HM Government

Zoonoses Overview Report

UK 2016

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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 2016. The data have 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 Community via the Trends and Sources Report under the Zoonoses Directive 2003 to 2099, by agencies contributing to the Report.

This report is a collaborative publication produced by:

- Public Health England (PHE): lead organisation for this year's report
- Department for Environment, Food and Rural Affairs (Defra)
- Food Standards Agency (FSA)
- Department of Health (DH)
- Animal 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, many of which are derived from dynamic databases, may occur following publication and will result in minor changes to subsequent annual reports.

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


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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 are sourced from laboratory-confirmed infections, enhanced surveillance schemes for specific zoonoses and notification of infectious diseases.

This year’s UK Zoonoses Report includes feature articles which highlight human and animal incidents and issues of public health significance which occurred during 2016, as well as summary data on zoonotic infection in humans and animals across the UK. The report provides the numbers of laboratory-confirmed cases of zoonotic diseases in humans and animals in England and Wales, Scotland and Northern Ireland over the past 10 years, and provides links to useful sources of information and other relevant publications for specific zoonoses.

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

Information on the animal aspects of infection is available:
https://www.gov.uk/government/collections/notifiable-diseases-in-animals
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/597694/pub-zoo0416.pdf

Feature Article 1: Locally acquired diphtheria in the UK : a zoonotic infection due to *Corynebacterium ulcerans*

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[1]Public Health England

Diphtheria was once one of the most feared diseases of childhood but is now rare in the UK following the introduction of mass immunisation in 1942. Diphtheria vaccine is made from inactivated diphtheria toxin and protects individuals from the effects of toxin-producing corynebacteria. Three *Corynebacterium* spp. can potentially produce toxin: *C. diphtheriae* (for which there is no animal source); *C. ulcerans* (traditionally associated with farm animal contact and dairy products); and *C. pseudo-tuberculosis* (also typically associated with farm animals but rarely infects humans) [1,2]. Classical respiratory diphtheria is characterized by formation of a grey-white pseudomembrane in the throat that is firmly adherent [3]. Milder respiratory disease may manifest as a sore throat, most commonly seen in patients who are fully or partially vaccinated. Diphtheria may also have a cutaneous presentation, characterised by rolled-edge ulcers. Patients may have both cutaneous and respiratory disease, and both may be caused by *C. ulcerans*.

A review of UK diphtheria cases between 1986 and 2008 emphasised the changing epidemiology and reported that the majority of toxigenic isolates in recent years were due to locally acquired *C. ulcerans* rather than imported *C. diphtheriae* [4]. Similar changes have been reported in other western European countries [1]. Moreover, the traditional association of human *C. ulcerans* with contact with cattle and/or consumption of raw dairy products was replaced with zoonotic risk from domestic pets, with cats and dogs identified as potential reservoirs [4].

The publication of revised guidelines for the public health management and control of diphtheria in 2015 [3] was, in part, prompted by the changing epidemiology, including the increasing number of *C. ulcerans* cases in England and the need for specific guidance on the management of toxogenic *C. ulcerans* and their animal contacts. Although person-to-person transmission of *C. ulcerans* is thought to occur only rarely, laboratory investigations and the public health response to diphtheria caused by *C. ulcerans* should be similar to those for *C. diphtheriae*, and is important to determine the source of the infection [3]. Management of animal contacts in confirmed toxigenic *C. ulcerans* cases requires close collaboration with APHA to decide on appropriate action to identify and manage potential animal source(s) and to risk assess animal settings where there is potential for contact with multiple animals or species [3].

All human isolates of *C. diphtheriae*, *C. ulcerans* and *C. pseudotuberculosis* identified by microbiological laboratories in the UK are sent for toxogenicity testing by the PHE Respiratory and Vaccine Preventable Bacteria Reference Unit (RVPBRU), which is the National Reference Laboratory for diphtheria [5]. We review here toxigenic cases of *C. ulcerans* in the UK during the last 6 years (2011 to 2016) to highlight issues associated with the control of a rare but important human pathogen, from both an animal and human health perspective.

Zoonotic toxigenic diphtheria in the UK between 2011 and 2016 : risk factors for infection and transmission of C. ulcerans

The spectrum of disease presentation and severity, associated with vaccination status, is as varied for toxigenic *C. ulcerans* infections as it is for those caused by *C. diphtheriae*. Between 2011 and 2016, half of the 22 cases of toxigenic diphtheria in the UK were due to *C. ulcerans* [6-10]. The 11 patients affected by *C. ulcerans* were aged between 9 and 67 years, 7 were female and, in contrast to the *C. diphtheriae* cases, only one had a recent history of travel. One unvaccinated and 1 partially vaccinated case presented as classic diphtheria. Three were respiratory cases (without the classic membrane), one was identified from pus drained from a lymph node (other presentation) and the remaining 5 had a cutaneous presentation. In all, 6 cases were hospitalised; 2 were treated successfully with anti-toxin and 2 with an unknown vaccination status died [6-10].

All 11 cases of toxigenic *C. ulcerans* infection reported contact with animals, with one case reporting contact with cats, guinea pigs and rabbits, and also had a possible history of consuming raw dairy products. None of the other cases reported a history of consuming raw dairy products or contact with the traditionally identified reservoir of farm animals, but all reported contact with dogs. Five had only dog contact, while the other cases also had contact with other companion animals including cats, horses, foxes and rabbits [6-10].

Human contacts of toxigenic *C. ulcerans* cases were tested for onward transmission, with an average of 1.9 household contacts (range 0-4) and 15 non-household contacts (range 2-81) identified in England. A large number of health care worker contacts (122) were identified for a fatal case in Scotland in 2015, resulting in a significant impact on health services during the required exclusion period [11]. All close contacts were offered chemoprophylaxis, vaccination as appropriate, and were swabbed. All were negative for corynebacteria, suggesting there was no identifiable onward human-to-human transmission of *C. ulcerans*. For 6 of the *C. ulcerans* cases, pharyngeal swabs were also taken from companion animals, including 9 dogs and a cat. Two of the dogs, one linked to a severe respiratory case and the other to a cutaneous presentation in a post-surgical wound, were culture positive for *C. ulcerans* and were subsequently treated with antibiotics under veterinary guidance [6-10].

The need for collaboration between human and animal public health

Recent epidemiological data and more sophisticated microbiological testing, has identified that diphtheria-like human illness caused by *C. ulcerans* is an emerging threat in developed countries, with incidence sometimes higher than that of diphtheria caused by *C. diphtheriae* [4]. *C. ulcera*ns has a broad host range and has been isolated from clinically affected and healthy wild and domesticated animal species, as reviewed by Tiwari and others [12]. It is a potential, though infrequent, cause of mastitis in cattle [13] and has been isolated from cats with nasal discharge in the UK [14]. A recent survey in Osaka district in Japan, reported a prevalence of *C. ulcerans* of 7.5% among 583 dogs although they did not show any clinical symptoms [15]. Similar information on prevalence of carriage and impact of *C. ulcerans* on animal health in the UK is not available.

Diphtheria is a rare but potentially fatal infection in humans and effective management of a case due to *C. ulcerans* requires co-ordination between human and animal health agencies. Toxigenic *C. ulcerans* is not a notifiable disease in animals. The practical and financial implications of sampling animals for testing and subsequent treatment must be considered [13] and it is important for veterinary staff to discuss implications of a positive test with the owner prior to testing [3]. Hogg et al. [13] raise a number of ethical and practical issues, including the different licensing of antibiotic types for human and veterinary use, and the lack of legal compulsion for owners to treat companion animals found to be harbouring a toxigenic *C. ulcerans* strain, particularly where the animals themselves are non-symptomatic.

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Feature Article 2: Psittacosis in a family who kept parrots

Authors: L Browning[1], J Champion[2], D Mellor[1]
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Psittacosis is primarily an infection of birds caused by the bacterium *Chlamydia psittaci*. The disease has been described in many species of birds, particularly psittacines: parrots; parakeets; budgerigars; and cockatiels. Other commonly affected species include pigeons and doves. Ducks, turkeys and, less frequently, chickens may also be affected. Birds can transmit *C. psittaci* to humans. Those at greatest risk of contracting the disease include bird fanciers and owners of pet birds. *C. psittaci* is not generally spread from person-to-person.

At the end of November 2016, a couple (household A) were both hospitalised, one week apart, with respiratory symptoms. Another family member who lived separately (household B) was also hospitalised with similar symptoms a few days later. Initially, all 3 patients tested negative for bacterial and viral pathogens, including *Legionella*. Six days after admission, the sputum sample from the patient from household B tested PCR positive for *C. psittaci*. Samples from the two patients from household A tested negative, but it was felt that their sample type ('gargle sample') may have not been the most appropriate to allow confirmation and so it was considered that *C. psittaci* was also the cause of their illness. All 3 subsequently recovered following treatment and were discharged from hospital.

Upon further investigation, it was discovered that

- both households A and B had a pet parrot
- one (B) also kept two chickens
- B had recently rescued an ill wild/feral pigeon which was housed within both household A and B (near to their pet parrots)
- the pigeon was also cared for by a friend (household C) – where it was kept outside

An Incident Management Team (IMT) was convened at the start of December 2016 by the local health protection team, and included representatives from Microbiology, Environmental Health, APHA, Scottish Agricultural College Consulting Veterinary Services (SAC CVS), Health Protection Scotland and the local veterinary surgeon. The pigeon had been euthanased immediately by Environmental Health who were unable to take samples for analysis. The parrot belonging to household A became unwell and died at the start of December, with clinical signs suggestive of disease consistent with *C. psittaci* infection. Although *C.psittaci* is not a notifiable disease in animals, APHA agreed to take appropriate samples for testing (spleen and faeces). The initial test

results showed a low antibody titre, and was therefore considered negative; however psittacosis still remained the top differential diagnosis for the parrot based on the history, clinical signs and epidemiological picture. The owners reportedly had close contact with their parrot. The diagnosis was confirmed 10 days later when a post mortem PCR sample from the parrot returned positive for *C. psittaci.*

Up to this point, a second parrot in household B had not displayed any clinical signs. It was recognised that it may be shedding the organism and therefore could pose a risk to public health. At the request of the IMT, the bird was tested. The PCR test was negative, although the antibody titre was high, suggesting exposure to *C. psittaci*, either as current infection but not shedding when tested, or latent infection from past exposure. The parrot was put on a 45 day course of doxycycline.

Once the diagnosis of *C. psittaci* was made, all close contacts of the infected bird were verbally informed of the situation and made aware of symptoms of *C. psittaci* in people. Three households were at risk of potential exposure. A ‘warn and inform’ letter was sent from the Health Protection team to each household advising of symptoms and to seek medical attention if any household member became unwell. In household C, where the pigeon was looked after outdoors, no-one became unwell. Household C also kept ducks and hens, although it was considered unlikely that these birds would be infected as they had not been in close contact with the pigeon.

In addition, a veterinary worker who was in contact with the ill parrot prior to its death subsequently displayed symptoms of an upper respiratory tract infection. A sputum sample was taken for testing and they were started on a course of doxycycline pending results, which were subsequently negative. Information on disinfecting and cleaning was provided to the households that had looked after the pigeon.

A number of issues were encountered whilst dealing with this incident including

- psittacosis is not notifiable in birds (it is notifiable in humans)
- no animal health-associated agency considered management of the sick pigeon within its responsibility
- what constitutes optimum prophylactic antibiotic administration to potentially exposed individuals is presently unclear and not well evidenced

Public Health etc. (Scotland) Act 2008 sections 73 and 76 were used to insist upon testing of the second parrot and disinfection of surroundings because both posed a possible public health risk [1].

As a result of questions raised by this and other incidents, a national guidance document for the investigation of psittacosis incidents is currently being developed by the Human Animal Infections and Risk Surveillance (HAIRS) group. The guidance will include details of the roles and responsibilities of all agencies and the associated legislation.

References

1. Scottish Government. Public Health etc. (Scotland) Act 2008. 2008. http://www.gov.scot/Resource/0039/00398162.pdf

Disease specific information for 2016

The number of reported cases in 2016 and for the previous ten years can be found in Table 3 for humans and Table 4 for animals.

Antimicrobial resistance

The final report and recommendations of the Antimicrobial Resistance (AMR) Review chaired by Lord Jim O'Neill (Review on AMR, 2016 https://amr-review.org/) was published in 2016. This independent review, which included a focus on economic aspects of AMR, was commissioned in 2014 by the previous Prime Minister. The UK government also published its formal response to the review in 2016 setting out how the recommendations would be taken forward: https://www.gov.uk/government/publications/government-response-the-review-on-antimicrobial-resistance.

For public health, the UK government has committed to reducing both healthcare associated Gram-negative bloodstream infections and inappropriate antibiotic prescribing, by 50% by 2020.

For animal health, the highest profile government commitments are around the introduction of targets for the reduction of antibiotic use in animals and strengthening stewardship in animals of antibiotics which are of greatest importance to human health. As set out in the UK's Five Year AMR Strategy: high levels of animal health and welfare and good disease control are essential factors in underpinning the success of these ambitions in a long-term and sustainable way.

Avian and animal influenza

Infection in humans

There were no human cases reported in the UK in 2016.

Infection in animals

Since late October 2016 and until the end of the year, highly pathogenic avian influenza (HPAI) of the subtype H5N8 (Eurasian strain) has been detected in wild migratory or captive birds in 18 Member States; namely Austria, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Romania, Slovakia, Sweden, Switzerland and the United Kingdom. In most Member States the virus has spilled over to poultry holdings leading also to lateral spread

between holdings in a few Member States, in particular in those with a high density of duck and geese holdings where the poultry cannot sufficiently be protected against contact with wild birds. In the UK, one outbreak in commercial poultry in England as well as a small number of findings in wild migratory wild birds were reported by the end of the year. In addition, a backyard or small holding in Wales became infected with HPAI in very late 2016, although disease was not confirmed on this site until 2017.

The number of infected migratory wild birds found dead, the geographical extent of these findings and the wide variety of species involved pose an immense threat for virus introduction into poultry or captive birds holdings as demonstrated by the high number of outbreaks (nearly 400 by the end of the year) in the EU alone.

The UK, and wider within the EU, have tried and tested disease response capability, good knowledge, legislation, technical and financial tools to effectively deal with outbreaks of avian influenza in poultry and captive birds. However, the very wide virus spread by wild birds and the increased risk of direct or indirect virus introduction into poultry or captive bird holdings has led to the largest HPAI epidemic in the EU so far. This situation calls for a reflection and evaluation of how preparedness, risk assessment, early detection and control measures could be improved.

All epidemiology reports relating to the UK outbreaks are available:
https://www.gov.uk/government/publications/reports-relating-to-recent-cases-of-avian-influenza-bird-flu

Scottish LPAI H5N1 incident, January 2016:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/508890/ai-outbreak-dunfermline-epidemiology.pdf

England HPAI H5N8 incident, December 2016:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/630442/ai-epi-report-may-2017.pdf

Wild bird incidents of HPAI, including 2016 diagnoses in GB:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/636054/ai-findings-1617.csv/preview

Bovine tuberculosis (*Mycobacterium bovis*)

Infection in humans

Tuberculosis in England, 2016 report:
https://www.gov.uk/government/publications/tuberculosis-in-england-annual-report

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

Infection in animals

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

GB TB data used for this report (accessed 18th August 2017):
https://www.gov.uk/government/statistical-data-sets/tuberculosis-tb-in-cattle-in-great-britain

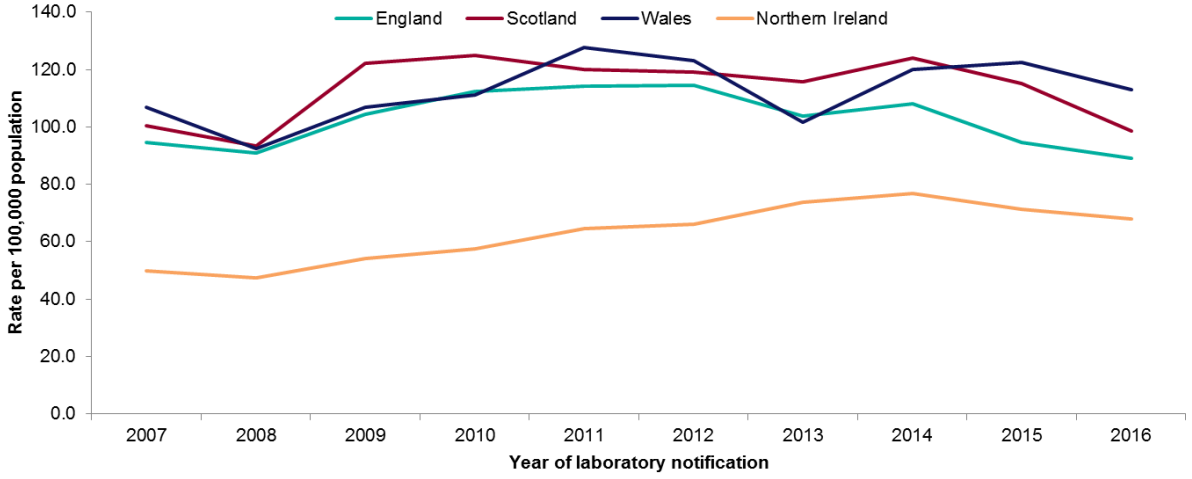
Campylobacteriosis (*Campylobacter spp.)*

Infection in humans

The reporting rate for *Campylobacter* has decreased in the UK from 96.9 per 100,000 population in 2015 to 90.8 per 100,000 in 2016. Every country reported fewer cases in 2016 than in 2015, with the largest decrease in reporting rate in Scotland. The rate of reported *Campylobacter* infections in England over the last decade has decreased to the lowest reported since 2008, and remains below the rate observed in Wales and Scotland (Figure 1). Northern Ireland continues to report rates lower than the rest of the UK (67.9 cases per 100,000 population).

Reporting rates of *Campylobacter* vary year on year, therefore any increase or decrease should be interpreted with caution as this may represent normal fluctuation in reporting rates.

Figure 1. Rate of reported *Campylobacter* infections by country per 100,000 population, 2007 to 2016



Infection in animals

Additional information on diagnoses of campylobacter in GB made by APHA and SRUC during 2016 is available: https://www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2016

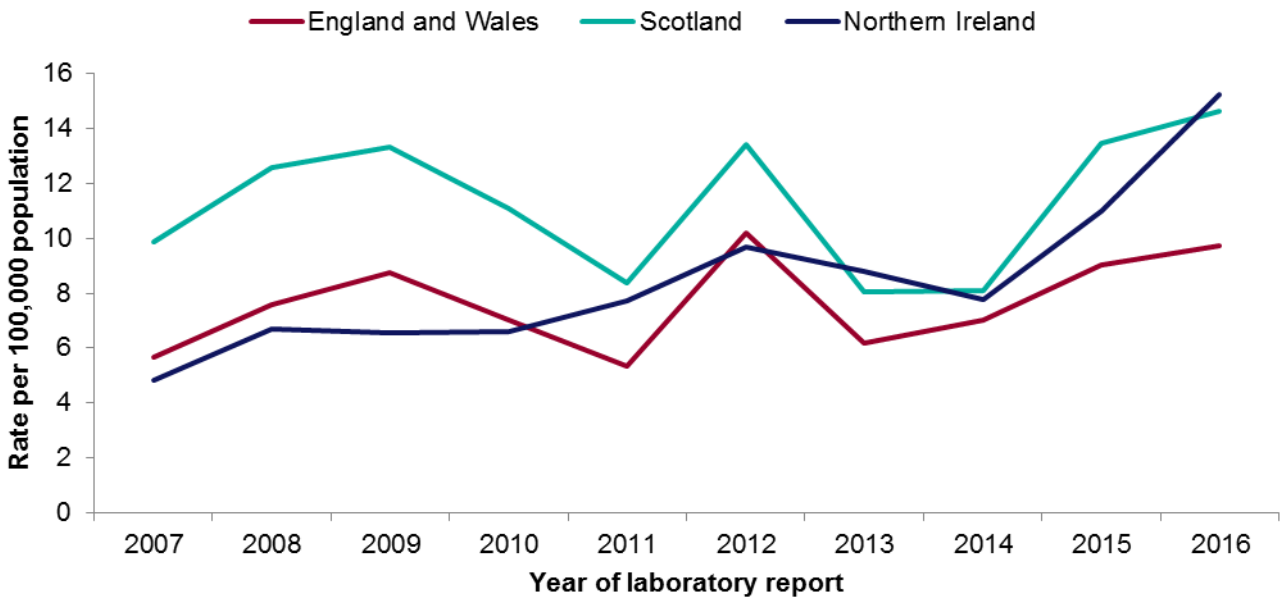
Cryptosporidiosis (*Cryptosporidium spp.)*

Infection in humans

The number of cases reported in the UK in 2016 was 6,711 (reporting rate 10.3 per 100,000 population), continuing the upward trend in reporting rate seen in 2015, compared to the previous two years, although still marginally less than the reporting rate seen in 2012 (10.4 cases per 100,00 population) (Figure 2). Much of the increase in 2016 was due to an increase in reports of indigenously acquired *C. hominis*.

There were no reports of foodborne outbreaks of *Cryptosporidium* in 2016. There were however 13 non-foodborne associated outbreaks, involving 120 laboratory confirmed cases. Of these, seven outbreaks were associated with recreational water activities (all swimming pools), five were associated with direct animal contact and one associated with an outdoor event.

Figure 2. Rate of reported *Cryptosporidium* infections by country per 100,000 population, 2007 to 2016



Infection in animals

Additional information on diagnoses of cryptosporidiosis in GB made by APHA and SRUC and investigations undertaken on 3 farms following human cases with possible animal association during 2016 is available:
https://www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2016

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

Hantavirus

There were no human cases diagnosed in 2016.

Leaflet on reducing the risk of human infection from pet rodents:
https://www.gov.uk/government/publications/pet-rats-mice-hamsters-reducing-the-risk-of-infection

Hantavirus risk assessment (Feb 2016):
https://www.gov.uk/government/publications/hairs-risk-assessment-hantavirus

Leptospirosis (*Leptospira interrogans serovars*)

Infection in humans

There were 72 human cases diagnosed in 2016. This is relatively consistent with the number of cases reported in 2014 and 2015.

Infection in animals

Additional information on diagnoses in GB made by APHA and SRUC during 2016 is available:
https://www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2016

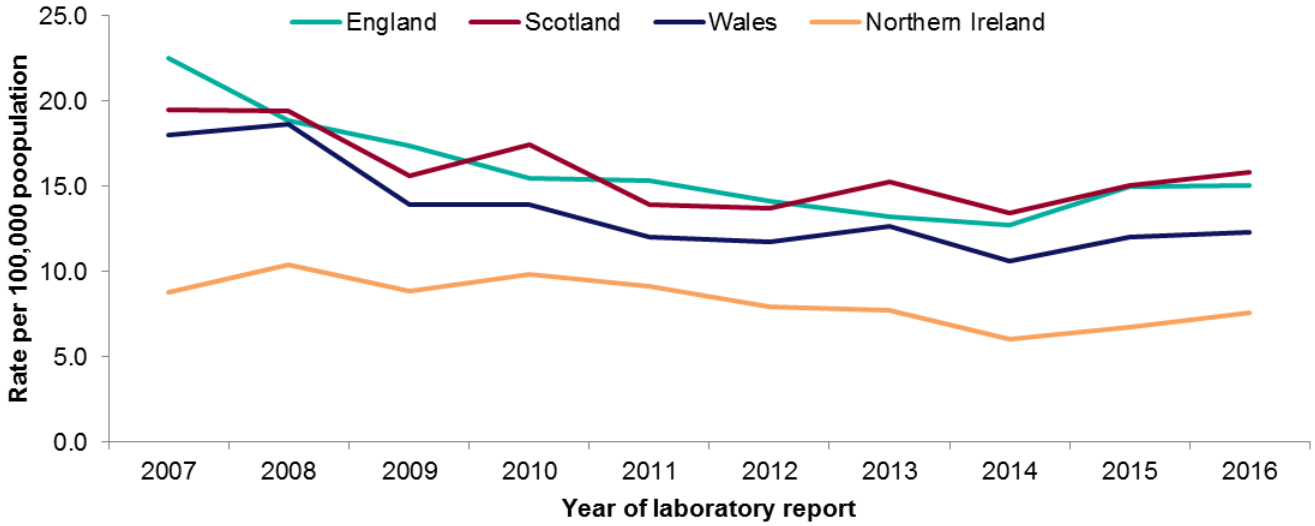
Salmonellosis (*Salmonella* spp)

Infection in humans

There were 10,341 reports of non-typhoidal *Salmonella* in 2016, an increase from the 9,492 reported in 2015, and a significant increase in reports compared to 2014 (8,078). An increase in the reporting rate was seen in all constituent countries (Figure 3).

The increase in reports of *Salmonella* in the UK over the last two years compared to previous years is considered to be at least partly due to the change in laboratory reporting systems in England and Wales between the end of 2014 and subsequent years with the introduction of the Second Generation Surveillance System (SGSS). Therefore direct comparisons between data reported since 2015 and previous years may require cautious interpretation.

Figure 3. Rate of reported non-typhoidal *Salmonella* infections by country per 100,000 population, 2007 to 2016



The most commonly reported serovar in England, Wales and Scotland was *S.* Enteritidis while in Northern Ireland it was *S.* Typhimurium (Table 1). Together *S.* Enteritidis and *S.* Typhimurium constituted 49% of all non-typhoidal salmonellae reported in the United Kingdom in 2016.

Reports of *S.* Enteritidis decreased in the UK in 2016 (2,760) compared to 2015 (2,857), due to a decrease in cases reported in England (reporting rate of 4.3 per 100,000 population in 2015 compared to 4.0 per 100,000 in 2016) and Northern Ireland (reporting rate of 2.6 per 100,000 population in 2015 compared to 1.9 per 100,000 in 2016). Increases were seen in Wales and Scotland from 2015 with Scotland reporting the largest increase in reporting rate rising from 5.9 to 6.9 per 100,000 population.

Reports of *S.* Typhimurium marginally increased in the UK in 2016 (1,953) compared to 2015 (1,878). An increase in the reporting rate of *S.* Typhimurium was seen in England (from 2.3 per 100,000 in 2015 to 3.1 per 100,000 in 2016) and Northern Ireland (from 1.6 per 100,000 in 2015 to 2.8 per 100,000 in 2016), while the reporting rate decreased in Wales (from 2.6 per 100,000 in 2015 to 2.0 per 100,000 in 2016) and Scotland (from 2.5 per 100,000 in 2015 to 2.4 per 100,000 in 2016).

Table 1. Number of the ten most common non-typhoidal *Salmonella* serovars isolated, by country, 2016

England		Wales		Scotland		Northern Ireland	
Serovar	n	Serovar	n	Serovar	n	Serovar	n
Enteritidis	2215	Enteritidis	141	Enteritidis	369	Typhimurium	51
Typhimurium	1711	Typhimurium	63	Typhimurium	128	Enteritidis	35
Newport	226	Infantis	13	Group B†	28	Infantis	7
Braenderup	179	Stanley	12	Stanley	20	Oranienburg	3
Infantis	173	Newport	10	Virchow	20	Agona	3
Stanley	142	Braenderup	9	Agona	19	Bredeney	2
Agona	141	Agona	7	Braenderup	15	Hadar	2
Kentucky	136	Arizonae	6	Infantis	15	Newport	2
Bareilly	126	Bareilly	6	Java	13	Stanley	2
Virchow	125	Saint-Paul	6	Group C1‡	12	*	

†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.
*No other serovars have more than one case reported

The serovars with the highest proportion of cases having foreign travel reported on their laboratory forms were *S.* Kentucky and *S.* Stanley (55% reported travel). A greater proportion of *S.* Enteritidis cases reported travel than *S.* Typhimurium cases (34% versus 17%).

While all *Salmonella* isolates received at the PHE reference laboratory undergo whole genome sequencing, currently approximately 65% of *Salmonella* isolates are routinely analysed using single neucleotide polymorphism (SNP) typing.

Infection in animals

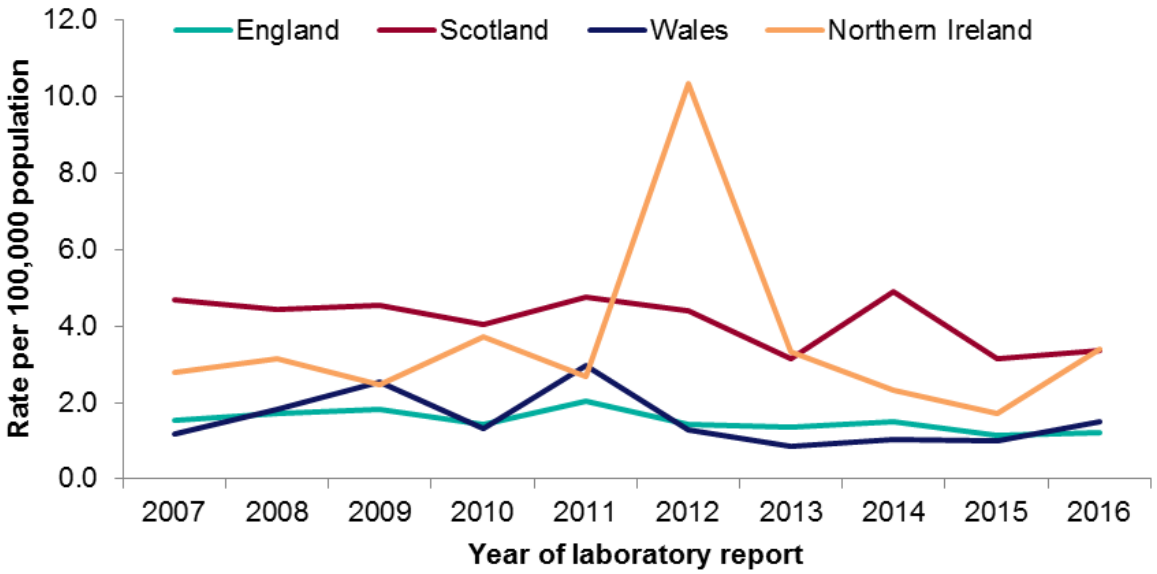
A description of *Salmonella* data collection and reporting in animals in GB is included in the Salmonella in Livestock Report: https://www.gov.uk/government/publications/salmonella-in-livestock-production-in-great-britain-2016

Shiga toxin producing *Escherichia coli* (STEC)

Infection in humans

Reports of STEC O157 in the UK increased from 863 cases in 2015 to 962 cases in 2016, half of which were in England (Figure 4). Increases were seen in all countries, with the largest increase in reporting rate in Northern Ireland, where nearly two times more cases were reported in 2016 compared to 2015.

Figure 4. Rate of reported STEC O157 infections by country per 100,000 population, 2007-2016



In 2016 there were 533 laboratory confirmed cases of STEC other than serogroup O157 (non-O157 STEC) confirmed in the UK. The burden of disease due to non-O157 STEC in the UK is underestimated when compared to STEC O157 due to diagnostic bias. Considering this caveat, O26 is the most commonly detected serogroup in the UK after O157. Recent changes in diagnostic techniques at front-line laboratories in the UK have improved detection of non-O157 STEC resulting in a notable increase in reports compared to previous years. In Northern Ireland, the number of non-O157 STECs detected in 2014 and 2015 were significantly higher than the number of O157 STECs detected. This is consistent with the picture in the Republic of Ireland, where serogroups other than O157 (mainly O26) now predominate.

In total, nine outbreaks of STEC in the UK affecting a total of 272 cases were reported in 2016. Five outbreaks were foodborne associated and there were a further four outbreaks that were non foodborne or not specified as follows:

- two petting farm outbreaks
- one outbreak with cases dispersed across the UK where no common source was identified
- one localised outbreak involving serogroup O55 in England was investigated but no common source of infection was determined. This was a recurrence of a strain previously identified and investigated in 2014 – 2015: http://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2017.22.36.30610

Infection in animals

Information regarding STEC outbreak investigations is given in the APHA non-statutory zoonoses reports: https://www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2016

Table 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 (eg 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

Table 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	Main species	Last Occurred in UK[1]	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	2016	✓	S
Bovine Spongiform Encephalopathy	Cattle	2015	✓	
Brucellosis (*Brucella abortus*)	Cattle[2]	2004 GB/ 2012 NI[3]	✓	✓
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

[1] Figures taken are correct as at 31st December 2016.
[2] 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.
[3] NI granted OBF status in 2015, last case identified in 2012; outbreak in Scotland in 2003 and Cornwall, England in 2004.

Glanders & Farcy (*Burkholderia mallei*)	Horses	1928	✓	S
Newcastle disease and paramyxovirus infection	Poultry and pigeons	2006	✓	S
Psittacosis (Ornithosis)	Poultry	Present	Ornithosis (incls. psittacosis) notifiable in Northern Ireland in poultry [4]	
Rabies (Terrestrial)	Dogs and other mammals	1970[5]	✓	S
Rabies (EBLV)	Bats	2016[6]	✓	S
Rift Valley fever	Cattle, sheep and goats	Never	✓	S
Salmonella	All species	Present	Salmonella, when carried in animals or poultry, which the Department considers to be a risk to human health, is notifiable in Northern Ireland	✓
Trichinella	Pigs, horses and other mammals	Present in wildlife[7]		S
Tuberculosis (*Mycobacterium bovis*)	Domestic cattle, buffalo, bison and deer	Present[8]	✓[9]	✓
Vesicular stomatitis virus (VSV)	Cattle/ other mammals	Never	✓	S
West Nile virus	Horses	Never	✓	S

[4] 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.

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

[6] European bat Lyssavirus type 2 was isolated from two Daubenton's bats in different areas of England in 2016.

[7] *Trichinella* is known to be present in wildlife in Northern Ireland. This follows the identification in Northern Ireland of a single fox positive for *Trichinella spiralis* in 2007 and again in 2009 during wildlife surveillance. A positive fox was found in England in 2013 (*Trichinella pseudospiralis*). An extensive investigation of wildlife and the epidemiology of the *Trichinella* species by the FSA identified no further cases showing this to be an isolated case. SAPO only refers to *T. spiralis.*

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

[9] 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.

Table 3: Laboratory-confirmed cases of zoonotic disease in humans, 2007 to 2016[10]

United Kingdom

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*
Anthrax	0	1	13	39	0	5	2	0	0	0
Avian Influenza	4	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	24	23	29	36	39	39	30	39	42	39
Brucellosis	15	15	18	12	25	14	14	11	12	17
Campylobacteriosis	57,908	55,617	65,077	70,229	72,112	72,588	66,558	70,540	63,292	59,105
Cryptosporidiosis	3,668	4,937	5,647	4,604	3,573	6,655	4,111	4,598	6,149	6,722
Hantavirus	1	0	0	1	0	2	3	4	4	0
Hepatitis E [**¥]	166	180	178	381	555	793	942	1,265	1,409	1,466
Leptospirosis	81	76	56	42	52	78	50	78	68	76
Listeriosis	254	207	234	179	165	185	178	188	189	203
Lyme disease	1,027	1,098	1,093	1,213	1,189	1,249	1,118	1,081	1,262	1,310
Pasteurellosis	457	497	559	586	668	666	717	776	855	815
Psittacosis	39	63	60	58	41	37	30	32	24	20
Q fever	72	67	31	55	114	124	47	61	21	34
Rabies 'classical'	0	1	0	0	0	1	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	13,279	11,517	10,486	9,692	9,395	8,792	8,461	8,078	9,485	10,341
STEC O157	1,120	1,247	1,315	1,052	1,484	1,260	1,015	1,186	867	963
Non-O157 STEC	25	36	45	44	37	59	100	306	372	533
Streptococcus suis	2	7	2	4	1	3	3	3	4	1
Taeniasis	101	100	72	114	94	70	80	71	85	74
Toxocariasis	1	2	4	12	4	7	3	5	6	6
Toxoplasmosis	146	457	494	414	364	328	325	370	371	352
Trichinellosis	0	0	0	1	0	0	0	1	0	0
vCJD[11]‡	5	2	3	3	5	0	1	0	0	1
Yersiniosis	78	62	62	54	55	55	60	65	44	87

* Provisional data
** Data has been updated following a data cleaning exercise. SGSS data has been included for England and Wales from 2010 onwards.
‡ Data source: NCJDRSU

[10] Not a definitive list of the zoonotic pathogens reported each year, but covers zoonotic diseases reported annually in the UK Zoonoses Report.
[11] 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: Five cases of Hydatid disease were reported in Scotland in 2016 and no cases were reported in Northern Ireland. Data from England and Wales are not available due to inconsistencies in surveillance data provided to PHE. This is being addressed and the data will be published as soon as the quality can be assured.

England and Wales

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*
Anthrax	0	1	0	5	0	4	1	0	0	0
Avian Influenza	4[12]	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	22	17	21	31	30	33	24	35	35	35
Brucellosis	8	5	13	11	17	9	12	10	11	17
Campylobacteriosis‡	51,831	49,891	57,685	62,588	64,572	65,044	59,040	62,494	55,697	52,528
Cryptosporidiosis	3,073	4,162	4,831	3,901	2,990	5,765	3,520	4,023	5,222	5,654
Hantavirus	1	0	0	1	0	2	3	3	4	0
Hepatitis E ¥	162	176	175	368	539	715	846	1,063	1,213	1,243
Leptospirosis	74	62	52	39	44	72	47	76	63	72
Listeriosis	226	181	213	160	148	167	160	169	170	184
Lyme disease**	797	813	863	905	959	1,040	936	856	1,060	1,136
Pasteurellosis	392	438	455	466	538	535	581	602	641	606
Psittacosis	38	62	58	53	40	27	29	25	22	17
Q fever[13]	64	55	27	52	106	112	45	56	19	33
Rabies 'classical'	0	0	0	0	0	1[14]	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	12,094	10,321	9,482	8,573	8,492	7,919	7,493	7,250	8,558	9,363
STEC O157	828	950	1,034	773	1,182	837	787	883	665	719
Non-O157 STEC	6	11	15	9	12	22	47	169	211	295
Streptococcus suis	1	7	1	3	0	3	1	3	4	0
Taeniasis	99	95	70	108	90	65	74	65	70	64
Toxocariasis	1	1	1	7	0	5	3	4	3	0
Toxoplasmosis	104	405***	422	345	341	311	311	344	342	335
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis (non-pestis)	55	39	47	47	51	44	52	58	39	76

* 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 2010 onwards to show the trend of local HEV testing

[12] H7N2
[13] Acute and chronic infections
[14] A UK National who visited India

Northern Ireland

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*
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	1	2	1	1	2	0	4	2	5	3
Brucellosis	5	10	4	0	2	2	0	0	1	0
Campylobacteriosis	885	848	977	1,040	1,175	1,211	1,355	1,414	1,320	1,258
Cryptosporidiosis	85	119	118	119	140	177	161	143	204	282
Hantavirus	0	0	0	0	0	0	0	0	0	0
Hepatitis E	0	0	0	0	1	0	1	9	10	18
Leptospirosis	1	1	0	0	3	2	2	0	2	1
Listeriosis	5	11	4	2	3	7	2	4	6	4
Lyme disease	0	0	2	0	1	2	6	1	2	4
Pasteurellosis	3	2	7	0	1	2	3	1	2	1
Psittacosis	0	0	0	0	0	0	0	0	0	0
Q fever	5	11	2	0	1	1	0	0	0	0
Rabies 'classical'	0	1[15]	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	0	0
Salmonellosis (non-typhoidal)	155	185	158	178	166	145	155	111	124	140
STEC O157	49	56	44	67	49	189[16]	61	40	32	63
Non-O157 STEC	0	0	0	0	0	2	1	62[17]	120[17]	175[17]
Streptococcus suis	0	0	0	0	0	0	0	0	0	0
Taeniasis	0	0	0	0	0	1	0	0	0	0
Toxocariasis	0	0	0	0	0	0	0	0	0	1
Toxoplasmosis	2	4	3	2	0	0	0	0	0	0
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis	1	0	0	0	0	0	1	3	0	2

* Provisional data

[15] UK national who visited South Africa
[16] 142 of these cases were associated with one outbreak
[17] Includes PCR/culture results and all specimen types

Scotland

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*
Anthrax	0	0	13	34	0	1	1	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	0
Mycobacterium bovis	1	4	7	4	7	6	2	2	2	1
Brucellosis	2	0	1	1	6	3	2	1	0	0
Campylobacteriosis	5,192	4,878	6,415	6,601	6,365	6,333	6,163	6,632	6,275	5,319
Cryptosporidiosis	510	656	698	584	443	713	430	432	723	786
Hantavirus	0	0	0	0	0	0	0	1	0	0
Hepatitis E	4	4	3	13	15	78	95	193	186	205
Leptospirosis	6	13	4	3	5	4	1	2	3	3
Listeriosis	23	15	17	17	14	11	16	15	13	15
Lyme disease	230	285	228	308	229	207[18]	176	224	200	170
Pasteurellosis	62	57	97	120	129	129	133	173	212	208
Psittacosis	1	1	2	5	1	10	5	7	2	3
Q fever	3	1	2	3	7	11	2	5	2	1
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)	1,030	1,011	846	941	737	728	813	717	803	838
STEC O157	243	241	237	212	253	234	167	263	170[1]	181[3]
Non-O157 STEC	19	25	30	35	25	35	52	75	78[2]	63[4]
Streptococcus suis	1	0	1	1	1	0	2	0	0	1
Taeniasis	2	5	2	6	4	4	6	6	15	10
Toxocariasis	0	0	3	4	4	2	0	0	3	5
Toxoplasmosis	40	48	69	67	23[19]	17	14	26	29	17
Trichinellosis	0	0	0	1	0	0	0	1	0	0
Yersiniosis (non-pestis)	22	23	15	7	4	11	7	4	5	9

* 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

[18] From 2012, reporting changed to acute cases only
[19] From 2011, reporting changed to acute cases only

Table 4: Government laboratory-confirmed cases or incidents of zoonotic infection in animals, 2007 to 2016

United Kingdom [A]

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthrax	0	0	0	0	0	0	0	0	1	0
Avian Influenza	1	2	0	0	0	0	0	1	1	2
New TB incidents in cattle herds	5,454	6,286	5,893	5,881	6,300	6,810	6,292	6,115	6,534	6,243
M. bovis isolates in non-bovine animals (excludes badgers)	77	123	156	142	142	99	138	134	146	142
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	146	107	149	144	140	16	26	16	7	15
Brucella abortus	151	177	71	74	21	23	26	8	0	0
Brucella melitensis	0	0	0	0	0	0	0	0	0	0
Brucella spp (in marine mammals)	11†	10†	7†	7†	9†	13†	6†	5	10†	11
BSE	60	35	11	11	7	3	3	1	2	0
Campylobacter	251	186	164	280	178	144	259	185	265	198
Chlamydiosis (*Chlamydia abortus*) fetopathy	553	372	406	397	447	539	331	446	336	417
Cryptosporidiosis	1,043 #	1,311†	1,436	1,768	1,381	1,896	1,874	1,374	1,191	960
Hydatid	0	0	0	0	0	0	1	0	0	0
Leptospirosis	197	238	89	113	50	85	69	59	34	30
Listeriosis	152	216	196	237	165	219	201	206	157	209
Orf	48	44	38	41	36	49	56	31	43	45
Pasteurella multocida	336†	394	540	510	464	379	531	390	384	385
Psittacosis (*C. psittaci*)	2	1	3	8	0	2	2	1	0	1
Q fever	4	5	3	5	8	6	3	4	8	12
Rabies 'classical'	0	1	0	0	0	0	0	0	0	0
Rabies EBLV	1	2	1	0	0	0	0	1	1	2
Salmonella (all types)	2,352	2,311	2,672	3,513	2,961	3,344	3,321	2,691	3,055	3,221
Streptococcus suis	100	132	115	139	124	96	146	157	158	246
Swine Influenza	10	16	18	40	37	38	33	32	28	31
Toxoplasmosis	424	257	232	267	189	348	444	275	298	301
Trichinellosis	1	0	1	0	0	0	1	0	0	0
Yersiniosis	24†	32†	37	23	44	50	82	169	143	166

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

England [A]

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthrax	0	0	0	0	0	0	0	0	1	0
Avian Influenza	1	2	0	0	0	0	0	1	1	1
New TB incidents in cattle herds	3,196	3,766	3,363	3,632	3,802	3,919	3,890	3,804	3,964	3,752
M. bovis isolates in non-bovine animals (excludes badgers)	68†	119†	144†	134†	133†	98†	132	132†	141	130
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	104†	77†	122†	130†	140†	14	21	8	7	8
Brucella abortus	0	0	0	0	0	0	0	0	0	0
Brucella melitensis	0	0	0	0	0	0	0	0	0	0
Brucella spp (in marine mammals)	0	6	4	0	1	7	0	2	0	2
BSE	32	24	8	11	5	2	1	1	1	0
Campylobacter	125	94	93	148	93	73	129	105	182*	150† & 32*
Chlamydiosis (*Chlamydia abortus*) fetopathy	263	201	219	215	226	260	166	220	296†	366†
Cryptosporidiosis	N/A	1,311†	1,346†	1,674†	1,095†	650	681	549	762†	550†
Hydatid	0	0	0	0	0	0	0	0	0	0
Leptospirosis	45	16	5	8	3	15	1	1	2	9†
Listeriosis	132†	191†	177†	215†	146†	85	180†	151†	121†	184†
Orf	29	26	26	29	20	30	35	18	43†	43†
Pasteurella multocida	336†	281†	319†	368†	316†	116	319†	279†	253†	194†
Psittacosis (*C. psittaci*)	1	0	1	4	0	1	1	1	0	1†
Q fever	4	3	3	5	3	5	3	4	7	12†
Rabies 'classical'	0	1	0	0	0	0	0	0	0	0
Rabies EBLV	1	2	0	0	0	0	0	1	0	2
Salmonella (all types)	1,948 *	1,729*	2,198*	3,044*	2,392*	2,739*	2,685*	2,263†	2,783†	2,845†
Streptococcus suis	67	96	83	94	94	66	100†	90†	110†	147†
Swine Influenza	9	16	13	31	34	36	33	27	25	31
Toxoplasmosis	166	93	115	101	84	146	132	212†	248†	234†
Trichinellosis	0	0	0	0	0	0	1	0	0	0
Yersiniosis	24†	32†	33†	15†	22†	8	7	22†	17†	10†

[A] The key to the UK and individual nation's data appears as the final table at the end of this section.
† GB data.
* England and Wales data.

Northern Ireland [A]

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	0
New TB incidents in cattle herds	1,264	1,274	1,293	1,160	1,386	1,695	1479	1,397	1,688	1,739
M. bovis isolates in non-bovine animals (excludes badgers)	9	4	12	8	9	1	0	2	1	3
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	42	30	27	14	0	0	0	0	0	3
Brucella abortus [A] - number of reactor herds per year and confirmed infected herds	151 53	177 34	71 13	74 25	21 4	23 1	26 0	8 0	0 0	0
Brucella melitensis	0	0	0	0	0	0	0	0	0	0
Brucella spp (in marine mammals)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0
BSE	14	4	3	0	2	1	0	0	0	0
Campylobacter	36	35	15	46	25	35	35	13	19	12
Chlamydiosis (*Chlamydia abortus*) fetopathy	40	36	39	55	61	68	51	56	40	51
Cryptosporidiosis	N/A	N/A	90	94†	286†	736†	668†	404†c	429	410
Hydatid	0	0	0	0	0	0	0	0	0	0
Leptospirosis	106	199	84	105	46	70	65	56	29	21
Listeriosis	20	25	19	22	19	45	21	55	36	25
Orf	3	1	1	1	1	0	3	2	0	2
Pasteurella multocida	N/A	113	221	142	148	140	212	111	131	191
Psittacosis (*C. psittaci*)	0	0	0	0	0	0	0	0	0	0
Q fever	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)	223	382	252	345	354	426	503	428	272	376
Streptococcus suis	17	10	14	21	12	19	46	67	48	99
Swine Influenza	0	0	5	4	0	0	0	5	3	0
Toxoplasmosis	54	64	44	51	45	100	229	63	50	67
Trichinellosis	1	0	1	0	0	0	0	0	0	0
Yersiniosis	N/A	N/A	4	8	22	34	72	147*	126	156

[A] The key to the UK and individual nation's data appears as the final table at the end of this section.
† Data only includes isolations from cattle and sheep.
†c Data only includes isolations from cattle.
*Marked increase is a consequence of 2014 being the first full year of using selective media at AFBI, making Yersinia detection much easier.

Scotland [A]

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	1
New TB incidents in cattle herds	58	47	49	45	43	54	28	47	40	37
M. bovis isolates in non-bovine animals (excludes badgers)	68†	119†	144†	134†	133†	98†	0	132†	0	0
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	104†	77†	122†	130†	140†	2	5	4	0	1
Brucella abortus	0	0	0	0	0	0	0	0	0	0
Brucella melitensis	0	0	0	0	0	0	0	0	0	0
Brucella spp (in marine mammals)	11	4	3	7	8	6	6	3	9	9
BSE	7	1	0	0	0	0	0	0	0	0
Campylobacter	44	35	39	47	34	25	55	36	64	150† + 4
Chlamydiosis (*Chlamydia abortus*) fetopathy	140	65	66	52	79	103	53	76	296†	366†
Cryptosporidiosis	N/A	1311†	1346†	1674†	1095†	309	319	212	762†	550†
Hydatid	0	0	0	0	0	0	0	0	0	0
Leptospirosis	41	22	0	0	0	0	3	2	2	9†
Listeriosis	132†	191†	177†	215†	146†	59	180†	151†	121†	184†
Orf	8	10	6	8	7	8	13	7	43†	43†
Pasteurella multocida	336†	281†	319†	368†	316†	99	319†	279†	253†	194†
Psittacosis (*C. psittaci*)	1	1	1	4	0	1	1	0	0	1†
Q fever	0	0	0	0	0	0	0	0	0	12†
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	1	0	0	0	0	0	0	0
Salmonella (all types)	181	200	222	124	215	179	133	2,263 †	2,783 †	2,845 †
Streptococcus suis	14	26	17	22	18	8	100†	90†	110†	147†
Swine Influenza	1	0	0	5	3	2	0	0	0	0
Toxoplasmosis	142	68	52	91	31	66	46	212†	248†	234†
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis	24†	32†	33†	15†	22†	8	1	22†	17†	10†

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

Wales [A]

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthrax	0	0	0	0	0	0	0	0	0	0
Avian Influenza	0	0	0	0	0	0	0	0	0	0
New TB incidents in cattle herds	935	1,198	1,186	1,039	1,046	1,109	877	858	836	709
M. bovis isolates in non-bovine animals (excludes badgers)	68†	119†	144†	134†	133†	98†	6	132†	4	9
Mycobacterium species in non-bovine animals (excluding *M. bovis*)	104†	77†	122†	130†	140†	0	0	4	0	3
Brucella abortus	0	0	0	0	0	0	0	0	0	0
Brucella melitensis	0	0	0	0	0	0	0	0	0	0
Brucella spp (in marine mammals)	0	0	0	0	0	0	0	0	1	0
BSE	7	6	0	0	0	0	2	0	1	0
Campylobacter	46	22	17	39	26	11	40	31	182*	150† + 32*
Chlamydiosis (*Chlamydia abortus*) fetopathy **	110	70	82	75	81	108	61	94	296†	366†
Cryptosporidiosis	N/A	1311†	1346†	1674†	1095†	201	206	209	762†	550†
Hydatid	0	0	0	0	0	0	1	0	0	0
Leptospirosis	5	1	0	0	1	0	0	0	1	9†
Listeriosis	132†	191†	177†	215†	146†	30	180†	151†	121†	184†
Orf	8	7	5	3	8	11	5	4	43†	43†
Pasteurella multocida	336†	281†	319†	368†	316†	24	319†	279†	253†	194†
Psittacosis (*C. psittaci*)	0	0	1	0	0	0	0	0	0	1†
Q fever	0	2	0	0	5	1	0	0	1	12†
Rabies 'classical'	0	0	0	0	0	0	0	0	0	0
Rabies EBLV	0	0	0	0	0	0	0	0	1	0
Salmonella (all types)	1,948*	1,729*	2,198*	3,044*	2,392 *	2,739*	2,685*	2,263 †	2,783 †	2,845 †
Streptococcus suis	2	0	1	2	0	3	100†	90†	110†	147†
Swine Influenza	0	0	0	0	0	0	0	0	0	0
Toxoplasmosis	62	32	21	24	29	36	37	212†	248†	234†
Trichinellosis	0	0	0	0	0	0	0	0	0	0
Yersiniosis	24†	32†	33†	15†	22†	0	2	22†	17†	10†

[A] The key to the UK and individual nation's data appears as the final table at the end of this section.
† GB data.
* England and Wales data.

Key to Table 4

The tables in Table 4 are not intended to provide a definitive list of all zoonotic pathogens, but include those for which data are available (notifiable/reportable and those recorded by 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 2016 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 (i.e. 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 test or had a tuberculous animal disclosed by routine meat inspection at slaughter, during the period shown. (Figures for Wales also include incidents where OTF status has been withdrawn for epidemiological reasons only). Data for GB countries for new TB incidents in cattle herds included in the relevant tables in table 4 is not directly comparable across the individual tables. 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. Prior to 2008 a different data system was in use and the data produced is not exactly comparable with the statistics produced from Sam. In addition the overall UK totals are not the sum of the number of new incidents in each national table as a balancing amount is included in the overall GB total for cases where the exact region is unknown, and is therefore only reflected in this UK figure. This balancing amount in 2016 was six, eight in 2015, nine in 2014, 18 in 2013, 33 in 2012, 23 in 2011, five in 2010, two in 2009, one in 2008 and one in 2007.								
***M. bovis* isolates in non-bovine animals** (excludes badgers)								
Mycobacterium in non-bovine animals (excluding *M. bovis*)								
Brucella abortus	Confirmed cases are statutorily reportable under Zoonoses Order 1989.							
Brucella melitensis								
***Brucella* spp.** (in marine mammals)								

Diagnosis	Cattle	Sheep	Goats	Pigs	Birds [1]	Misc.	Wildlife [2]
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 are 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).							
Rabies 'classical'							

Diagnosis	Cattle	Sheep	Goats	Pigs	Birds [1]	Misc.	Wildlife [2]
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 2016, 14 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).

Table 5: Food vehicles associated with foodborne gastrointestinal outbreaks in 2016 in the UK, in relation to *Campylobacter, Listeria monocytogenes, Salmonella*, and STEC

Food vehicle category	*Campylobacter*	*Listeria monocytogenes*	*Salmonella*	STEC**
Poultry meat	6	--	--	--
Red meat	--	--	1	2
Game	--	--	--	1
Crustacean & shellfish	--	--	--	--
Vegetables, Salads & fruits	--	--	1	1
Eggs & egg dishes	--	--	5	--
Milk & dairy product	--	--	--	1
Composite/Mixed foods	--	--	1	--
Unknown	2	--	4	--
Total*	8	0	12	5

* 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

**Outbreak data derived from both eFOSS and the National Enhanced Surveillance System for STEC (VeSSY) in England.

Table 6: Animal population

Number of livestock in the UK in 2016

	England*	Wales**	Scotland***	N. Ireland†	UK
Cattle #	5,438,645 Φ	1,159,901 Φ	1,689,269 Φ	1,664,592 Φ	9,952,407 Φ
Sheep	15,283,000	9,810,486	6,826,116	2,022,973 Φ	33,942,509 Φ
Pigs	3,911,000	23,204	330,206	601,101	4,865,593 Φ
Poultry	128,879,000	7,828,676	14,114,748	21,783,780	172,606,224
Goats	83,000	11,928	4,614	3,815 Φ	95,417 Φ
Farmed deer	21,000	992	7,005	2,444	31,441
Horses	177,000	45,492	35,719	10,294	268,069 Φ

Data sourced via the Radar Veterinary Surveillance database (Defra)
* obtained from the June 2016 England Agricultural Census
** obtained from the June 2016 Wales Agricultural Census
*** obtained from the June 2016 Scottish Agricultural Census
† Northern Ireland data provided by Department of Agriculture, Environment and Rural Affairs Northern Ireland, 2017 from Agriculture Survey for 2016 and APHIS records.
Φ data as provided to European Commission when reporting TB and Brucella survey results or to EFSA for the 2016 Trends and Sources report, but originally derived from the various data sources described above.

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 2016[20]

PFMA (Pet Food Manufacturers' Association) research shows that in 2016 40% of UK households owned at least one pet. This would be approximately 11 million households with pets, out of approximately 26 million UK households in total. The pet population stands at around 57 million.

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

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

The table below shows the estimated population of UK pets, as well as a breakdown of the most popular pets, in 2015-2016.

Species	Approximate number of pets (millions)
Dogs	8.5
Cats	7.5
Rabbits	0.8
Birds (indoor)	0.6
Guinea pigs	0.7
Hamsters	0.4
Outdoor fish	20
Indoor fish	16
Domestic fowl	0.5
Lizards	0.3

Appendix 1: 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
https://www.gov.uk/government/publications/non-statutory-zoonoses-disease-surveillance-reports-2016

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

European Food Standards Authority: EFSA FSA foodborne viruses workshop
http://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
https://www.food.gov.uk/science/research/foodborneillness/fs421009

Food Standard Agency: Measuring foodborne Illnesses levels
http://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
https://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
http://www.hps.scot.nhs.uk/giz/resourcedetail.aspx?id=1258

Health Protection Scotland: Outbreaks in Scotland in 2016
http://www.hps.scot.nhs.uk/outbreaks/

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

Joint Agency Guidelines for the Investigation of Zoonotic Disease (England and Wales) https://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 https://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 https://www.gov.uk/government/collections/gastrointestinal-infections-guidance-data-and-analysis

Public Health England: Zoonoses web pages https://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 http://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* O0157 http://www.wales.nhs.uk/sitesplus/888/page/43884

Appendix 2: Abbreviations and acronyms

AFBI	Agri-Food and Biosciences Institute
AI	Avian Influenza
AMR	Antimicrobial Resistance
APHA	Animal and Plant Health Agency
APHIS	Animal Public Health Information System
BRU	Brucella Reference Unit
BSE	Bovine Spongiform Encephalopathy
C-BSE	Classical Bovine Spongiform Encephalopathy
CoP	Code of Practice
DAERA	Department of Agriculture, Environment and Rural Affairs (Northern Ireland)
Defra	Department for Environment, Food and Rural Affairs
DH	Department of Health
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
EU	European Union
FSA	Food Standards Agency
FSS	Food Standards Scotland
GB	Great Britain (England, Wales, Scotland)
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
HSE	Health and Safety Executive
IMT	Incident Management Team
L-BSE	L-Type Bovine Spongiform Encephalopathy
LA	Local Authority

LPAI	Low Pathogenic Avian Influenza
NCJDRSU	National CJD Research & Surveillance Unit
NHS	National Health Service
NI	Northern Ireland
OBF	Officially Brucellosis Free
OIE	World Organisation for Animal Health
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
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (HSE)
RVPBRU	PHE Respiratory and Vaccine Preventable Bacteria Reference Unit
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
UK	United Kingdom (England, Wales, Scotland, Northern Ireland)
vCJD	Variant Creutzfeldt-Jakob Disease
VeSSY	National Enhanced Surveillance System for STEC
VIDA	Veterinary Investigation Diagnosis Analysis Database
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 3: 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
https://www.gov.uk/government/organisations/animal-and-plant-health-agency

Brucella reference unit (BRU)
Royal Liverpool and Broadgreen University Hospital, Prescott Street, Liverpool, L9 8XP
https://www.gov.uk/government/collections/brucella-reference-unit-bru

Cryptosporidium Reference Unit (PHE Collaborating Laboratory)
Public Health Wales, Microbiology Swansea, Singleton Hospital, Swansea, SA2 8QA
www.wales.nhs.uk/sites3/page.cfm?orgId=457&pid=25284

Department 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 5A, Nobel House, 17 Smith Square, London, SW1P 3JR
https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs

Department of Health
Richmond House, 79 Whitehall, London, SW1A 2NS
www.dh.gov.uk

Department of Health, Social Services & Public Safety (Northern Ireland)
Castle Buildings, Stormont, Belfast, BT4 3SJ
www.dhsspsni.gov.uk

Food Standards Agency (FSA)
Aviation House, 125 Kingsway, London, WC2B 6NH
www.food.gov.uk

Food Standards Scotland (FSS)
4th floor, Pilgrim House, Aberdeen, AB11 5RL
http://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
http://www.thehtd.org/

National Leptospirosis Service
Public Health England
https://www.gov.uk/guidance/leptospira-reference-unit-services

National Lyme Disease Testing Service (Scotland)
Microbiology department, Raigmore Hospital, Inverness, IV2 3UJ
http://www.hps.scot.nhs.uk/reflab/STRL.aspx

Public Health Agency (Northern Ireland)
18 Ormeau Avenue, Belfast, BT2 8HS
www.publichealth.hscni.net/

Public Health England (PHE)
PHE Colindale, 61 Colindale Avenue, London, NW9 5EQ
www.phe.gov.uk

Public Health Wales
Communicable Disease Surveillance Centre, Health Protection Division, The Temple of Peace and Health, Cathays Park, Cardiff, CF10 3NW
http://www.wales.nhs.uk/sitesplus/888/page/43899/

Rare and Imported Pathogens Laboratory, Porton
Public Health England Porton Down, Salisbury, Wiltshire, SP4 0JG
https://www.gov.uk/government/collections/rare-and-imported-pathogens-laboratory-ripl

Scotland's Rural College
West Mains Road, Edinburgh, EH9 3JG
http://www.sruc.ac.uk/

Scottish *E. coli* O157/VTEC Reference Laboratory (SERL)
Department of Laboratory Medicine, Royal Infirmary of Edinburgh, Edinburgh, EH16 4SA
http://www.hps.scot.nhs.uk/reflab/SERL.aspx

Scottish Government, Rural Directorate
Saughton House, Broom House Drive, Edinburgh, EH11 3XD
www.scotland.gov.uk

Scottish Parasite Diagnostic and Reference Laboratory
House-on-the-Hill, Stobhill Hospital, 133 Balornock Road, Glasgow, G21 3UW
http://www.nhsggc.org.uk/about-us/professional-support-sites/microbiology/scottish-microbiology-reference-laboratories/scottish-parasite-diagnostic-reference-laboratory/

Scottish *Salmonella* Reference Laboratory
North Glasgow University Hospitals NHS Trust, 133 Balornock Road, Glasgow, G21 3UW
http://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
http://www.hps.scot.nhs.uk/reflab/STRL.aspx

Toxoplasma Reference Unit (PHE Collaborating Laboratory)
Public Health Wales, Microbiology Swansea, Singleton Hospital, Swansea, SA2 8QA
www.wales.nhs.uk/sites3/page.cfm?orgId=457&pid=25359

Welsh Government (WG)
Cathays Park, Cardiff, CF10 3NQ
www.wales.gov.uk