than-we-thought/

21 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

22 Boubaker G, *et al.* (2013) A Multiplex PCR for the Simultaneous Detection and Genotyping of the *Echinococcus granulosus* Complex. *PLoS Negl Trop Dis,* 2013; 7(1): e2017. doi:10.1371/journal.pntd.0002017

non-UK nationals and have a history of prior residence in, 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

Hydatid data for 2017 is not available due to inconsistencies in surveillance data. Discussions are ongoing to resolve this issue as soon as possible.

Infection in animals

In the UK, *E. granulosus* (sheep strain) is present in the farmed livestock population in areas of Scotland, England and Wales. Hydatid disease in animals is not notifiable in the UK and the identification of the parasite in animal tissues is not reportable. Identification of the cyst at meat inspection in animal tissues requires the condemnation of all or part of the carcase and/or the offal as may be judged appropriate to the circumstances of the case by an Official Inspector or Official Veterinarian. Meat inspection in all approved slaughterhouses is carried out by or is under the supervision of an Official Veterinarian in Great Britain and the post mortem findings are recorded centrally. In Northern Ireland, Veterinary Service staff are situated in all meat plants and carry out post mortem inspection of all carcases, including inspection for evidence of hydatid cysts.

In GB, abattoir surveillance of carcases identified 1,315 cases of Echinococcus granulosus-caused visible cysts in bovine carcases (of 3,676,638 animals slaughtered), 13 positive goats (of 7,705 slaughtered) and 23,596 positive sheep carcases (of 26,569,918 inspected post mortem at abattoirs). In Northern Ireland, there were 2 cases of hydatid disease in sheep reported at an abattoir in 2017,[23] and no cases were reported in 2016.

Dog owners are advised to consult their private veterinary surgeon for specific guidance for their own animals (pets and farm dogs). Worming dogs regularly with an appropriate treatment remains highly effective and a key personal health protection measure.

[23] Abattoir cases are not included in Appendix 4

Further information

Detailed information on hydatid disease control is available on the Welsh Government website
http://gov.wales/topics/environmentcountryside/ahw/disease/hydatiddisease/?lang=en

Hantavirus

There are many different hantaviruses, some of which have a 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. Once infected, the rodent may shed infectious virus for prolonged periods. The first human case of Seoul hantavirus infection in the UK was confirmed in 2012 (unspeciated hantavirus infections had been diagnosed previously).

Transmission of hantaviruses to humans occurs through the inhalation of infected animal excreta and saliva. Although some hantaviruses are associated with asymptomatic infections or mild disease, most can cause serious infections in humans such as 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%.

Infection in humans

In 2017, as in 2016, there were no confirmed cases of hantavirus infection in the UK.

Infection in animals

Seoul hantavirus causes asymptomatic infection in rats, and there are no routine surveillance systems in place in the UK.

Hepatitis E

Hepatitis E virus (HEV) is an enteric virus which is found worldwide. It is endemic throughout Europe, including the UK. There are 4 main genotypes: 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).

In humans HEV infection is usually a mild, self-limiting illness, however in rare cases fulminant disease (acute liver failure) may develop and can prove fatal. Clinical symptoms are variable and appear to be associated with the viral genotype. For example, genotype 1 is known to cause high mortality in pregnant women, while genotype 3 infections can progress to chronic hepatitis in immuno-compromised individuals, mainly among solid organ transplant recipients. Mortality in the general population is usually 1-3%.

In developed countries, including the UK, HEV genotype 3 is the indigenous genotype and is transmitted mainly through ingestion of undercooked products from infected animals. Most cases are sporadic, however occasional outbreaks have followed consumption of undercooked pork or deer meat, or uncooked shellfish. Other routes of transmission include transfusion of infected blood products.

A joint PHE and NHSBT (National Health Service Blood and Transplant) study provided novel data on the impact of HEV on blood safety[24], and suggested that the HEV genotype 3 is widespread in blood donors. Selective screening to reduce exposure to HEV in immune-suppressed patients was introduced in 2016. This was extended to universal screening of blood donations from April 2017[25].

Infection in humans

Hepatitis E cases increased each year up to and including 2016. However, there was a downward trend in 2017 across the UK, with 912 cases reported in England and Wales (1,243 in 2016); 170 (205 in 2016) in Scotland and 10 (18 in 2016) in Northern Ireland. The factors influencing these fluctuations are unclear but may reflect the changing level of exposure to the virus via the food chain possibly influenced by possible changes in animal husbandry, farming practices, food processing and meat importation. Recent studies undertaken in blood donors from England indicate an overall antibody seroprevalence rate of 11% with an average of 1:3000 (0.03%) donations being HEV RNA positive[26]. Persistent, chronic hepatitis E infections are increasingly recognised in the immunosuppressed population.

In 2017, 79% of cases (n=720) in England and Wales were assessed as being non-travel associated, and this is the same as in 2016 (79%, n=982). A large proportion of

[24] Hewitt PE, *et al.* Hepatitis E virus in blood components: a prevalence and transmission study in southeast England. *Lancet,* 2014;384(9956):1766-73

[25] Domanovic et al (2017) ref and also Expert advisory committee on the Safety of Blood, Tissues and Organs (SaBTO) https://app.box.com/s/m6or0zdspah90u6kg3r9/1/14460576146/113700100341/1

[26] Domanovic et al Hepatitis E and blood donation safety in selected European countries: a shift to screening? Eurosurveillance 22(16), 20 April 2017 https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2017.22.16.30514

cases (41%, n=377) were in males over 50 years of age. There was no geographical clustering.

Please note case numbers for previous years in Appendix 3 have been updated – since 2010 surveillance for acute hepatitis E cases reports reference laboratory data together with additional cases reported by local diagnostic laboratories through the Second Generation Surveillance System (SGSS)[27].

The development of phylogenetic analysis has assisted the further resolution of HEV genotypes and sub-genotypes and enhanced understanding of the contribution of different genotypes to the burden of disease. Almost all of the acute cases reported in the UK are G3 infections and, based on phylogeny, these can be sub-divided into 2 distinct groups: G3 group 1 and G3 group 2. Since 2011 G3 group 2 viruses have predominated and this continued in 2017[28]. Similar trends of increasing HEV case numbers linked to genotype 3 group 2 have been reported from a number of other European countries[29].

Infection in animals

Hepatitis E does not cause disease in pigs and in the UK 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, the Veterinary Medicines Directorate (VMD), FSA, APHA and the British Pig Executive (BPEX) [30]) to better understand the possible role of infection in pigs on human disease incidence. It showed a sero-prevalence of 93% for HEV in 629 pigs at UK abattoirs[31]. Where samples could be analysed, pigs generally had the genotype 3 group 1 virus suggesting that the likely source of human infections with genotype 3 group 2 in the UK is not UK pigs.

[27] Oeser et al (2017) Using data linkage to improve surveillance methods for acute hepatitis E infections in England and Wales 2010-2016. Epidemiol & Infect 45(14): 2886-2889

[28] Ijaz S, *et al*. Indigenous hepatitis E in England and Wales from 2003 to 2012: evidence of an emerging novel phylotype of viruses. *JID,* 2014; 209:1212-18

[29] Adlhoch C, *et al*. Hepatitis E virus: assessment of the epidemiological situation in humans in Europe, 2014/5. *J Clin Virol,* 2016; 82:9-16

[30] Name changed to AHDB Pork in 2015

[31] Grierson S et al. Prevalence of Hepatitis E Virus Infection in Pigs at the Time of Slaughter, United Kingdom, 2013. Emerg Infect Dis, 2015; 21(8): 1396-1401

Leptospirosis (*Leptospira interrogans* serovars)

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

Humans mainly acquire infection by direct contact with the urine of chronically infected animals. Infection may occur when spirochaetes in contaminated water or soil come in contact with cuts or abrasions, with mucous membranes or with conjunctiva. Spirochaetes 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.

Leptospires are globally 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 may present in a number of clinical syndromes in animals, commonly abortion or milk drop, but also as systemic infection. The disease is a major cause of economic loss to intensive cattle and pig industries in developed countries. Clinical disease can be controlled by vaccination in cattle and dogs, and is frequently undertaken in the UK. Clinical disease in animals in GB is less common than in the past, although it remains a significant problem in Northern Ireland.

Infection in humans

During 2017, 92 cases of leptospirosis were reported in the UK, 87 in England and Wales and 5 in Scotland. Leptospirosis enhanced surveillance was in place between 29 December 2016 and 28 December 2017 and has provided an important insight into the epidemiology of leptospira infections diagnosed in the UK (see Feature article 5).

Infection in animals

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

There were 30 incidents of leptospirosis diagnosed in the UK in 2017, of which 4 were in Great Britain. All of the diagnosed GB incidents occurred in pigs, and the remaining 26 incidents occurred in Northern Ireland.

During 2017 the APHA tested 6,785 serum samples from a range of species for diagnostic, monitoring and export purposes (mainly dogs). A summary of the positive

samples is given in Table 5. This data only indicates serological evidence of exposure and/ or vaccination, and not clinical disease.

Table 5: Detection of antibody (possibly vaccination associated) to pathogenic leptospires in serum samples submitted to APHA for testing using the MAT, 2017*

	Dogs	Cattle	Pigs
Total samples	2,675	2,053	1,486
Positive *L.* Australis	39**	5	3
Positive *L.* Autumnalis	9	0	1
Positive *L.* Ballum	6	0	0
Positive *L.* Bataviae	2	2	0
Positive *L.* Bratislava	55	2	66
Positive *L.* Canicola	123**	2	0
Positive *L.* Copenhageni	119	8	6
Positive *L.* Grippotyphosa	15	0	0
Positive *L.* Hardjo	15	218**	0
Positive *L.* Hebdomanis	3	10	0
Positive *L.* Icterohaemorrhagiae	85**	6	4
Positive *L.* Javanica	4	0	0
Positive *L.* Mini	1	2	0
Positive *L.* Mosdok	1	2	1
Positive *L.* Pomona	5	2	7
Positive Pool 1(*Leptospira* canicola, copenhageni, ballum, icterohaemorrhagiae)	2	0	0
Positive Pool 3 (*Leptospira* australis, bratislava, autumnalis)	1	0	0
Positive *L.* Prajitno	1	14	0
Positive *L.* Sejroe	4	3	0
Positive *L.* Tarassovi	2	1	1
Positive *L.* Zanoni	1	0	0

* Results only reflect the serological tests requested for each submission, and therefore significant titres to other *Leptospira* serovars may have been missed

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

Listeriosis (*Listeria monocytogenes*)

Listeria monocytogenes is a bacterium that is widely distributed in the environment, including in soil, decaying vegetation and fodder such as silage in which the bacteria can multiply. In humans, listeriosis is a severe disease that rarely occurs, but most commonly affects the elderly, persons with impaired immunity, pregnant women and unborn or newborn infants. Infection commonly causes gastroenteritis and, in more severe cases, invasive disease in the form of bacteraemia, sepsis and meningitis. There is a high fatality rate amongst cases, and in the UK, *L. monocytogenes* is recognised as being the leading cause of death due to a foodborne pathogen. Transmission generally occurs through the consumption of contaminated raw and chilled, ready-to-eat foods,

and both outbreaks and sporadic infections can occur. Zoonotic infection acquired directly from animals is also possible, although cases reporting animal contact are rare.

In animals, listeriosis is mainly a disease of farmed ruminants, with cattle and sheep considered the most important species. Infection in animals occurs due to direct ingestion of soil or through soil-contaminated feed, notably spoilt silage.

Infection in humans

There were 153 cases of listeriosis reported in the UK in 2017, a decrease compared to 202 cases in 2016, and the lowest total reported in the past 10 years (Appendix 3). Of the total number of cases in 2017, 44% of cases were female, and 17% of cases were associated with pregnancy (Table 6).

Table 6: Laboratory confirmed reports of listeriosis in humans in the UK, 2015 to 2017

		2015	2016	2017
England and Wales	**Pregnancy-associated cases**	26	27	26
	Others	142	156	109
	Total England and Wales cases	168	183	135
Scotland	**Pregnancy-associated cases**	1	1	1
	Others	12	14	16
	Total Scotland cases	13	15	17
Northern Ireland	**Pregnancy-associated cases**	1	0	0
	Others	5	4	1
	Total Northern Ireland cases	6	4	1
United Kingdom	**Total**	187	202	153

The use of WGS for microbiological typing of *Listeria* isolates has led to an increased detection of linked cases, often over a prolonged time period due to the long-term persistence of listeria in food business premises.

There were 4 incidents (>1 linked case) of listeriosis investigated in the UK in 2017, 3 of which comprised isolates spanning 2013 to 2017 inclusively. One outbreak was associated with a cooked chicken producer, 1 with a sandwich producer and for 2 the source of infection was unknown (Appendix 5).

Additionally, 2 incidents were investigated where a single case was microbiologically linked to 1 or more positive food samples through WGS analysis; 1 involving hospital sandwiches and 1 a raw cheese product.

Infection in animals

The majority of listeriosis cases in UK animals typically 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 2017, 145 diagnoses of listeriosis in animals were made in the UK (Table 7), a 33% decrease from 215 cases in 2016. This reflects a decrease in diagnoses in both GB and Northern Ireland.

Table 7: Confirmed Listeria cases (all species) in animals in the UK, 2015 to 2017

Animal	2015	2016	2017
Birds (at farm)	0	0	2
Cattle	43	44	38
Sheep and goats	113	169	103
Other	1	2	2
Total	157	215	145

Lyme disease (*Borrelia burgdorferi*)

Lyme disease is caused by the bacterium *Borrelia burgdorferi* and is transmitted to humans and animals through the bite of an infected *Ixodes* tick. 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 disease in England and Wales 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 1,750 serologically confirmed cases of Lyme disease in humans in the UK in 2017: 1,579 in England and Wales (of which 1,214 were acute infections), 168 in Scotland, and 3 in Northern Ireland. Laboratory-confirmed reports of Lyme disease have increased in recent years. (Table 8). Since 2013, cases in England and Wales have been separated into acute and longstanding infections.

There are several factors that could have contributed to the rise in case numbers including: increased awareness of the disease; greater access to diagnostics; more sensitive diagnostic methods; and more complete reporting of cases. Other potential contributory factors may be the changing population sizes and geographical ranges of the tick vector *Ixodes ricinus* as a result of milder winters, increased recreational travel to high endemic areas, and the increasing popularity of activity holidays such as trekking and biking both in the UK and abroad.

Table 8: Reference laboratory reports of Lyme disease in humans in the UK, 2015 to 2017

Country	Laboratory report	2015	2016	2017
England and Wales	Acute	747	885	1,214
	Longstanding or equivocal*	313	249	365
	Total	1,060	1,134	1,579
Scotland		200	170	168
Northern Ireland		2	4	3
United Kingdom		1,262	1,308	1,750

Of the 1,579 cases in England and Wales, 6% (n=100) reported recent travel (compared with 9% in 2017). The seasonal pattern in 2017 was similar to previous years, with infections reported throughout the year and peaking in the third quarter. This is consistent with the major tick feeding period which occurs in the late spring and early summer months.

Case reports were received from all regions of England and Wales in 2017, with the South of England contributing around 70%.

Pasteurellosis (*Pasteurella* spp.)

Pasteurellosis is a bacterial disease with a worldwide distribution. Within the *Pasteurella* genus, *P. multocida* is the most commonly reported organism, and is well known as both a common commensal and pathogen in a variety of animal species.

The most common mode of zoonotic transmission to humans is via dog or cat bites and scratches. These frequently lead to cutaneous infections, which may be severe. Systemic disease can also occur.

Infection in humans

There were 928 laboratory confirmed reports of human pasteurellosis in the UK in 2017 (Table 9), a 12% increase from the 815 cases reported in 2016. Infection with *P.* multocida accounted for 68% of reports (n=627). Cases of *Pasteurella* spp. appear to

have increased in the last 5 years (Appendix 3). The reason for this is uncertain although it may be due to increased reporting.

Table 9: Laboratory confirmed reports of pasteurellosis in humans in the UK, 2017

Serovar	England and Wales	Scotland	Northern Ireland	United Kingdom
P. canis	91	45	--	136
P. multocida	519	108	--	627
P. pneumotropica	10	4	--	14
***P.* other named**	27	14	--	41
Pasteurella spp	97	13	--	110
Total	744	184	--	928

Infection in animals

There were 395 cases of *P. multocida* diagnosed by government laboratories in animals in the UK in 2017[32] (Table 10).

Table 10: Laboratory confirmed reports of *P. multocida* in animals in the UK, 2016 to 2017

Year	2016			2017		
	GB	NI	UK	GB	NI	UK
Cattle	110	148	258	97	141	238
Sheep	48	0	48	75	8	83
Pigs	30	37	67	36	13	49
Birds	4	6	10	6	12	18
Miscellaneous / wildlife	1	1	2	0	2	2
Goats	1	0	1	5	0	5
Total	194	192	386	219	176	395

In addition, SRUC isolated *P. multocida* from 11 cats, 13 dogs, a rabbit and a grey seal in 2017. These were not submitted to APHA's VIDA database, and are therefore not included in the routine pasteurellosis data.

Q Fever (*Coxiella burnetii*)

Q fever is caused by the bacterium *Coxiella burnetii*. This can survive for long periods in the environment and is generally transmitted in aerosols or by fomites, including dust particles. Transmission to humans mostly occurs through exposure to aerosols containing *C. burnetii*. These 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

[32] Current diagnostic criteria only consider *P. multocida*

relapses may occur. Since 1999, Health Protection Agency/PHE data shows that on average, 17% of annually diagnosed cases are chronic infections.

C. burnetii infection occurs mainly in domesticated ruminants (cattle, sheep and goats), where it can cause abortion. Most cases of livestock abortion due to Q fever are sporadic, although outbreaks can occur.

Infection in humans

In 2017, 24 cases of Q fever were reported in the UK (19 cases in England and Wales, 4 in Scotland and 1 in Northern Ireland), a reduction from the 34 cases reported in 2016 (Appendix 3). After an increase in the number of cases in 2011-2012, the reasons for which remain unclear, numbers have declined and remain at expected levels.

Infection in animals

There were 5 cattle incidents of Q fever abortion in GB confirmed in 2017. Three were in England (in Lancashire, North Yorkshire and Shropshire) and 2 were in Scotland, both in Dumfries and Galloway. All of the cattle incidents involved dairy herds.

There were no reported cases of Q fever in Northern Ireland in 2017.

Further information

Information on Q fever infection risks during the lambing season www.gov.uk/guidance/pregnancy-advice-on-contact-with-animals-that-are-giving-birth

Q fever information for farmers www.gov.uk/government/publications/q-fever-good-practice-for-farmers

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. 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[33].

In animals, 3 forms are classically described: prodromal, excitement (furious) and paralytic (dumb). The disease is absent from terrestrial mammals in the UK. The last case of rabies in an animal outside of quarantine in GB was a dog in Newmarket in 1970[34]. In Northern Ireland the last case was reported in 1923. The last case of rabies in quarantine in the UK was reported in 2008 in England.

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 2017, there were 5 cases of imported human rabies, the last in 2012.

There were no human cases of rabies in the UK in 2017.

Infection in animals

In 2017, 31 zoo bats, 20 dogs, 1 cat, and an otter were submitted to the APHA for laboratory testing. None of the samples were positive for rabies virus.

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 01 January 2012 the UK harmonised its pet movement controls with the rest of the EU (but retained *Echinococcus multilocularis* tapeworm treatment controls for dogs). Under the EU scheme, the risk of rabies entering the UK remains very low, and these controls make it easier to travel with pets. During 2017, 287,016 dogs, 26,480 cats, and 765 ferrets entered GB under the EU pet travel scheme[35], compared to 275,876, 24,145 and 129 respectively in 2016.

Further information

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

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

[34] Pethece CK, Hopes R. A case of rabies at Newmarket. *Vet Rec,* 1970;86(10):299.b www.ncbi.nlm.nih.gov/pubmed/5461596

[35] This data was extracted from the APHA's Pets Database and represents information supplied by third parties (pet transport carriers).

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. EBLV-2 was first recognised in UK bats in 1996.[36]

Since 1977, there have been 4 human cases of EBLV in Europe, including 2 cases of EBLV-2. In all cases the person had not received rabies vaccination either before or after the incident.

Infection in humans

One case of EBLV-2 occurred in 2002 in Scotland, when a bat handler was diagnosed following multiple bites from Daubenton's bats (*Myotis daubentonii*)[37]. There have been no human cases of bat rabies in the UK since.

Infection in animals

Both active and passive surveillance have been undertaken by APHA. 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[38].

Since 1996, 14 bats have tested positive (virus isolation) through APHA's passive lyssavirus surveillance scheme, and 1 bat in Scotland tested positive (EBLV-2 RNA detected) through active surveillance (Table 11). In 2017, 390 dead bats from the UK were submitted to the passive surveillance scheme, and 1 tested positive for EBLV-2.

Table 11: Detection of EBLV-2 in Daubenton's bats in the UK, 1996 to 2017[39]

Date	No. isolations	County	Sex and age
1996	1	Sussex	Female, Adult
2002	1	Lancashire	Female, Juvenile
2003	1*	Lancashire	Male, Adult
2004	1	Surrey	Female, Juvenile
2006	1	Oxfordshire	Female, Juvenile

[36] Harris SL *et al.* Passive surveillance (1987 to 2004) of United Kingdom bats for European bat lyssaviruses. *Vet Rec* 2006; 159(14):439-46
[37] Crowcroft N. Rabies-like infection in Scotland. *Euro Surveill*. 2002;6(50):pii=1984
[38] Harris SL, *et al.* Targeted surveillance for European bat lyssaviruses in English bats (2003-06). *J Wildlife Disease* 2009; 45(4):1030-41
[39] Johnson N. Two EBLV-2 infected Daubenton's bats detected in the north of England. *Vet Rec* 2016; 179:311-312 (Errata)

2007	1	Shropshire	Female, Adult
2008	3**	Surrey Shropshire Perthshire	Female, Adult Male, Juvenile Male, Adult
2009	1	West Lothian	Female, Juvenile
2014	1	Shropshire	Male (no data on age)
2015	1	Powys	Male, Juvenile
2016	2	North Yorkshire Northumberland	Female, Juvenile Male, Adult
2017	1	Derbyshire	Male, Juvenile

* Carcase frozen and submitted for testing October 2004

** One incident of EBLV-2 RNA detected in an oral swab taken as part of surveillance for lyssaviruses in Scotland

Further information

General information including guidance on post exposure treatment is available from PHE www.gov.uk/government/collections/rabies-risk-assessment-post-exposure-treatment-management

www.gov.uk/government/publications/rabies-risks-from-bat-bites

General information including guidance on rabies in bats is available from APHA www.gov.uk/guidance/rabies-in-bats

Information on bats is available online from the Bat Conservation Trust 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)

There are more than 2,600 *Salmonella* serovars, but salmonellosis in humans and animals is largely caused by a small subset of the more than 1,500 identified serovars of *S. enterica* subspecies *enterica.* 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 zoonotic. 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 nearly half of all human salmonellosis cases.

In 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.

Infection in humans

In 2017, 10,089 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 cases in the community[40] (95% CI 1.2 – 18.2). This suggests the total number of cases in the UK in 2017 was approximately 47,000 (with 95% CI 12,106 – 183,620). Since this is a population estimate, the confidence intervals need to be taken into consideration, but nevertheless, this is the most accurate measure we have of the unavoidable under-reporting to laboratory surveillance systems.

Salmonella Enteritidis remained the most commonly reported serovar in 2017, accounting for 27% of cases (Table 12). Overall, in 2017 there was a small decrease in reports in the UK, across all countries other than England where a small increase was reported. *Salmonella* Typhimurium (including monophasic strains) was the second most commonly reported serovar, comprising 21% of cases, and increased by 10% from 2016. This is due to an increase in the number of cases reported in England; decreases were seen in all other UK countries.

Table 12: The 10 most common non-typhoidal salmonella serovars in humans isolated in 2017 in each country of the UK

England		Wales		Scotland		Northern Ireland	
Serovar	**n**	**Serovar**	**n**	**Serovar**	**n**	**Serovar**	**n**
Enteritidis	2,324	Enteritidis	130	Enteritidis	247	Enteritidis	34
Typhimurium	1,964	Typhimurium	62	Group B†	113	Typhimurium	23
Newport	346	Newport	18	Typhimurium	105	Infantis	8
Infantis	241	Infantis	14	Saint Paul	24	Mikawasima	6
Agona	210	Hadar	12	Newport	23	Newport	4
Stanley	165	Java	10	Group C1‡	20	Stanley	4
Kentucky	147	Arizonae	9	Infantis	20	Agona	3
Virchow	132	Stanley	7	Java	19	Java	3
Java	121	Corvallis	7	Stanley	16	Saint-Paul	3
Bareilly	94	Agona	6	Group C2#	15	*	

†Group B includes S. Agama, Agona, Bredeney, Coeln, Derby, Gloucester, Heidelberg, Indiana, Kiambu, Kimuenza, Mons, Reading, Saint Paul, Schwarzengrund, Stanley, and Typhimurium
‡Group C1 includes S. Braenderup, Cerro, Choleraesuis, Colindale, Concord, Infantis, Larochelle, Livingstone, Mbandaka, Menston, Montevideo, Ohio, Oslo, Riggil, Rissen, Tennessee, Thompson, and Virchow
#Group C2 includes S. Bovismorbificians and Newport
*No other serovars have more than 2 cases reported

[40] 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

Thirteen foodborne salmonella outbreaks were reported in the UK in 2017, compared to 12 in 2016. Two were caused by *S*. Enteritidis, 5 by *S.* Typhimurium and the remainder by *S.* Adjame, *S.* Agona, *S.* Chester, *S.* Give, *S.* Infantis and *S.* Stanley. Eggs were implicated as the source in 2 outbreaks (both *S.* Enteritidis), and pork products in an additional 2 (both monophasic *S.* Typhimurium). A summary of foodborne outbreaks by zoonotic pathogen, broken down by food vehicle category, is given in Appendix 5.

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, 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[41]. All NCPs focus on reducing the prevalence of the most important serovars of *Salmonella* that can affect human health and, as such, 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 poultry populations (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 need to be treated with caution in view of the inherent biases associated with the data, that is the level of diagnostic and surveillance testing carried out.

There were 3,194 isolations of *Salmonella* in the UK in 2017, compared with 2,867 in 2016, of which 3,049 were reported by GB. This comprised 2,821 isolations from species covered by statutory reporting requirements: 1,154 from chickens; 499 from turkeys; 440 from cattle; 395 from ducks; 138 from pigs; 110 from sheep; 39 from horses; 20 from pheasants; 15 from pigeons; 6 from geese; and 5 from partridges plus 228 isolations from non-statutory species (cats, dogs and reptiles).

There were 143 isolations of *Salmonella* in 2017 from animals and poultry as covered by statutory reporting requirements in Northern Ireland. These were 86 isolations from chickens, 48 from cattle, 7 from pigs, 1 from sheep, 1 from a deer and none from turkeys.

[41] Regulation (EC) No. 2160/2003

Farmed livestock (excluding species in the NCPs) and horses

There were 440 *Salmonella* isolations from cattle in GB during 2017, a 16% increase compared with 2016 (n= 378) (Figure 3). There was a slight increase in isolations from sheep (110 compared to 108), and a decrease in pigs (138 compared to 146).

In Northern Ireland, there were 48 *Salmonella* isolates from cattle, and 7 from pigs and 1 from sheep in 2017. This compares to the 2016 figures of 64 isolates from cattle, 17 from pigs and 15 from sheep.

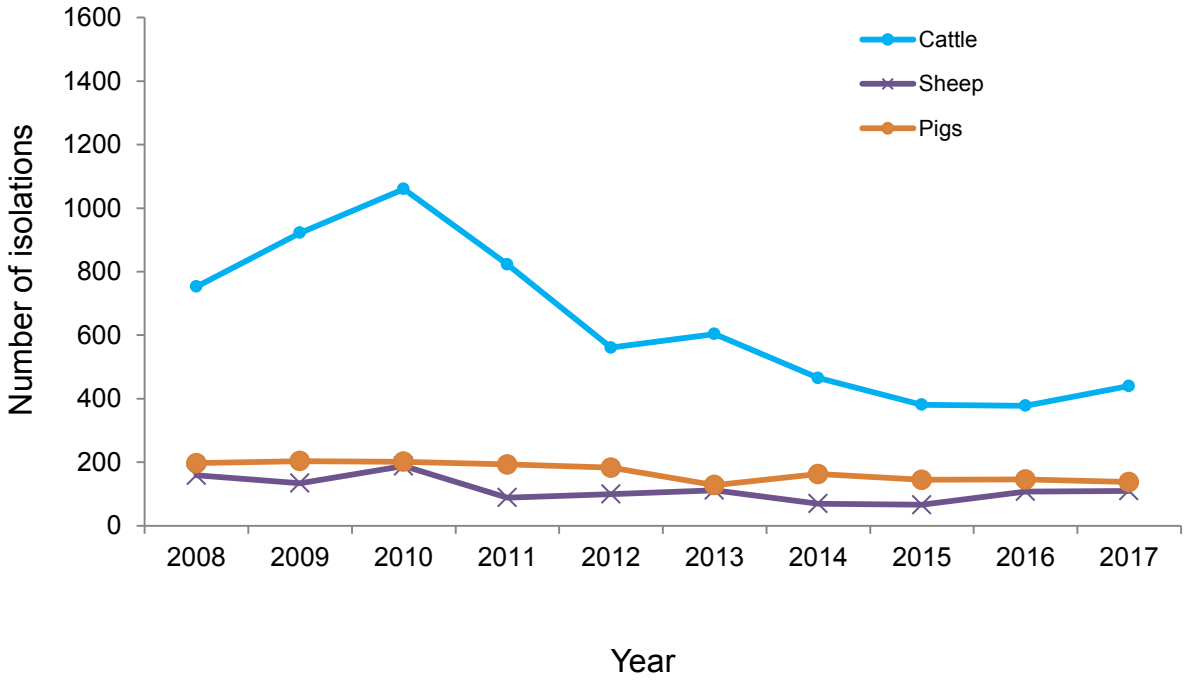

Figure 3: Number of laboratory-confirmed isolations of *Salmonella* in animals in GB, 2007 to 2017

Cattle

There were 488 isolations in cattle in the UK during 2017 (compared with 442 in 2016). *S*. Dublin, which seldom causes disease in humans, accounts for the majority with 334 isolations in 2017, compared with 311 in 2016. There were also 57 isolations of *S*. Typhimurium, 3 isolations of *S*. Enteritidis and 14 monophasic *S*. Typhimurium strains from cattle during 2017 plus a number of other serovars and a few untypable strains.

In GB, there were 291 isolations of *S*. Dublin (compared with 257 in 2016), 56 of *S*. Typhimurium, 3 of *S*. Enteritidis and 13 monophasic *S*. Typhimurium strains. In Northern Ireland, there were 43 reported isolations of *S*. Dublin (compared with 54 in 2016), 1 of *S*. Typhimurium, 1 monophasic *S*. Typhimurium and 3 other serovars.

Sheep and goats

There were 111 isolations from sheep during 2017 (compared with 123 during 2016): 110 from Great Britain (compared to 108 in 2016), and 1 from Northern Ireland (compared with 15 in 2016). There were no isolations in goats.

Pigs

There were 145 isolations from UK pigs during 2017 (compared with 163 in 2016). *S.* Typhimurium accounted for 42 isolations. For the monophasic *S.* Typhimurium strains, there were 41 (GB) reported isolations of *S.* 4,5,12:i:- and 38 (GB) isolations of *S.* 4,12:i:- and 2 monophasic not speciated in Northern Ireland. These results indicate the continued maintenance of monophasic *S.* Typhimurium strains in pigs in the UK. The remaining 22 isolates were of other serovars.

In GB in 2017, there were 138 isolations from pigs (compared with 146 in 2016). Of these, 41 were *S.* Typhimurium, 41 were monophasic Typhimurium *S*. 4,5,12:i:-, and 38 were monophasic Typhimurium *S.* 4,12:i:. There were 18 isolates of other serovars reported during the year.

In Northern Ireland, there were 7 isolations in 2017 (compared with 17 in 2016): 1 *S.* Typhimurium; 2 monophasic *S.* Typhimurium; and 4 other serovars.

Horses

Thirty-nine isolations of *Salmonella* were received from horses during 2017, all in GB. This is a decrease from the 49 isolates reported in 2016 (48 from GB and 1 from Northern Ireland).

Ducks and geese

There were 395 isolations in ducks during 2017, all from GB (compared with 338 in 2016). There were no such reports from Northern Ireland in 2017 or 2016.

There have been very few isolations of *Salmonella* from geese in recent years, with 6 in 2017 and 4 in 2016, all from GB.

Results from the UK Salmonella NCPs in chickens and turkeys

The NCPs have been operating for varying lengths of time. The breeding chicken NCP is the longest-established (2017 was its eleventh year) whereas the turkey NCP is the most recent addition at 8 years. Each year, the UK NCP results have been significantly below EU reduction targets:

- in 2017, no regulated serovars were isolated from adult breeding chicken flocks (0% prevalence) − this gives an overall prevalence of 0% UK breeding chicken flocks testing positive for the regulated *Salmonella* serovars

- out of the total 4,428 laying hen flocks included during the year, 6 adult flocks were positive for *S*. Enteritidis, giving an overall prevalence of 0.1%
- the prevalence of the target serovars in broiler flocks was 0.01% in 2017. Three broiler flocks were detected positive for monophasic *S*. Typhimurium, and 2 flocks positive for *S*. Typhimurium out of a total of approximately 53,174 flocks tested during the year
- no regulated serovars were isolated from breeding turkey flocks (0% prevalence), whilst the prevalence in fattening turkey flocks was 0.3% (7/2578 flocks) − 4 fattening flocks tested positive for *S*. Enteritidis and 3 for monophasic *S*. Typhimurium

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[42], at a number of points in the feed production process. The isolation rate of *Salmonella* from animal feedstuffs and feedstuff ingredients in GB has remained stable since 2014. The percentage of total positive tests in 2017 was 0.7%. (298 positive tests compared with 277 in 2016). In 2017 in Northern Ireland there were 8 animal feed samples positive for salmonella from routine official surveillance samples taken under the annual FSA and DAERA surveys.

A description of salmonella data collection and reporting in animals in GB is included in the Salmonella in Livestock Report: www.gov.uk/government/publications/salmonella-in-livestock-production-in-great-britain-2017

Shiga toxin producing Escherichia coli (STEC)

Escherichia coli are a normal component of the bacterial fauna in the gastrointestinal tracts of humans and animals. Although many strains are considered to be harmless, there are a number of subgroups associated with human disease. These include shiga toxin producing strains of *E. coli* (STEC) which cause gastrointestinal disease in humans with potentially severe complications, such as haemolytic uraemic syndrome (HUS). HUS is a severe multi-system disorder characterised by acute kidney failure, although other complications, including those of the central nervous system can occur. Children are at most risk of developing HUS following STEC infection.

[42] England: https://www.food.gov.uk/sites/default/files/multimedia/pdfs/enforcement/feed-law-code-england.pdf;
NI: https://www.food.gov.uk/sites/default/files/feed_law_enforcement_guidance_ni_0.pdf;
Wales: https://www.food.gov.uk/sites/default/files/wales-feed-law-code.pdf;
Scotland: http://www.foodstandards.gov.scot/sites/default/files/Feed%20Law%20Code%20of%20Practice%20Scotland%20-%202016.pdf

Ruminants, particularly cattle and sheep, are the main reservoirs for STEC in the UK although the bacterium can also be found in a wide range of other animals, including birds, goats and deer. STEC does not cause disease in these animals but can be excreted in their faeces and can survive in the environment for months. Direct or indirect contact with animals, their faeces or environment, person to person spread, and consumption of food or water contaminated with STEC are the primary modes of transmission.

Infection in humans

STEC are distinguished by serogroup and there are 174 known serogroups based on O (somatic) antigen polysaccharides, of which O157 is currently the most commonly diagnosed in the UK. The predominance of STEC O157 in national datasets should be interpreted with caution as most hospital laboratories use testing algorithms which are specific to the detection of STEC O157. For cases of severe disease consistent with STEC infection, where O157 is not isolated at the frontline hospital laboratory, it is recommended that faecal specimens are referred to the PHE Gastrointestinal Bacteria Reference Unit for re-testing for the presence of both O157 and non-O157 STEC (PHE STEC Operational Guidelines)[43].

In 2017, there were 775 laboratory confirmed human cases of STEC O157 reported in the UK (563 in England and Wales, 167 in Scotland, and 45 in Northern Ireland)[44]. The incidence of STEC O157 has decreased in all countries compared to 2016. The reporting rate for the UK overall is the lowest it has been in the last 10 years and follows a year on year decline in STEC serogroup O157 in England in particular since 2015.

Scotland has consistently recorded the highest rates of infection since 2008, including in 2017, with the exception of 2012 when a large outbreak occurred in Northern Ireland (Figure 4).

[43] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/323416/VTEC_operational_manual.pdf
[44] The figures presented in this report are culture positive cases only. Other reports use the ECDC definition which includes serology-only positive cases that either had HUS or were epidemiologically -linked to a culture positive case. Those figures will therefore be slightly higher

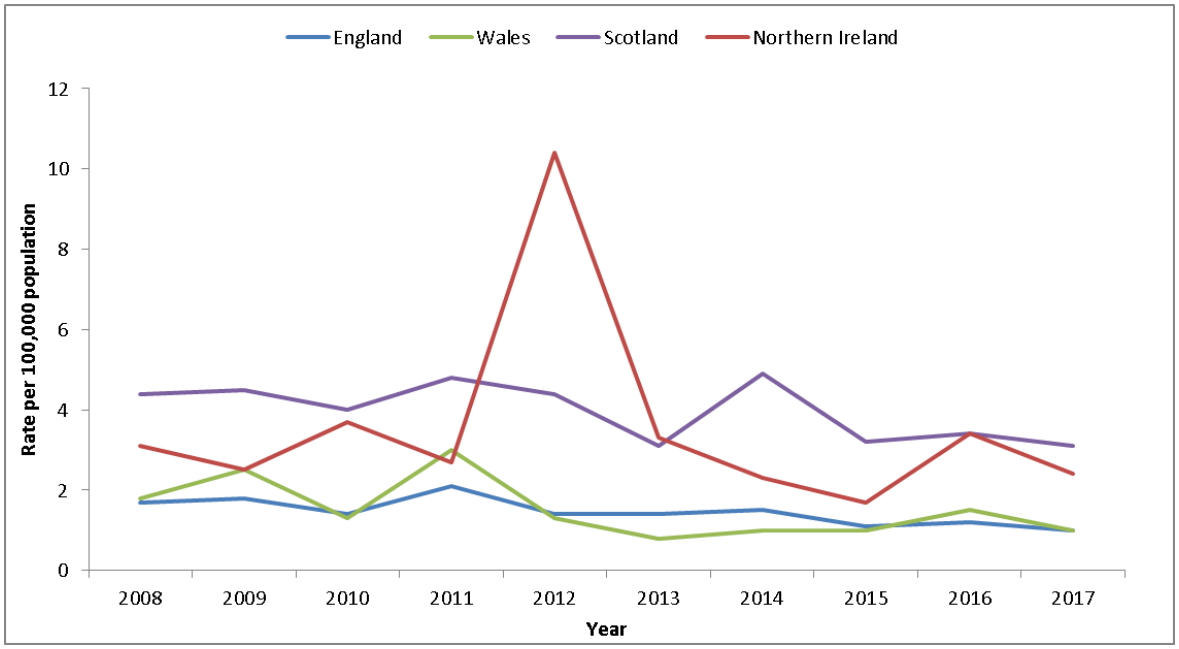

Figure 4: Annual rates of laboratory confirmed reports of human STEC O157 infections in the UK, 2008 to 2017

The burden of disease due to non-O157 STEC is underestimated, and so a number of frontline laboratories have introduced a PCR to directly detect shiga toxin genes. This has improved the detection of serogroups other than O157. In 2017, there were 589 laboratory confirmed cases of non-O157 STEC identified in the UK (384 in England, 1 in Wales, 59 in Scotland and 145 in Northern Ireland), a notable increase in reports compared to previous years. O26 is the most common serogroup in the UK after O157 (Table 13).

Table 13: The 10 most commonly reported STEC serotypes among clinical infections in the UK and by country, 2017*

Serotype	England#	Wales	Scotland	Northern Ireland	United Kingdom
O157	538	32	167	45	782
O26	48	0	8	19	75
O91	47	0	2	0	49
O146	40	0	3	0	43
O103	25	0	11	0	36
O145	11	0	13	1	25
O128AB	24	0	0	0	24
O117	15	0	2	0	17
O38	13	0	0	0	13
O111	11	0	1	0	12

*Testing for non-O157 STEC infections varies by laboratory; totals presented do not represent the prevalence of infections in the population

Multiple serotypes are recovered from some patients and these figures include 2 individuals infected with more than one non-O157 STEC strain

A total of 10 outbreaks were reported in 2017. Most were small, with a range of 3 to 17 people affected. Seven outbreaks involved STEC O157 and 3 involved non-O157 (O26, O145 and O55). These included:

STEC O157 outbreaks:

- 2 foodborne outbreaks linked to raw drinking milk and burgers
- 1 outbreak associated with a paddling pool
- 1 nursery school outbreak where the source of infection was unknown
- 1 outbreak linked to raw pet food
- 2 outbreaks where the source of infection was unknown

STEC Non-O157 outbreaks:

There was 1 dispersed O26 outbreak in August 2017 in which 3 cases were reported; 2 in Scotland and 1 in England. No common source of infection was determined through investigations. There was a national cluster of STEC serogroup O145 in September 2017. Of the 5 cases associated with this outbreak, 4 were from England and 1 from Scotland. No common source was identified through the questionnaires. An outbreak of STEC O55 was reported in the South of England. No common source of infection was identified. This was a reoccurrence of outbreaks previously identified and investigated in 2014 to 2016.

Infection in animals

STEC O157 infection is widespread in cattle and sheep in the UK. However, because it does not cause disease in the animal population 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 potentially infected with STEC O157 during their lifetime.

Information regarding STEC outbreak investigations is given in the APHA non-statutory zoonoses reports
www.gov.uk/government/uploads/system/uploads/attachment_data/file/681452/pub-zoo0417.pdf

Further Information

Advice leaflets on minimising the risk of infection with STEC

http://adlib.everysite.co.uk/resources/000/264/533/sci_vtec_leaflet.pdf

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

www.wales.nhs.uk/sitesplus/888/page/43884

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

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 3 main 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

There are also less common routes of transmission, such as receiving organ transplants or blood products from donors with toxoplasmosis, and ingesting the parasite following direct contact with products of conception during lambing.

Infection in humans

A total of 298 laboratory confirmed cases of toxoplasmosis were reported in the UK during 2017, compared with 377 in 2016 (Appendix 3). In England and Wales, 262 cases of toxoplasmosis were reported: 242 cases had acute infection (92%); 2 had reactivated infection (0.8%); 1 (0.4%) was a chronic infection and the remaining 17 infections were undetermined (6%). In addition, there were 36 cases reported from Scotland and none from Northern Ireland.

Infection in animals

In 2017, there were 252 toxoplasmosis incidents diagnosed in the UK (177 in GB), a decrease in comparison with 301 in 2016.

Of the cases in GB, 171 were diagnosed in sheep, and 6 in goats. In addition, 3 separate fox serum samples also tested positive, with a single horse sample giving a negative result.

In Northern Ireland, there was an increase in the number of *T. gondii* incidents diagnosed during 2017 (n= 75) compared to 2016 (n= 67). However, there was a 25% increase in samples tested compared to 2016. Northern Ireland found *T. gondii* in 27 of 57 serology samples from cattle tested in 2017.

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 the cattle samples will have been taken from animals with a recent history of abortion it is likely that the majority of these positives were associated with natural infection.

Trichinellosis (*Trichinella* spp.)

Trichinellosis is caused by a parasitic nematode worm (*Trichinella* spp.) known as 'the muscle worm', which can infect many species of mammals and some birds. There are 9 species of *Trichinella*, of which *T. spiralis* is the most common in Europe[45]. 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.

In humans, European outbreaks of trichinellosis are regularly reported and are 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 40 years.

Infection in humans

There were no human cases in 2017 in the UK.

Eleven cases of trichinellosis were diagnosed in the UK between 2000 and 2014, including an outbreak of 8 cases in England and Wales in 2000 associated with the consumption of imported meat products. The remaining 3 cases were travel related: 1 in England and Wales in 2001, 1 in Scotland in 2010 in a person who had eaten partially cooked meat in France, and the other in Scotland in 2014 which had been acquired in the Czech Republic.

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

Infection in animals

Pigs and horses are routinely monitored at abattoir for the presence of trichinella. In 2017, FSA received test results for 7,353,597 farmed pigs. In addition, 2,467 horses, 739 farmed wild boar and 614 feral wild boar in the UK were tested. All samples examined were negative.

A UK monitoring programme for trichinella in wildlife began in November 1999 and ended in March 2015. This programme initially tested only foxes but, from 2006, other susceptible wildlife were also considered. *T. spiralis* was found in a fox in Northern Ireland in both 2007 and 2009, and a fox in England was positive for *T. pseudospiralis* in 2013. In the UK in 2017, 280 foxes tested negative for *Trichinella spp*.

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 bovine spongiform encephalopathy (BSE), which was first recognised in cattle in 1986.

The last death from definite or probable vCJD in the UK occurred in 2016, making a total of 178 deaths recorded since 1995. The number of deaths per year peaked at 28 in 2000. There have been no cases of vCJD in people born after the 1980s in the UK.

Further information

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

Creutzfeldt-Jakob disease surveillance in the UK, January 1990 – December 2017
www.cjd.ed.ac.uk/sites/default/files/report26.pdf

Infection in animals

TSEs include Bovine Spongiform Encephalopathy (BSE) in cattle, scrapie in sheep and goats and Chronic Wasting Disease (CWD) in deer. The European Food Safety Authority (EFSA) has advised that BSE is the only animal TSE that has been shown to

be zoonotic. BSE caused a major epizootic in cattle in the UK, which peaked in 1992 with over 37,000 cases in cattle and has since declined steadily. The annual incidence of BSE cases in Europe has declined since 2001/2002 following the introduction of EU-wide feed controls and targeted surveillance in 2001. There have also been a small number of cases in the USA, Canada, Brazil and Japan, plus in Oman and the Falkland Islands in animals imported from the UK. Worldwide there have been 2 naturally occurring cases of BSE in goats: 1 in France and 1 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[46,47] 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.

In 2017, no cases of BSE were diagnosed in cattle in the UK.

CWD in deer has for many years been endemic in North America, and cases have been reported in North Korea in cervids imported from North America. In 2016 the first European cases were confirmed in reindeer and elk in Norway. To date no cases have been confirmed in the UK. In 2017, 2 cervids presenting symptoms compatible with CWD were tested for the disease in line with EU legislation, and APHA subsequently confirmed that they were negative. Following the report of the first of these 2 suspects, 3 Risk Assessments on CWD risks in the UK[48] were commissioned from the FSA on the risk to the human food chain, from APHA on the risk to animal health, and from PHE on the risk to human health from contamination outside the food chain. They concluded that the risk of CWD being found in the UK is low and the risk to public health is very low. In line with EFSA advice following the CWD cases in Norway, the EU has implemented a 3-year cervid surveillance programme, beginning on 1 January 2018, in Member States (not including the UK) which have indigenous populations of reindeer and elk.

Yersiniosis (*Yersinia* spp.)

Yersiniosis in the UK is caused by *Yersinia enterocolitica* and *Y. pseudotuberculosis.* Plague is caused by *Y. pestis* but this specific pathogen 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. Yersiniosis in humans is mostly caused by

[46] Barron RM, *et al.* High titres of TSE infectivity associated with extremely low levels of PrPSc in vivo. *J Biol Chem*, 2007; 282:35878-35886
[47] Piccardo P, *et al.* Accumulation of abnormal prion protein that is not infectious. *PNAS*, 2007; 104: 4712-4717
[48] https://www.gov.uk/government/publications/chronic-wasting-disease-risk-assessments

Y. enterocolitica, and humans usually acquire infection through food contaminated with the faeces of infected animals. *Y. pseudotuberculosis* has been isolated from various species of wild and domestic mammals, birds and reptiles.

Infection in humans

In 2017 there were 141 cases of human yersiniosis reported in the UK (Table 14), compared with 87 in 2016. There has been an increase in yersiniosis compared to the previous 5 years due to a small number of local hospital laboratories in England that have started using PCR to detect yersinia. This approached has improved the detection of *Yersinia* species at these centres, and this has had an impact on the number of yersinia cases reported. Surveillance data shows a seasonal peak in May and June, but the epidemiology of yersiniosis is not currently well known in the UK.

Table 14: Confirmed human cases of yersiniosis in the UK, 2017

	England & Wales	Scotland	Northern Ireland	United Kingdom
Y. enterocolitica	114	11	0	125
Y. pseudotuberculosis	6	1	0	7
Yersinia spp	9	0	0	9
Total	129	12	0	141

Infection in animals

During 2017,153 cases (131 in Northern Ireland and 22 in GB) of yersiniosis were diagnosed in animals in the UK, a decrease from the overall 2016 case numbers (156 in Northern Ireland and 12 in GB). The 2017 cases were diagnosed in cattle (n=104), sheep (n=23), goats (n=11), pigs (n=7), wildlife and miscellaneous (n= 4), and there were single cases diagnosed in a horse, an alpaca, a pigeon and an unspecified bird.

Further information

Reports on yersinia in animals in GB are produced by the APHA in the Non-Statutory Zoonoses Reports
www.gov.uk/government/uploads/system/uploads/attachment_data/file/681452/pub-zoo0417.pdf

Appendix 1: 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 (for example Hepatitis E)	✓		✓	✓
Botulism	✓	✓		
Brucellosis	✓	✓		✓
Chlamydiosis (avian)				✓
Chlamydiosis (ovine)				✓
Diphtheria	✓	✓	✓	
Clinical syndrome due to STEC *E. coli* (including 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)

Selected human zoonotic infections are statutorily notifiable under the Public Health (Control of Disease) Act 1984, the Public Health (Infectious Diseases) Regulations 1988, the Public Health etc. (Scotland) Act 2008 and the Public Health Act (Northern Ireland) 1967. This legislation was amended in England and Wales (2010) and Scotland

(2008) to include a revised list of notifiable diseases, and, for the first time, a list of organisms which are notifiable when identified in laboratories.

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 table above lists notifiable zoonotic diseases only; further organisms are notifiable when identified 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 2: 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,* and of *Echinococcus multilocularis,* under the Zoonoses Order 1989 (as amended). 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 or pathogen	Main species	Last Occurred in UK[49]	Notifiable to APHA in GB, Veterinary Service in NI	Reportable (S= only reportable under SAPO)
Anthrax (*Bacillus anthracis*)	Cattle/other mammals	2015	✓	S
Avian Influenza (HPAI and influenza A virus of H5 or H7 subtype that is not classified as highly pathogenic). LPAI viruses may also be zoonotic even if not notifiable.	Poultry/ waterfowl	2017	✓	S
Bovine Spongiform Encephalopathy	Cattle	2015	✓	
Brucellosis (*Brucella abortus*)	Cattle[50]	2004 GB/ 2012 NI[51]	✓	✓
Brucellosis (*Brucella melitensis*)	Sheep and goats	Never	✓	✓
Brucella suis	Pigs	Never	✓	✓
Echinococcus granulosus	Sheep and dogs	Present		S
Echinococcus multilocularis	Dogs	Not in indigenous animals	✓	✓
Equine Viral Encephalomyelitis	Horses	Never	✓	S
Glanders & Farcy (*Burkholderia mallei*)	Horses	1928	✓	S

[49] Figures taken are correct as at 31st December 2017

[50] 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

[51] NI granted OBF status in 2015, last case identified in 2012; outbreak in Scotland in 2003 and Cornwall, England in 2004

Newcastle disease and paramyxovirus infection	Poultry and pigeons	2006	✓	S
Psittacosis (Ornithosis)	Poultry	Present	Ornithosis (incls. psittacosis) notifiable in Northern Ireland in poultry [52]	
Rabies (Terrestrial)	Dogs and other mammals	1970[53]	✓	S
Rabies (EBLV)	Bats	2017[54]	✓	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	Rarely present in wildlife[55]		S
Tuberculosis (*Mycobacterium bovis*)	Domestic cattle, buffalo, bison and deer	Present[56]	✓[57]	✓
Vesicular stomatitis virus (VSV)	Cattle/ other mammals	Never	✓	S
West Nile virus	Horses	Never	✓	S

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

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

[54] European bat Lyssavirus type 2 was isolated from 1 Daubenton's bat in England in 2017

[55] *Trichinella* was identified during wildlife surveillance in Northern Irelandin a single fox (positive for *Trichinella spiralis* in 2007) and again in 2009. A positive fox was found in England in 2013 (*Trichinella pseudospiralis*). In England an extensive investigation of wildlife identified no further cases, showing this to be an isolated case. SAPO only refers to *T. spiralis*

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

[57] In addition to any bovines and deer with suspect clinical signs of tuberculosis, under the Tuberculosis (England) Order 2014 (as amended), the Tuberculosis (Wales) Order 2011 (as amended), and the Tuberculosis (Scotland) Order 2007 (as amended), there is a statutory requirement in GB to notify to the APHA 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 APHA 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 APHA is encouraged

Appendix 3: Laboratory-confirmed cases of zoonotic disease in humans

United Kingdom, 2008 to 2017[58]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Anthrax	1	13	39	0	5	2	0	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	23	29	36	39	39	30	39	42	39	40
Brucellosis	15	18	12	25	14	14	11	12	17	5
Campylobacteriosis	55,617	65,077	70,229	72,112	72,588	66,558	70,540	63,201	59,938	63,946
Cryptosporidiosis	4,937	5,647	4,604	3,573	6,655	4,111	4,598	6,149	6,722	5,052
Hantavirus**	0	0	1	0	2	3	4	4	0	0
Hepatitis E¥	187	252	381	551	792	940	1,264	1,408	1,466	1,092
Hydatid disease†*	--	--	--	--	--	--	--	--	--	--
Leptospirosis	76	56	42	52	78	50	78	68	76	92
Listeriosis	207	234	179	165	185	178	188	187	202	153
Lyme disease	1,098	1,093	1,213	1,189	1,249	1,118	1,081	1,262	1,310	1,750
Pasteurellosis	497	559	586	668	666	717	776	855	815	928
Psittacosis	63	60	58	41	37	30	32	24	20	4
Q fever	67	31	55	114	124	47	61	21	34	24
Rabies 'classical'	1	0	0	0	1	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)*	11,517	10,486	9,692	9,395	8,792	8,461	8,078	9,485	9,608	10,089
STEC O157**	1,247	1,315	1,052	1,484	1,260	1,015	1,186	867	959	775
Non-O157 STEC	36	45	44	37	59	100	306	372	533	589
Streptococcus suis	7	2	4	1	3	3	3	4	1	4
Taeniasis	100	72	114	94	70	80	71	85	74	54
Toxocariasis	2	4	12	4	7	3	5	6	6	5
Toxoplasmosis	457	494	414	364	328	538	367	374	377	298
Trichinellosis	0	0	1	0	0	0	1	0	0	0
vCJD[59]‡	2	3	3	5	0	1	0	0	1	0
Yersiniosis	62	62	54	55	55	60	65	44	87	141

* Provisional data

** Data has been updated following a data cleaning exercise

‡ Data source: NCJDRSU

[58] Not a definitive list of the zoonotic pathogens reported each year, but covers zoonotic diseases reported annually in the UK Zoonoses Report.

[59] Deaths

¥ Hepatitis E now includes SGSS reports to help improve our understanding of the current case load. Cases reported through SGSS are retrospectively analysed and reported from 2010 onwards to show the trend of local HEV testing
†*Hydatid: 5 cases of hydatid disease were reported in Scotland in 2016 and no cases were reported in Northern Ireland. Data from 2017 is not available due to inconsistencies in surveillance data. This is being addressed and the data will be published as soon as the quality can be assured.

England and Wales

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Anthrax	1	0	5	0	4	1	0	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	17	21	31	30	33	24	35	35	35	37
Brucellosis	5	13	11	17	9	12	10	11	17	5
Campylobacteriosis‡	49,891	57,685	62,588	64,572	65,044	59,040	62,494	55,697	52,382	56,729
Cryptosporidiosis	4,162	4,831	3,901	2,990	5,765	3,520	4,023	5,222	5,654	4,292
Hantavirus	0	0	1	0	2	3	3	4	0	0
Hepatitis E¥	183	249	368	536	714	845	1,063	1,212	1,243	912
Hydatid disease†*	--	--	--	--	--	--	--	--	--	--
Leptospirosis	62	52	39	44	72	47	76	63	72	87
Listeriosis**	181	213	160	148	167	160	169	168	183	135
Lyme disease**	813	863	905	959	1,040	936	856	1,060	1,134	1,579
Pasteurellosis	438	455	466	538	535	581	600	642	606	744
Psittacosis	62	58	53	40	27	29	25	22	17	**
Q fever[60]	55	27	52	106	112	45	56	19	33	19
Rabies 'classical'	0	0	0	0	1[61]	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)**	10,321	9,482	8,573	8,492	7,919	7,493	7,250	8,558	8,630	9,121
STEC O157**	950	1,034	773	1,182	837	787	883	665	715	563
Non-O157 STEC	11	15	9	12	22	47	169	211	295	385
Streptococcus suis	7	1	3	0	3	1	3	4	0	2
Taeniasis	95	70	108	90	65	74	65	70	64	51
Toxocariasis	1	1	7	0	5	3	4	3	0	2
Toxoplasmosis	405***	422	345	341	311	311	344	342	335	262
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis (non-pestis)	39	47	47	51	44	52	58	39	76	129

* Provisional data

** Data has been updated following a validation exercise

*** Enhanced surveillance system introduced

‡ Data for previous years revised through use of an improved database query method and data validation

¥ Hepatitis E now includes SGSS reports to help improve our understanding of the current case load. Cases reported through SGSS are retrospectively analysed and reported from 2008 onwards to show the trend of local HEV testing. A thorough review of the last 10 years has recently been undertaken and figures are updated accordingly

†*Hydatid data is not available due to inconsistencies in surveillance data. This is being addressed and the data will be published as soon as the quality can be assured

**2017 Psittacosis data is not available due to an ongoing laboratory reporting issue that is being investigated

[60] Acute and chronic infections

[61] A UK National who visited India

Northern Ireland

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
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	2	1	1	2	0	4	2	5	3	1
Brucellosis	10	4	0	2	2	0	0	1	0	0
Campylobacteriosis	848	977	1,040	1,175	1,211	1,355	1,414	1,320	1,258	1,421
Cryptosporidiosis	119	118	119	140	177	161	143	204	282	251
Hantavirus	0	0	0	0	0	0	0	0	0	0
Hepatitis E	0	0	0	1	0	1	9	10	18	10
Hydatid disease†*	--	--	--	--	--	--	--	--	--	--
Leptospirosis	1	0	0	3	2	2	0	2	1	0
Listeriosis	11	4	2	3	7	2	4	6	4	1
Lyme disease	0	2	0	1	2	6	1	2	4	3
Pasteurellosis	2	7	0	1	2	3	1	2	1	0
Psittacosis	0	0	0	0	0	0	0	0	0	0
Q fever	11	2	0	1	1	0	0	0	0	1
Rabies 'classical'	1[62]	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	185	158	178	166	145	155	111	124	140	128
STEC O157	56	44	67	49	189[63]	61	40	32	63	45
Non-O157 STEC	0	0	0	0	2	1	62[64]	120[65]	175[65]	145[65]
Streptococcus suis	0	0	0	0	0	0	0	0	0	0
Taeniasis	0	0	0	0	1	0	0	0	0	0
Toxocariasis	0	0	0	0	0	0	0	0	1	0
Toxoplasmosis	4	3	2	0	0	0	0	0	0	0
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis	0	0	0	0	0	1	3	0	2	0

* Provisional data

†* Hydatid: Hydatid data is not available due to inconsistencies in surveillance data. This is being addressed and the data will be published as soon as the quality can be assured

[62] UK national who visited South Africa

[63] 142 of these cases were associated with 1 outbreak

[64] Includes PCR and culture results, including PCR positive only results and all specimen types

Scotland

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Anthrax	0	13	34	0	1	1	0	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	4	7	4	7	6	2	2	2	1	2
Brucellosis	0	1	1	6	3	2	1	0	0	0
Campylobacteriosis	4,878	6,415	6,601	6,365	6,333	6,163	6,632	6,184	5,298	5,796
Cryptosporidiosis	656	698	584	443	713	430	432	723	786	509
Hantavirus	0	0	0	0	0	0	1	0	0	0
Hepatitis E	4	3	13	15	78	95	193	186	205	170
Hydatid disease†*	0	0	1	3	0	3	1	0	3	1
Leptospirosis	13	4	3	5	4	1	2	3	3	5
Listeriosis	15	17	17	14	11	16	15	13	15	17
Lyme disease	285	228	308	229	207[65]	176	224	200	170	168
Pasteurellosis	57	97	120	129	129	133	173	212	208	184
Psittacosis	1	2	5	1	10	5	7	2	3	4
Q fever	1	2	3	7	11	2	5	2	1	4
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)	1,011	846	941	737	728	813	717	803	838	840
STEC O157	241	237	212	253	234	167	263	170[1]	181[3]	167[5]
Non-O157 STEC	25	30	35	25	35	52	75	78[2]	63[4]	59[6]
Streptococcus suis	0	1	1	1	0	2	0	0	1	2
Taeniasis	5	2	6	4	4	6	6	15	10	3
Toxocariasis	0	3	4	4	2	0	0	3	5	3
Toxoplasmosis	48	69	67	23[66]	17	22[7]	23	32	42	36
Trichinellosis	0	0	1	0	0	0	1	0	0	0
Yersiniosis (non-pestis)	23	15	7	4	11	7	4	5	9	12

* Provisional data

[1] 170 faecal positive culture confirmed cases, 12 cases not confirmed by culture

[2] 78 faecal positive culture confirmed cases, 19 cases not confirmed by culture

[3] 181 faecal positive culture confirmed cases; 2 cases not confirmed by culture

[4] 63 faecal positive culture confirmed cases; 19 cases not confirmed by culture

[5] 167 faecal positive culture confirmed cases; 7 cases not confirmed by culture

[6] 59 faecal positive culture confirmed cases; 25 cases not confirmed by culture

[7] Totals from 2013 have been amended following data reconciliation with the Scottish Toxoplasma Reference Labroratory

†* Hydatid: Hydatid data from 2014 has been amended following a review of the surveillance data

[65] From 2012, reporting changed to acute cases only

[66] From 2011, reporting changed to acute cases only

Appendix 4: Government laboratory-confirmed cases or incidents of zoonotic infection in animals

United Kingdom [A], 2008 to 2017[A]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Anthrax	0	0	0	0	0	0	0	1	0	0
Avian Influenza (HPAI)[A]	2	0	0	0	0	0	1	1	1	15
New TB incidents in cattle herds [A]	6,286	5,893	5,881	6,300	6,810	6,274	6,106	6,540	6,248	6,861
M. bovis isolates in non-bovine animals (excludes badgers)	123	156	142	142	99	138	134	146	140	106
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	107	149	144	140	16	26	16	7	12	17
Brucella abortus [A]	177	71	74	21	23	26	8	0	0	0
Brucella melitensis [A]	0	0	0	0	0	0	0	0	0	0
Brucella spp [A] (in marine mammals)	10	7	7	9	13	6	5	10	9	8
BSE	37	12	11	7	3	3	1	2	0	0
Campylobacter [A]	186	164	280	178	144	259	185	265	158	189
Chlamydiosis (*Chlamydia abortus*) fetopathy [A]	372	406	397	447	539	331	446	336	420	267
Cryptosporidiosis [A]	1,311†	1,436	1,768	1,381	1,896	1,874	1,374	1,191	933	706
Hydatid [A]	0	0	0	0	0	1	0	0	0	0
Leptospirosis [A]	238	89	113	50	85	69	59	34	29	30
Listeriosis [A]	216	196	237	165	219	201	206	157	215	145
Orf [A]	44	38	41	36	49	56	31	43	48	34
Pasteurella multocida [A]	394	540	510	464	379	531	390	384	387	395
Psittacosis (*C. psittaci*) [A]	1	3	8	0	2	2	1	0	1	2
Q fever [A]	5	3	5	8	6	3	4	8	12	5
Rabies 'classical'	1	0	0	0	0	0	0	0	0	0
Rabies EBLV	2	1	0	0	0	0	1	1	2	1
Salmonella (all types) [A]	2,311	2,672	3,513	2,961	3,344	3,321	2,691	3,055	2,867	2,964
Streptococcus suis [A]	132	115	139	124	96	146	157	158	222	137
Swine Influenza [A]	16	18	40	37	38	33	32	28	33	20
Toxoplasmosis [A]	257	232	267	189	348	444	275	298	301	252
Trichinellosis	0	1	0	0	0	1	0	0	0	0
Yersiniosis [A]	32†	37	23	44	50	82	169	143	168	153

[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

Data only includes isolations from cattle and sheep in GB

England [A]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Anthrax	0	0	0	0	0	0	0	1	0	0
Avian Influenza (HPAI) [A]	2	0	0	0	0	0	1	1	1	11
New TB incidents in cattle herds [A]	3,766	3,363	3,632	3,802	3,919	3,890	3,804	3,973	3,762	3,824
M. bovis isolates in non-bovine animals (excludes badgers) †	119†	144†	134†	133†	98†	132	132†	141	139†	105†
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	77†	122†	130†	140†	14	21	8	7	12†	6
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	4	0	1	7	0	2	0	0	0
BSE	25	9	11	5	2	1	1	1	0	0
Campylobacter [A]	94	93	148	93	73	129	105	182*	146†	129*
Chlamydiosis (*Chlamydia abortus*) fetopathy [A]	201	219	215	226	260	166	220	296†	369†	221†
Cryptosporidiosis [A]	1,311†	1,346†	1,674†	1,095†	650	681	549	762†	553†	384†
Hydatid [A]	0	0	0	0	0	0	0	0	0	0
Leptospirosis [A]	16	5	8	3	15	1	1	2	9†	4†
Listeriosis [A]	191†	177†	215†	146†	85	180†	151†	121†	187†	119†
Orf [A]	26	26	29	20	30	35	18	43†	43†	33†
Pasteurella multocida [A]	281†	319†	368†	316†	116	319†	279†	253†	195†	219†
Psittacosis (*C. psittaci*) [A]	0	1	4	0	1	1	1	0	1†	2†
Q fever [A]	3	3	5	3	5	3	4	7	12†	3
Rabies 'classical'	1	0	0	0	0	0	0	0	0	0
Rabies EBLV	2	0	0	0	0	0	1	0	2	1
Salmonella (all types) [A]	1,729*	2,198*	3,044*	2,392*	2,739*	2,685*	2,263†	2,783†	2,631†	2,821†
Streptococcus suis [A]	96	83	94	94	66	100†	90†	110†	128†	118†
Swine Influenza [A]	16	13	31	34	36	33	27	25	33†	20†
Toxoplasmosis [A]	93	115	101	84	146	132	212†	248†	234†	177†
Trichinellosis	0	0	0	0	0	1	0	0	0	0
Yersiniosis [A]	32†	33†	15†	22†	8	7	22†	17†	12†	22†

[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

* England and Wales data

Wales [A]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza (HPAI) [A]	0	0	0	0	0	0	0	0	0	1
New TB incidents in cattle herds [A]	1,198	1,186	1,039	1,046	1,109	877	858	839	711	789
M. bovis isolates in non-bovine animals (excludes badgers) †	119†	144†	134†	133†	98†	6	132†	4	139†	105†
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	77†	122†	130†	140†	0	0	4	0	12†	1
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	1	0	8†
BSE	7	0	0	0	0	2	0	1	0	0
Campylobacter [A]	22	17	39	26	11	40	31	182*	146†	129*
Chlamydiosis (*Chlamydia abortus*) fetopathy**	70	82	75	81	108	61	94	296†	369†	221†
Cryptosporidiosis [A]	1311†	1346†	1674†	1095†	201	206	209	762†	553†	384†
Hydatid [A]	0	0	0	0	0	1	0	0	0	0
Leptospirosis [A]	1	0	0	1	0	0	0	1	9†	4†
Listeriosis [A]	191†	177†	215†	146†	30	180†	151†	121†	187†	119†
Orf [A]	7	5	3	8	11	5	4	43†	43†	33†
Pasteurella multocida [A]	281†	319†	368†	316†	24	319†	279†	253†	195†	219†
Psittacosis (*C. psittaci*) [A]	0	1	0	0	0	0	0	0	1†	2†
Q fever [A]	2	0	0	5	1	0	0	1	12†	0
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	1	0	0
Salmonella (all types) [A]	1,729 *	2,198 *	3,044 *	2,392 *	2,739 *	2,685 *	2,263 †	2,783 †	2,631 †	2,821 †
Streptococcus suis [A]	0	1	2	0	3	100†	90†	110†	128†	118†
Swine Influenza [A]	0	0	0	0	0	0	0	0	33†	20†
Toxoplasmosis [A]	32	21	24	29	36	37	212†	248†	234†	177†
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis [A]	32†	33†	15†	22†	0	2	22†	17†	12†	22†

[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

* England and Wales data

Northern Ireland[A]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza (HPAI) [A]	0	0	0	0	0	0	0	0	0	3
New TB breakdowns in cattle herds per year and the % Herd incidence	1,274 5.58	1,293 5.61	1,160 5.12	1,386 6.00	1,695 7.32	1,479 6.44	1,397 6.03	1,688 6.88	1,739 7.45	2,208 9.61
M. bovis isolates in non-bovine animals (excludes badgers)	4	12	8	9	1	0	2	1	1	1
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	30	27	14	0	0	0	0	0	0	0
Brucella abortus- number of reactor herds per year and confirmed infected herds	177 34	71 13	74 25	21 4	23 1	26 0	8 0	0 0	2 0	1 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	0	N/A	N/A	N/A
BSE	4	3	0	2	1	0	0	0	0	0
Campylobacter [A]	35	15	46	25	35	35	13	19	12	35
Chlamydiosis (*Chlamydia abortus*) fetopathy [A]	36	39	55	61	68	51	56	40	51	46
Cryptosporidiosis [A]	N/A	90	94 Φ	286 Φ	736 Φ	668 Φ	404 ΦC	429	380 ΦC	322 ΦC
Hydatid [A]	0	0	0	0	0	0	0	0	0	0
Leptospirosis [A]	199	84	105	46	70	65	56	29	20	26
Listeriosis [A]	25	19	22	19	45	21	55	36	28	26
Orf [A]	1	1	1	1	0	3	2	0	5	1
Pasteurella multocida [A]	113	221	142	148	140	212	111	131	192	176
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]	382	252	345	354	426	503	428	272	236	143
Streptococcus suis [A]	10	14	21	12	19	46	67	48	94	19
Swine Influenza [A]	0	5	4	0	0	0	5	3	0	0
Toxoplasmosis [A]	64	44	51	45	100	229	63	50	67	75**
Trichinellosis	0	1	0	0	0	0	0	0	0	0
Yersiniosis [A]	N/A	4	8	22	34	72	147*	126	156	131

[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

ΦC Data only includes isolations from cattle

*Marked increase is due to 2014 being first full year of using selective media at AFBI, making Yersinia detection much easier

**25% increase in samples tested compared to 2016

Scotland [A]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza (HPAI) [A]	0	0	0	0	0	0	0	0	0	0
New TB incidents in cattle herds [A]	47	49	45	43	54	28	47	40	36	40
M. bovis isolates in non-bovine animals (excludes badgers) †	119†	144†	134†	133†	98†	0	132†	0	139†	105†
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	77†	122†	130†	140†	2	5	4	0	12†	10
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)	4	3	7	8	6	6	3	9	9	8
BSE	1	0	0	0	0	0	0	0	0	0
Campylobacter [A]	35	39	47	34	25	55	36	64	146†	25
Chlamydiosis (*Chlamydia abortus*) fetopathy [A]	65	66	52	79	103	53	76	296†	369†	221†
Cryptosporidiosis [A]	1311†	1346†	1674†	1095†	309	319	212	762†	553†	384†
Hydatid [A]	0	0	0	0	0	0	0	0	0	0
Leptospirosis [A]	22	0	0	0	0	3	2	2	9†	4†
Listeriosis [A]	191†	177†	215†	146†	59	180†	151†	121†	187†	119†
Orf [A]	10	6	8	7	8	13	7	43†	43†	33†
Pasteurella multocida [A]	281†	319†	368†	316†	99	319†	279†	253†	195†	219†
Psittacosis (*C. psittaci*) [A]	1	1	4	0	1	1	0	0	1†	2†
Q fever [A]	0	0	0	0	0	0	0	0	12†	2
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	1	0	0	0	0	0	0	0	0
Salmonella (all types) [A]	200	222	124	215	179	133	2,263 †	2,783 †	2,631 †	2,821 †
Streptococcus suis [A]	26	17	22	18	8	100†	90†	110†	128†	118†
Swine Influenza [A]	0	0	5	3	2	0	0	0	33†	20†
Toxoplasmosis [A]	68	52	91	31	66	46	212†	248†	234†	177†
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis [A]	32†	33†	15†	22†	8	1	22†	17†	12†	22†

[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 table 4 are not intended to provide a definitive list of all zoonotic pathogens, but include those for which data is available (notifiable/reportable and those recorded by the APHA's Veterinary Diagnostic Analysis (VIDA) system (GB data) and /or AFBI systems). The VIDA data provides figures only for new incidents with relevant VIDA codes (although numbers of incidents in this report may differ marginally from those published in the 2017 FZ2100 annual report due to updated database recording). The FSA supplied the trichinellosis data. The species for which diagnoses may be recorded and other notes relevant in interpreting the other tables in table 4 are provided below.

In the table below, shaded boxes indicate a diagnosis is not available for that species.

Diagnosis	Cattle	Sheep	Goats	Pigs	Birds [1]	Misc.	Wildlife [2]
Anthrax (incidents)							
Avian influenza (only reports outbreaks of highly pathogenic strains (HPAI) and influenza A virus of H5 or H7 subtype that are not classified as highly pathogenic). Tables show number of HPAI incidents p.a. on the basis of when infection was confirmed in domesticated poultry (diagnoses in wild birds are not included).							
New TB incidents in cattle herds New TB incidents in cattle herds represent herds which were previously OTF, but either had cattle that reacted to a tuberculin skin test or had a culture-positive tuberculous animal disclosed by routine meat inspection at slaughter, during the period shown (figures for Wales also include incidents where OTF status was withdrawn for epidemiological reasons only). Since 2008 the GB figures are based on data derived from APHA's Sam system. Sam is an APHA IT system that holds information on all customers, and helps manage specific work areas such as TB. The overall UK totals are not the exact sum of the number of new incidents in each national table as a 'balancing item' may be included in the overall GB total to account for a very small number of herd incidents where the exact region is unknown, and is therefore only reflected in this GB or UK total figure. This balancing amount in 2017 was zero, 2016 4, 2015 was 10, 9 in 2014, 18 in 2013, 33 in 2012, 23 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*)							

Diagnosis		Cattle	Sheep	Goats	Pigs	Birds [1]	Misc.	Wildlife [2]
Brucella abortus	Confirmed cases are statutorily reportable under Zoonoses Order 1989 or in Northern Ireland under the Zoonoses Order 1991.							
Brucella melitensis								
***Brucella* spp.** (in marine mammals)								
BSE Total number of BSE cases provided. This includes both classical cases (C-BSE) and atypical cases (H-BSE and L-BSE). Atypical types have been reported in the UK since 2005. Cases are allocated to year of initial report for suspect cases or year of slaughter.								
Campylobacter Confirmed cases obtained through scanning surveillance. Data for GB countries included in the relevant tables in table 4 has been derived from the incidents recorded on APHA's Veterinary Diagnostic Analysis (VIDA) system. This uses strict criteria and so not all isolated pathogens are included in the relevant tables (pet animal diagnoses are not included). In NI data from Campylobacter diagnoses in pigs is also included.								
Chlamydiosis (*Chlamydia 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 (from VIDA database in GB). Therefore tables in table 4 state laboratory, not abattoir, diagnoses.								
Leptospirosis Confirmed incidents 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 incidents obtained through scanning surveillance (VIDA database in GB).								
Q Fever (*Coxiella burnetii*) Confirmed incidents obtained through scanning surveillance (VIDA database in GB).								

Diagnosis	Cattle	Sheep	Goats	Pigs	Birds [1]	Misc.	Wildlife [2]
Rabies 'classical'							
Rabies EBLV Passive surveillance for lyssaviruses in UK bats has been ongoing since 1987 with the first detection of EBLV-2 in a Daubenton's bat in the UK in 1996. As of the end of 2017, 15 cases of EBLV-2 had been detected, all in Daubenton's bats since this surveillance began.							
***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 incidents obtained through scanning surveillance (VIDA database in GB).							
Trichinellosis Data from FSA surveillance.							
Yersiniosis Confirmed cases obtained through scanning surveillance (VIDA database in GB).							

[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 relation to *Campylobacter*, *Listeria monocytogenes*, *Salmonella* and STEC in the UK in 2017

Food vehicle category	*Campylobacter*	*Listeria monocytogenes*	*Salmonella*	STEC**
Poultry meat	7	0	0	0
Red meat	0	0	3	1
Vegetables, salads & fruits	0	0	2	0
Eggs & egg dishes	2	0	2	0
Milk & dairy products	0	1	0	1
Composite/Mixed foods***	0	1	1	0
Unknown	0	2	5	2
Total*	9	4	13	4

* The food vehicle reported in the table above is the primary food vehicle implicated in the outbreak. In some outbreaks, other foods were also potentially implicated based on the results of analytical studies but these are not reported in the table. Outbreaks associated with person to person spread, environmental or zoonotic transmission are not included
**Outbreak data derived from both eFOSS and the National Enhanced Surveillance System for STEC (NESSS) in England
***Includes prepacked sandwiches and Yorkshire pudding wraps

Appendix 6: Animal population

Number of livestock in the UK in 2017

	England*	Wales**	Scotland***	N. Ireland†	UK
Cattle	5,418,000	1,137,400	1,781,705	1,666,000	10,003,105
Sheep	15,757,000	10,040,000	6,985,157	2,053,000	34,835,157
Pigs	3,969,000	24,500	325,867	649,000	4,968,367
Poultry	134,869,000	7,742,000	14,114,748	24,911,000	181,636,748
Goats	84,000	12,308	4,877	4,166	105,351
Farmed deer	20,000	958	8,039	2003	31,000
Horses	170,000	44,700	34,604	10,000	259,304

Data sourced via the Radar Veterinary Surveillance database (Defra)
* obtained from the June 2017 England Agricultural Census
** obtained from the June 2017 Wales Agricultural Census
*** obtained from the June 2017 Scottish Agricultural Census
† Northern Ireland data provided by Department of Agriculture, Environment and Rural Affairs (DAERA), Northern Ireland, 2017 from Agriculture Survey for 2017 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 2017[67]

PFMA (Pet Food Manufacturers' Association) research shows that in 2017 44% of UK households owned at least 1 pet. This would be approximately 12 million households with pets, out of approximately 27 million UK households in total. The pet population stands at around 54 million.

Historically, a sample of over 2,000 people were interviewed each year, but in the last 2 years a sample of over 4,000 people have been interviewed. In order to further reduce statistical uncertainty, survey results are averaged over 2 years, giving an effective sample of over 8,000 people.

The table below shows the estimated population of UK pets, as well as a breakdown of the most popular pets, in 2016-2017.

Species	Approximate number of pets (millions)
Dogs	8.5
Cats	8
Rabbits	0.9
Birds (indoor)	0.7
Guinea pigs	0.5
Hamsters	0.3
Outdoor fish	15-20
Indoor fish	15-20
Domestic fowl	0.6
Lizards	--

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

Appendix 7: Further reading

General further reading

Advisory Committee on the Microbiological Safety of Food: An update on the microbiological risk from shell eggs and their products
https://acmsf.food.gov.uk/sites/default/files/acmsf-egg-reportv1.pdf

Advisory Committee on the Microbiological Safety of Food: Reports on microbiological work
http://acmsf.food.gov.uk/acmsfreps/acmsfreports

Animal and Plant Health Agency: Non-Statutory Zoonoses Reports
www.gov.uk/government/uploads/system/uploads/attachment_data/file/681452/pub-zoo0417.pdf

Cross Government guidance: management of the public health consequences of tuberculosis in cattle and other animals (England)
www.gov.uk/government/publications/bovine-tuberculosis-tb-public-health-management

European Food Standards Authority: EFSA FSA foodborne viruses workshop
www.efsa.europa.eu/en/supporting/pub/1103e

Food Standards Agency: A report on the study of Infectious Intestinal Disease in England
www.food.gov.uk/science/research/foodborneillness/microfunders/intestinal

Food Standards Agency: Feasibility of introducing methods, in the UK, for reducing shedding of *E. coli* O157 in cattle
www.food.gov.uk/science/research/foodborneillness/fs421009

Food Standard Agency: Measuring foodborne Illnesses levels
www.food.gov.uk/science/microbiology/fds/58736

Food Standards Agency: Risk assessment on Meticillin-Resistant *Staphylococcus aureus* (MRSA), with a focus on Livestock-associated MRSA, in the UK Food Chain
www.food.gov.uk/sites/default/files/mrsa_risk_assessment_feb17.pdf

Food Standards Agency: Zika virus and transmission via food risk assessment
https://acmsf.food.gov.uk/sites/default/files/acm_1252_zika_ra.pdf

Guidelines on the roles and responsibilities of agencies involved in the Investigation and Management of Zoonotic Disease in Scotland
www.hps.scot.nhs.uk/giz/resourcedetail.aspx?id=1258

Health Protection Scotland – Outbreaks in Scotland in 2017
www.hps.scot.nhs.uk/outbreaks/

HSE zoonoses guidance
www.hse.gov.uk/agriculture/topics/zoonoses.htm

Joint Agency Guidelines for the Investigation of Zoonotic Disease (England and Wales)
www.gov.uk/government/publications/zoonotic-diseases-investigation-guidelines

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

Preventing or controlling ill health from animal contact at visitor attractions
www.asao.co.uk/wp-content/uploads/2015/06/Code-of-Practice-Preventing-Controlling-Ill-Health-from-Animal-Contact-updated-2015.pdf

Public Health England: Gastrointestinal infections: Guidance, data and analysis
www.gov.uk/government/collections/gastrointestinal-infections-guidance-data-and-analysis

Public Health England: Zoonoses web pages
www.gov.uk/government/collections/zoonotic-diseases-zoonoses-guidance-data-and-analysis

Scottish Government: Shedding light on *E. coli* O157 – what you need to know
www.gov.scot/Publications/2005/03/20839/54388

Veterinary Laboratories Agency: VTEC O157 in cattle
http://adlib.everysite.co.uk/resources/000/264/533/sci_vtec_leaflet.pdf

Wales: *Escherichia coli* O157
www.wales.nhs.uk/sitesplus/888/page/43884

Appendix 8: List of Abbreviations/acronyms

ACMSF	Advisory Committee on the Microbiological Safety of Food
ACT	Acting on Campylobacter Together
AFBI	Agri-Food and Biosciences Institute
AI	Avian Influenza
AMR	Antimicrobial Resistance
APHA	Animal and Plant Health Agency
APHIS	Animal Public Health Information System
BPEX	British Pig Executive
BRU	Brucella Reference Unit
BSE	Bovine Spongiform Encephalopathy
bTB	Bovine tuberculosis
C-BSE	Classical Bovine Spongiform Encephalopathy
CCDC	Consultant in Communicable Disease Control
CJD	Creutzfeldt-Jakob disease
CoP	Code of Practice
DAERA	Department of Agriculture, Environment and Rural Affairs (Northern Ireland)
Defra	Department for Environment, Food and Rural Affairs
DHSC	Department of Health and Social Care
EBLV	European Bat Lyssavirus
ECDC	European Centres for Disease Control
eFOSS	electronic Foodborne and Non-Foodborne Gastrointestinal Outbreak Surveillance System
EFSA	European Food Standards Authority
ESQ	Enhanced Surveillance Questionnaires
EU	European Union
FSA	Food Standards Agency
FSS	Food Standards Scotland
GB	Great Britain (England, Wales, Scotland)
GI	Gastrointestinal Illness

H-BSE	H-Type Bovine Spongiform Encephalopathy
HAIRS	Human Animal Infections and Risk Surveillance Group
HEV	Hepatitis E Virus
HPAI	Highly Pathogenic Avian Influenza
HPS	Health Protection Scotland
HPT	Health Protection Team
HRA	High Risk Area
HSE	Health and Safety Executive
HUS	Haemolytic Uraemic Syndrome
IGRA	Interferon Gamma Release Assay
IMT	Incident Management Team
L-BSE	L-Type Bovine Spongiform Encephalopathy
LPAI	Low Pathogenicity Avian Influenza
LRA	Low Risk Area
MAT	Microscopic Agglutination Test
MRSA	Meticillin-Resistant *Staphylococcus aureus*
NCJDRSU	National CJD Research & Surveillance Unit
NCP	*Salmonella* National Control Programmes
NHS	National Health Service
NHSBT	National Health Service Blood and Transplant
NI	Northern Ireland
OBF	Officially Brucellosis Free
OTF	Officially Tuberculosis Free
PCR	Polymerase Chain Reaction
PFMA	Pet Food Manufacturers' Association
PHA	Public Health Agency (Northern Ireland)
PHE	Public Health England
PHW	Public Health Wales
RDM	Raw diary milk
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (HSE)
RNA	Ribonucleic Acid
SACCVS	Scottish Agricultural College Consulting Veterinary Services

SAPO	Specified Animal Pathogens Order (2008)
SERL	Scottish *E. coli* O157/VTEC Reference Laboratory
SG	Scottish Government
SGSS	Second Generation Surveillance System
SNP	Single Nucleotide Polymorphisms
SRUC	Scotland's Rural College (includes SACCVS)
STEC	Shiga toxin producing *Escherichia coli* (previously termed 'VTEC': Verocytotoxigenic-producing *Escherichia coli*)
TB	Tuberculosis
TSE	Transmissible Spongiform Encephalopathy
UK	United Kingdom (England, Wales, Scotland, Northern Ireland)
UKZADI	UK Zoonoses, Animal Diseases and Infections
vCJD	Variant Creutzfeldt-Jakob Disease
VeSSY	National Enhanced Surveillance System for STEC
VIDA	Veterinary Investigation Diagnosis Analysis Database
VMD	Veterinary Medicines Directorate
VRG	Veterinary Risk Group
VSV	Vesicular Stomatitis Virus
VTEC	Verocytotoxigenic *Escherichia coli* (now replaced by 'STEC': Shiga toxin producing *Escherichia coli*)
WG	Welsh Government
WGS	Whole Genome Sequencing

Appendix 9: Acknowledgements

This report was produced by a group led by Dilys Morgan, PHE. 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

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

Brucella reference unit (BRU)

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

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

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

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

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

www.gov.uk/guidance/cryptosporidium-reference-unit-cru

Department of Agriculture, Environment and Rural Affairs (Northern Ireland) (DAERA)

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

www.daera-ni.gov.uk

Department for Environment, Food and Rural Affairs (Defra)

Area 2B, Nobel House, 17 Smith Square, London, SW1P 3JR

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

Department of Health and Social Care

39 Victoria Street, London, SW1H 0EU

www.gov.uk/government/organisations/department-of-health-and-social-care

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

Castle Buildings, Stormont, Belfast, BT4 3SJ

www.dhsspsni.gov.uk

Food Standards Agency (FSA)

Clive House, 70 Petty France, London SW1H 9EX

www.food.gov.uk

Food Standards Scotland (FSS)

4th floor, Pilgrim House, Aberdeen, AB11 5RL

www.foodstandards.gov.scot/

Health Protection Scotland (HPS)

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

www.hps.scot.nhs.uk

Hospital for Tropical Diseases

2nd Floor, Mortimer Market Centre, Mortimer Market, London, WC1E 6JB

www.thehtd.org/

National Leptospirosis Service (PHE Collaborating Laboratory)

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

www.gov.uk/guidance/leptospira-reference-unit-services

National Lyme Disease Testing Service (Scotland)

Microbiology department, Raigmore Hospital, Inverness, IV2 3UJ

www.hps.scot.nhs.uk/reflab/STRL.aspx

Public Health Agency (Northern Ireland)

12-22 Linenhall St, Belfast, BT2 8HS

www.publichealth.hscni.net/

Public Health England (PHE)

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

www.gov.uk/government/organisations/public-health-england

Public Health Wales

Communicable Disease Surveillance Centre, Health Protection Division, 2 Capital Quarter, Tyndall Street, Cardiff, CF10 3NW

www.wales.nhs.uk/sites3/page.cfm?orgid=457&pid=25313

Rare and Imported Pathogens Laboratory, Porton

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

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

Scotland's Rural College

West Mains Road, Edinburgh, EH9 3JG

www.sruc.ac.uk/

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

Department of Laboratory Medicine, Royal Infirmary of Edinburgh, Edinburgh, EH16 4SA

www.hps.scot.nhs.uk/reflab/SERL.aspx

Scottish Government, Rural Directorate

Saughton House, Broomhouse Drive, Edinburgh, EH11 3XD

www.scotland.gov.uk

Scottish Parasite Diagnostic and Reference Laboratory

New Lister Building, Glasgow Royal Infirmary, Alexandra Parade, Glasgow, G21 3UW

www.nhsggc.org.uk/about-us/professional-support-sites/microbiology/scottish-microbiology-reference-laboratories/scottish-parasite-diagnostic-reference-laboratory/

Scottish *Salmonella* Reference Laboratory

New Lister Building, Glasgow Royal Infirmary, Alexandra Parade, Glasgow, G21 3UW

www.nhsggc.org.uk/about-us/professional-support-sites/microbiology/scottish-microbiology-reference-laboratories/scottish-salmonella-shigella-c-difficile-reference-laboratory/

Scottish *Toxoplasma* Reference Laboratory

Microbiology department, Raigmore Hospital, Inverness, IV2 3UJ

datawww.hps.scot.nhs.uk/reflab/STRL.aspx

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

Public Health Wales, Microbiology ABM, 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