Highlights in this issue:
- Equine influenza activity continues in the United Kingdom
- Summary of equine post mortem examinations conducted nationally
- Focus article: Strangles – a pathogenic legacy of the war horse

Important note:
The data presented in this report must be interpreted with caution, as there is likely to be some bias in the way that samples are submitted for laboratory testing. For example they are influenced by factors such as owner attitude or financial constraints or are being conducted for routine screening as well as clinical investigation purposes. Consequently these data do not necessarily reflect true disease frequency within the equine population of Great Britain.
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**ACKNOWLEDGEMENTS**
Introduction

Welcome to the third quarterly equine disease surveillance report for 2015 produced by Department for Food, Environment and Rural Affairs (DEFRA), British Equine Veterinary Association (BEVA), Animal & Plant Health Agency (APHA) and the Animal Health Trust (AHT). Regular readers will be aware that this report collates equine disease data arising from multiple diagnostic laboratories and veterinary practices throughout the United Kingdom giving a unique insight into equine disease occurrence on a national scale.

National disease occurrence

EQUINE HERPES VIRUS-1 (EHV-1) ABORTION

On 21st October 2015 an EHV-1 abortion was diagnosed on a stud in Sussex, England. The affected animal was a five-year-old vaccinated Thoroughbred mare. The positive diagnosis was made by qPCR on placental and fetal tissues confirmed by histopathology. Three other mares were in contact with the affected mare and all have been placed in isolation in accordance with the HBLB Codes of Practice.

On 26th October 2015 an EHV-1 abortion was also confirmed on a premises in Oxfordshire, England affecting a three-year-old Thoroughbred mare. The positive diagnosis was made by qPCR on placental and fetal tissues. Control measures were also undertaken in accordance with the HBLB Codes of Practice.

EQUINE INFLUENZA VIRUS (EI)

On 7th October 2015, a single case of EI was diagnosed on a premises in Kent, England with 20 resident horses. The affected horse was a four-year-old non-vaccinated Dutch Warmblood that presented with pyrexia, cough, mucopurulent nasal discharge and enlarged lymph nodes.

On 5th November 2015 a single case of EI was confirmed on a premises in East Sussex, England with approximately 30 animals housed there. The affected horse was an 11-year-old non-vaccinated Sports Horse mare that had arrived on the premises after being imported within the last week and presented with dry harsh cough, mucopurulent nasal discharge, lethargy and limb oedema on 1st November 2015.

On 13th November 2015 a single case of EI was diagnosed on livery premises in Staffordshire, England. The affected horse was a four-year-old non-vaccinated Thoroughbred-cross gelding that had arrived on the premises after being imported and presented with pyrexia, cough, mucopurulent nasal discharge, lethargy and lymph node swelling.

On 18th November 2015 a single case of EI was confirmed on a premises in Cheshire, England with 10 other resident horses. The affected horse was a seven-year-old non-vaccinated gelding that presented with signs of bilateral nasal discharge, swollen lymph nodes and mild pyrexia for the previous three days. Positive diagnosis was made by qPCR on a nasopharyngeal swab.
The positive diagnoses in all four cases were made by qPCR on nasopharyngeal swabs.

These cases have been reported by the text alert service (Tell-Tail) for UK equine practitioners sponsored by Merial Animal Health. This free of charge service alerts practitioners to outbreaks of equine influenza in the UK via text message. Equine veterinary practitioners can sign up for this scheme by registering at the following website http://www.merial.co.uk. This service has also been offered to the members of the National Trainers Federation (NTF).

If you would like more information regarding outbreaks of equine influenza virus or would like to sign up for our sentinel practice scheme, please contact: equiflunet@aht.org.uk or follow the link to www.equiflunet.org.uk for more information on equine influenza.

International disease occurrence beginning 4Q 2015

EASTERN EQUINE ENCEPHALOMYELITIS (EEE)

USA
As of 12th October 2015 there had been 49 EEE cases confirmed in the USA in 2015, of which 21 were in Florida, 13 in Texas, three each in Michigan, New York and Virginia, two in N. Carolina and one each in Alabama, Mississippi, New Jersey and S. Carolina.

EQUINE HERPES VIRUS-1 (EHV-1)

USA
In October 2015 a case of EHV-1 neurological disease was reported in a two-year-old Thoroughbred filly at Parx Racing, Pennsylvania with the affected horse treated at an equine clinic. Quarantine has been implemented at the racetrack, permitting horses to enter but not to leave for the duration of the quarantine period.

EQUINE INFECTIOUS ANAEMIA (EIA)

ROMANIA
In October 2015 four separate outbreaks of EIA were reported in Romania, with two of these in Arad and the other two in Botosani. No further details about the outbreaks were made available.

EQUINE INFLUENZA VIRUS (EI)

USA
In October 2015 a case of EI was confirmed in a horse after being admitted to a teaching hospital in Oregon.

VENEZUELAN EQUINE ENCEPHALOMYELITIS (VEE)

PANAMA
On 29th September 2015, the Ministry of Agricultural Development, Panama City reported an outbreak of VEE in the Darien region of Panama, Central America to the World Organisation for Animal Health (OIE). Four crossbred horses, from a village with 18 resident horses, were confirmed as affected in an outbreak that commenced on 25th June. The positive diagnosis was made by
IgM-capture ELISA conducted by the regional reference laboratory based at the Gorgas Memorial Institute for Health Studies on 20th August 2015. Measures undertaken included movement controls, control of vectors, enhanced surveillance and vaccination in response to the outbreak.

VESICULAR STOMATITIS (VS)

USA
As of 18th November 2015, there is evidence of a slowing in the spread of VS in the USA according to the latest United States Department of Agriculture (USDA) Situation Report. The number of additional cases per month is in the single digits for the first time for several months. The number of virus-confirmed premises currently stands at 308 with the respective totals of virus-confirmed premises in the eight affected states as follows: Arizona (14), Colorado (173), Nebraska (23), New Mexico (12), S. Dakota (18), Texas (three), Utah (15), Wyoming (50). There are an additional 492 premises on which VS has occurred but has not been virologically confirmed.

WEST NILE VIRUS (WNV)

FRANCE
As of 23rd October 2015, 45 infected animals had been confirmed on 34 premises with 30 cases on 22 premises in Bouches-du-Rhone, 14 cases on 11 premises in Gard and one case in L’Hérault. Sequencing of the virus has revealed that the strain involved in this outbreak is WNV lineage 1 of the West Mediterranean Clade, which is the same virus that was circulating in previous French outbreaks from 2000 to 2004.

HUNGARY
As of 23rd October 2015, three separate outbreaks of WNV were reported in Pest, Hungary, although no further details about the outbreaks were available.

SPAIN
On 15th October 2015, an outbreak of WNV was reported in Cadiz, although no further details about the outbreaks were available.

USA
As of 23rd October 2015, WNV has been confirmed in 64 horses in nine states including Texas (22), Washington (18), Colorado (11), Kentucky (eight), and single cases each in California, New Jersey, New Mexico, Nevada and Oklahoma.

DEFRA business

Tripartite Agreement
A meeting of the three Chief Veterinary Officers, officials from the competent authorities and the TPA bodies took place on 8-9 October in Chantilly, France to review the experience gained since the scheme was reviewed. Despite some minor operational difficulties, the revised TPA seemed to work well in all three countries and uptake by the industry was good. As a next step, an audit procedure will be trialled to ensure the integrity of the system via good compliance by its users.
Focus article

In this report we are pleased to include a focus article written by Andrew Waller, Head of Bacteriology at the Animal Health Trust, Kentford, UK. The article presents an intriguing insight into what modern genome sequencing is telling us about the historically important pathogen *S. equi*, the cause of strangles in horses and its evolution over time. We reiterate that the views expressed in this focus article are the author’s own and should not be interpreted as official statements of APHA, BEVA or the AHT.


We would remind readers and their colleagues that a form is available on the AHT website for registration to receive reports free of charge, via e-mail, on a quarterly basis. The link for this registration form is available via http://www.aht.org.uk/cms-display/equine_disease_registration.html.
The results of virological testing for July to September 2015 are summarised in Table 1 and include data relating to Equine Viral Arteritis (EVA), Equine Infectious Anaemia (EIA) and West Nile Virus (WNV) from the Animal & Plant Health Agency (APHA), Weybridge. The sample population for the APHA is different from that for the other contributing laboratories, as the APHA’s tests are principally in relation to international trade (EVA and EIA). APHA now provides testing for WNV as part of clinical workup of neurological cases on specific request and provided the local regional APHA office has been informed.

### Table 1: Diagnostic virology sample throughput and positive results for the third quarter of 2015

<table>
<thead>
<tr>
<th>Serological Tests</th>
<th>Number of Samples Tested</th>
<th>Number Positive</th>
<th>Number of Contributing Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVA ELISA</td>
<td>626</td>
<td>11*</td>
<td>5</td>
</tr>
<tr>
<td>EVA VN</td>
<td>47</td>
<td>17*</td>
<td>3</td>
</tr>
<tr>
<td>APHA EVA VN</td>
<td>474</td>
<td>22*</td>
<td>1</td>
</tr>
<tr>
<td>EHV-1/-4 CF test</td>
<td>362</td>
<td>0*</td>
<td>1</td>
</tr>
<tr>
<td>EHV-3 VN test</td>
<td>1</td>
<td>0*</td>
<td>1</td>
</tr>
<tr>
<td>ERV-4-A/-B CF test</td>
<td>117</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Influenza HI test</td>
<td>151</td>
<td>2*</td>
<td>1</td>
</tr>
<tr>
<td>EIA (Coggins)</td>
<td>106</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>EIA ELISA</td>
<td>410</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>APHA EIA (Coggins)</td>
<td>1216</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>APHA WNV (cELISA)</td>
<td>2</td>
<td>0†</td>
<td>1</td>
</tr>
<tr>
<td><strong>Virus Detection</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EHV-1/-4 PCR</td>
<td>196</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>EHV-2/-5 PCR</td>
<td>17</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>EHV-3 virus isolation</td>
<td>38</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Influenza NP ELISA</td>
<td>17</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Influenza Directigen</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Influenza PCR</td>
<td>201</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>APHA Influenza PCR</td>
<td>132</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Influenza VI in eggs</td>
<td>9</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>EHV VI</td>
<td>16</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>EVA VI/PCR</td>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>AHVLA EVA VI/PCR</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>29</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

**ELISA = enzyme-linked immunoassay, VN = virus neutralisation, VLA = Animal Health Veterinary Laboratories Agency, CF = complement fixation, HI = haemagglutination inhibition, Coggins = agar gel immuno diffusion test, PCR = polymerase chain reaction, NP = nucleoprotein, VI = virus isolation, EVA = equine viral arteritis, EHV = equine herpes virus, ERV = equine rhinitis virus, EIA = equine infectious anaemia, # = Seropositive due to vaccination, *= Diagnosed positive on basis of seroconversion between paired sera, **= Seropositive due to vaccination, †= negative by IgM capture ELISA (tested positive for WNV by total Ab detection cELISA. Official veterinary inquiry confirmed no clinical signs but a history of vaccination.)**
Equine Influenza Virus (EI)

In the third quarter of 2015 seven outbreaks of EI were diagnosed in the UK by the Animal Health Trust based on positive qPCR on nasopharyngeal swabs (summarised below). All involved non-vaccinated animals and EI virus was isolated from five outbreaks. All five isolated viruses were characterised as being Florida Clade 2 sublineage of H3N8 equine influenza, sharing a substitution at 144 of the HA protein (referred to as 144-like).

<table>
<thead>
<tr>
<th>Date of EI Diagnosis</th>
<th>Location of affected premises</th>
<th>Vaccinated against EI</th>
<th>Number of other horses affected</th>
<th>Clade of EI virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd July 2015</td>
<td>West Midlands</td>
<td>No</td>
<td>No others affected</td>
<td>Florida Clade 2, 144-like</td>
</tr>
<tr>
<td>2nd July 2015</td>
<td>Lanarkshire</td>
<td>No</td>
<td>1 out of 2</td>
<td>Florida Clade 2, 144-like</td>
</tr>
<tr>
<td>7th July 2015</td>
<td>Tyne &amp; Wear</td>
<td>No</td>
<td>4 out of 20</td>
<td>Florida Clade 2, 144-like</td>
</tr>
<tr>
<td>23rd July 2015</td>
<td>Scottish Borders</td>
<td>No</td>
<td>0 out of 1</td>
<td>Florida Clade 2, 144-like</td>
</tr>
<tr>
<td>28th July 2015</td>
<td>Lancashire</td>
<td>No</td>
<td>0 out of 20</td>
<td>Unable to isolate virus</td>
</tr>
<tr>
<td>12th August 2015</td>
<td>Norfolk</td>
<td>No</td>
<td>0 out of 10</td>
<td>Florida Clade 2, 144-like</td>
</tr>
<tr>
<td>4th September 2015</td>
<td>Norfolk</td>
<td>No</td>
<td>5 out of 12</td>
<td>Unable to isolate virus</td>
</tr>
</tbody>
</table>

On 2nd July 2015, two separate outbreaks of EI were confirmed on premises in Lanarkshire and West Midlands. The affected animal in Lanarkshire was a six-year-old pony mare that presented with dry cough, enlarged submandibular lymph nodes and nasal discharge three days after attending a show near Edinburgh. The affected horse in West Midlands was a 15-year-old cob that presented with dry cough, enlarged submandibular lymph nodes and serous nasal discharge for six days prior to being examined.

On 7th July 2015, an outbreak of EI was diagnosed on a livery yard in Tyne and Wear, England. At least four horses out of 20 on the premises presented with dry cough and mucoid to mucopurulent nasal discharge after a new horse, also affected, arrived on the premises five days earlier.

On 23rd July 2015, a case of EI was confirmed on a premises in the Scottish Borders. The affected animal was a five-year-old Irish Sports Horse that presented with mild cough, serous nasal discharge and lethargy for the preceding three days.

On 28th July 2015, a case of EI was diagnosed on a premises in Lancashire. The affected animal was a five-year-old Cob that presented with productive cough, mucopurulent nasal discharge, conjunctivitis and inappetance for the preceding 24 hours.

On 12th August 2015, a case of EI was confirmed on a premises in Norfolk, England. The affected horse was a 15-year-old Cob that presented with mucopurulent nasal discharge and increased respiratory effort.

On 4th September 2015, a case of EI was diagnosed on a premises in Norfolk, England. The affected horse was a two-year old pony gelding that presented with mucopurulent discharge and coughing one day previously, having been introduced onto the premises the day before that.
**Equine Herpes Virus-1 (EHV-1)**

**Abortion**
On 10th August 2015, a single case of EHV-1 abortion was confirmed on a stud farm in West Sussex with 70 resident animals. The affected mare was a 19-year-old non-vaccinated Warmblood and the positive diagnosis was made by qPCR on fetal tissues.

**Respiratory Disease**
On 1st July 2015, a case of EHV-1 respiratory disease was confirmed on a premises in Devon. The affected donkey was 25-year-old gelding that presented with profuse serous nasal discharge and was on treatment for ongoing liver disease. Positive diagnosis was made by qPCR on a nasopharyngeal swab.

On 21st August 2015, a case of combined EHV-1 and *S. equi* infection was confirmed on a premises in Renfrewshire, Scotland with 35 animals. The affected gelding presented with intermittent cough, mucopurulent nasal discharge and pyrexia for the preceding week. The positive diagnoses were both made by qPCR on a nasopharyngeal swab.
A summary of the diagnostic bacteriology testing undertaken by different contributing laboratories is presented in Table 2. For contagious equine metritis (CEM) 24 HLB accredited laboratories in the UK contributed data.

**Table 2: Diagnostic bacteriology sample throughput and positive results for the third quarter 2015**

<table>
<thead>
<tr>
<th></th>
<th>Number of Samples Tested</th>
<th>Number Positive</th>
<th>Number of Contributing Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEMO (HLB)</td>
<td>787</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>CEMO (APHA)</td>
<td>490</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>778¹</td>
<td>6²</td>
<td>22</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>778¹</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>Strangles*culture</td>
<td>1232</td>
<td>83</td>
<td>18</td>
</tr>
<tr>
<td>Strangles PCR</td>
<td>1889</td>
<td>215</td>
<td>4</td>
</tr>
<tr>
<td>Strangles ELISA²</td>
<td>3406</td>
<td>399²</td>
<td>5</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>244</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td>MRSA</td>
<td>253</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>110</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Clostridium difficile (toxin by ELISA or munochromatography)</td>
<td>110</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Borrelia (by ELISA)</td>
<td>24</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Rhodococcus equi culture/PCR</td>
<td>135</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Lawsonia intracellular** culture/PCR</td>
<td>166</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

*Numbers may be attributable to disease exposure, vaccination, infection and carrier states.

APHA CEMO Data for the period July to September 2015
We are again pleased to include data relating to CEM testing from the Animal & Plant Health Agency (APHA), in this quarterly report. The sample population for the APHA is different from that for the other contributing laboratories as the APHA tests are principally in relation to international trade and/or outbreak investigations.

**Strangles**
Strangles remains endemic in the UK, especially among parts of the non-Thoroughbred horse population. Diagnoses are confirmed in the UK based on traditional culture of *S. equi* and qPCR on respiratory samples and/or seropositive using a serological ELISA.

**APHA Salmonella results**
Eight samples were submitted this quarter to the Animal and Plant Health Agency (APHA) and all of these were positive. From the incidents involving strains typed by the APHA, the serovars/phagetypes reported were *S. Typhimurium* DT104 (1 sample), *S. Enteritidis* (4 samples; 1 PT1, 1 PT33 and 2 that could not be typed), *S. Newport* (1 sample), a single incident of monophasic *Salmonella* Typhimurium *S. 4,12:i:-* DT193 and one *Salmonella* was incompletely typable (*S. 6,7:k:-*). *S. Enteritidis* and *S. Typhimurium* DT104 are likely to be of human monophasic *Salmonella Typhimurium,*
Strangles - a pathogenic legacy of the war horse
Andrew S. Waller, Animal Health Trust, Lanwades Park, Newmarket, Suffolk, CB8 7UU

Strangles, characterised by pyrexia followed by abscessation of the lymph nodes of the head and neck, was first described in 1251 (Rufus 1251) and the causative agent, Streptococcus equi (S. equi), was identified in 1888 (Schutz 1888). However, despite more than a century of research into this disease, strangles remains the most frequently diagnosed infection of horses with over 600 outbreaks being identified in the UK alone each year (Parkinson and others 2011). This article reviews some of the recent advances in our understanding of the evolution of S. equi and puts this into the context of preventing and resolving outbreaks of infection.

Recently, Harris et al. published their analysis of the genomes of a large collection of S. equi strains that were recovered from horses throughout the world and spanned a time period of 55 years (Harris and others 2015). Surprisingly, given that the historical record of strangles suggests that S. equi should date back to at least the 13th century; strains recovered from horses across the globe were found to share a common ancestor that actually dated to the 19th or early 20th century. This period corresponds to a time when horses were a major mode of transport and played important roles in a number of global conflicts such as World War I, where an estimated eight million horses died on the battlefield. At its peak 1,000 horses per day were imported to the UK from the USA and horses from all around the world were called into action. The mixing of these horses, and their replacement with young animals on an unprecedented scale, through initiatives like the formation of the National Stud, would have provided ideal conditions for the emergence and spread of the fittest strain of S. equi from which today’s global population has evolved.

A proportion of recovered horses become persistently infected with S. equi, carrying the organism within their guttural pouches. These healthy ‘carrier’ animals play a vital role in the recurrence of strangles and the spread of S. equi to new yards and countries (Waller 2014). Persistent bacteria must survive in the face of a strong immune response, produced by the horse following recovery from strangles, and in an environment that is very different to that experienced by the bacterium during acute disease. These conditions select for changes in the DNA of persistent bacteria, such that genes that are no longer required for survival in the guttural pouch are lost and those that are targeted by the immune response mutate (Figure 1).
Figure 1: Artist’s impression of the acute and persistent phases of strangles in the horse. The transition of intact chains of *Streptococcus equi* to the lymph nodes of the horse’s head is depicted. An abscess is shown to develop and burst into the guttural pouch where chondroids (dried balls of pus) form, enabling the organism to persist. Within the guttural pouch, the DNA of *S. equi* decays, symbolized by the transformation of bacterial chains into an intact and then broken helix, as the bacterium evolves to meet the challenges of its new environment. (Illustration is by Alana Woodward, Virology Research Group, Animal Health Trust).

Indeed, the rate of DNA mutation and loss was significantly higher in isolates recovered from persistently infected horses when compared to isolates recovered from horses with acute disease (Harris and others 2015). Genes that were lost by persistent strains of *S. equi* included those involved in citrate metabolism, production of the hyaluronic acid capsule and the biosynthesis of an iron-binding siderophore, known as equibactin. The loss of at least some of these genes reduces the potential for *S. equi* to transmit to other animals (Harris and others 2015). So although the persistent strain survives in the guttural pouch, it may be less able to cause acute strangles. This decreased virulence potential provides one explanation for outbreaks of ‘atypical’ strangles in young horses, where naïve animals do not display classic clinical signs of strangles despite being infected with *S. equi* (Prescott and others 1982). The loss of genes that do not affect the ability of *S. equi* to cause strangles facilitates streamlining of the genome, whereby the organism loses ancestral capabilities leading to host-restriction, explaining why *S. equi* only causes disease in horses. Loss of genes during persistent infection also highlights potential problems for the detection of infected animals. For example, two horses in Devon tested negative for the eqbE qPCR test in a recent study despite being infected with *S. equi* (Webb and others 2013). Fortunately, the triplex qPCR described in this paper was able to detect *S. equi* strains lacking the eqbE target and these horses were able to receive treatment before they could transmit the infection to other animals. Such examples highlight that the various PCR and qPCR tests are not all the same and that single target assays for *S. equi* have the potential to generate false negative results.

Interestingly, several genes that encoded proteins located on the cell surface of *S. equi*, were particularly diverse in strains recovered from both persistent and acute infections (Harris and others 2015). The mutation of surface proteins may assist the bacterium to evade the immune response. In the guttural pouch, this may help the mutant variant to be shed and transmit to new animals. Such data has important implications for the design of more effective vaccines, as it suggests that changes in a limited number of proteins could have an unusually large effect on the ability of *S. equi* to evade the protection conferred.
Unfortunately, the only currently available European vaccine against strangles, Equilis StrepE (MSD) is based on a strain that rarely infects horses residing in the UK today and differs from the majority of circulating strains (Ivens and others 2011; Parkinson and others 2011) by an evolutionary time-span equivalent to >200 years (Harris and others 2015). Indeed, the first identified cases of strangles that were caused by the prevalent ST-151 type of S. equi (Figure 2) occurred in three horses that had been vaccinated using the Equilis StrepE vaccine (Harris and others 2015; Kelly and others 2006). Whilst this finding does not mean that Equilis StrepE will not confer cross-protection against the currently circulating strains of S. equi, further research is warranted.

Figure 2: Graph showing the proportion of outbreaks of strangles in the UK from 2003 until 2011 from which ST-179 and ST-151 strains were isolated. Error bars represent the 95% confidence intervals.

Analysis of the genome sequences of isolates recovered from UK horses revealed the complex epidemiology of this disease. For example, a large outbreak of strangles in Lincolnshire was most likely linked to a previous episode of disease and the presence of several persistently infected horses on the affected premises. These data highlight the importance of identifying and treating persistently infected animals in order to prevent recurrent outbreaks. Two new arrivals at the Lincolnshire premises were shown to be persistently infected with two different strains that were unrelated to the current outbreak, illustrating the prevalence of persistently infected horses in the population of animals being received. Another outbreak in Essex involved only ten horses, but yielded three different types of S. equi. One of the horses in this outbreak was shown to be infected with more than one type of S. equi at the same time, highlighting the scale of endemic disease within some premises and the limitations of eradication procedures that do not consider all horses on an affected yard.

The ST151 strains, and variants thereof, are now widespread in the UK and Europe; their transmission facilitated through the modern-day international movement of horses and a lack of pre-import screening to identify persistently infected carriers. Improved screening of horses and the treatment of carriers pre-movement is essential to break the lifecycle of infection exploited by S. equi. As with vaccines against equine influenza, updates for strangles vaccines may also prove to be vital in order to ensure that adequate levels of protection against the currently circulating strains of S. equi can be achieved.
The recent advances in our knowledge of S. equi provide an unprecedented opportunity to improve the design of preventative vaccines towards protecting our future generations of horses.

References:
RUFUS, J. Ed (1251) De Medicina Equorum
SCHUTZ, J. W. (1888) The Streptococcus of Strangles. The Journal of Comparative Pathology and Therapeutics 1, 191 - 208
A summary of diagnostic toxicosis and parasitology testing undertaken by contributing laboratories is presented in Tables 3 and 4, respectively. Results for toxicosis are based on histopathologically confirmed evidence of disease only (where applicable).

### Table 3: Diagnostic toxicosis sample throughput and positive results for the third quarter 2015

<table>
<thead>
<tr>
<th>Disease Type</th>
<th>Number of Samples Tested</th>
<th>Number Positive</th>
<th>Number of Contributing Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Sickness</td>
<td>23</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Hepatic toxicoses</td>
<td>42</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Atypical myopathy</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

* Includes contributing laboratories with no cases submitted

### Table 4: Diagnostic parasitology sample throughput and positive results for the third quarter 2015

*Complement Fixation Test; CFT suspect/positive samples are tested in IFaT test

<table>
<thead>
<tr>
<th>Parasite Type</th>
<th>Number of Samples Tested</th>
<th>Number Positive</th>
<th>Number of Contributing Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endoparasites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascarids</td>
<td>4827</td>
<td>144</td>
<td>16</td>
</tr>
<tr>
<td>Cyathostomes</td>
<td>893</td>
<td>125</td>
<td>8</td>
</tr>
<tr>
<td>Dictyocaulus</td>
<td>145</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Strongyles</td>
<td>5464</td>
<td>1997</td>
<td>21</td>
</tr>
<tr>
<td>Tapeworms (ELISA based)</td>
<td>33</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Tapeworms (Faecal exam)</td>
<td>1292</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Trichostrongylus</td>
<td>43</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Strongyloides</td>
<td>2831</td>
<td>142</td>
<td>16</td>
</tr>
<tr>
<td>Oxyuris equi</td>
<td>1164</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Fasciola</td>
<td>2215</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Coccidia</td>
<td>312</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Cryptosporidia</td>
<td>133</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>APHA Theileria equi (CFT)*</td>
<td>181</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>APHA Theileria equi (IFaT)**</td>
<td>257</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>APHA Theileria equi (cELISA)**</td>
<td>197</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>APHA Babesia caballi (CFT)*</td>
<td>181</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>APHA Babesia caballi (IFAT)**</td>
<td>197</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>APHA Babesia caballi (ELISA)**</td>
<td>257</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Ectoparasites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mites</td>
<td>261</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Lice</td>
<td>133</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Ringworm</td>
<td>318</td>
<td>81</td>
<td>14</td>
</tr>
<tr>
<td>Dermatophilus</td>
<td>234</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Candida</td>
<td>152</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

*Complement Fixation Test; CFT suspect/positive samples are tested in IFAT test

**Indirect Fluorescent Antibody Test; competitive Enzyme-linked immunosorbent assay; positive cELISA results are not undergoing confirmatory testing
Grass sickness surveillance data
(http://www.equinegrasssickness.co.uk/)

The nationwide EGS surveillance scheme was established in spring 2008 to facilitate the investigation of changes in geographical distribution and incidence of the disease in Great Britain. Data gathered by this scheme are collated in a strictly confidential database.

A total of 16 cases of equine grass sickness (EGS) were reported during the third quarter of 2015 (July – September), of which 62.5% occurred in England (n=10) and 37.5% occurred in Scotland (n=6). One affected premises reported multiple cases during this quarter, two cases were reported occurring within one day of each other. A further four affected premises had a prior history of EGS cases.

The cases comprised 50% geldings (n=8), 44% mares/fillies (n=7) and one of unspecified gender. The median age of affected animals was 5.75 years (range 2 – 22 years). The most numerous affected breeds were Cob or Cob crosses (n=4) and Welsh or Welsh crosses (n=3).

Seventy-five percent of cases (n=12) were reported to have acute EGS, 6% (n=1) were reported to have sub-acute EGS and 9% (n=3) were diagnosed with chronic EGS. Of the three cases of chronic EGS, one was reported to have survived to date.

The majority of cases (87.5%, n=14) were diagnosed based solely on clinical signs and clinical examination. The remaining two cases underwent surgery, with diagnostic confirmation obtained by histopathological examination of ileal biopsy samples.
East Anglia
A total of 29 cases were examined including 19 aborted fetuses and fetal membranes.

A total of 19 aborted fetuses and/or placentae were examined during the quarter. Umbilical cord torsion was identified contributing to fetal death in 10 cases, in four cases there was evidence of placental insufficiency due to villous atrophy and mineralisation and in one case premature placental separation was noted. There was a single case of EHV-1 infection causing abortion and in three cases the cause of abortion was not able to be determined although there was clear evidence of fetal distress prior to death in two of these fetuses.

Two cardiovascular cases were examined, which included one case of bacterial endocarditis and one case of ruptured chordae tendineae of the mitral valve.

Two horses were examined for gastrointestinal disease. One case had jejunal volvulus with diaphragmatic rupture and thoracic herniation and large colon perforation with peritonitis. The other was a case of small intestinal torsion in a three-month-foal but in which a predisposing cause could not be determined.

A single musculoskeletal cases was examined in which dilation and severe chronic carpal bursitis was identified in a Thoroughbred colt.

One neoplasia case was investigated, in which extensive melanomatosis was identified in a an aged grey Arab stallion, with fatal haemorrhage from a neoplasm in the diaphragm the most likely cause of death.

One case of multisystemic granulomatous disease was also diagnosed.

A case of sudden death was investigated in which an aortic tear without predisposing aneurysm with secondary periaortic haemorrhage was found.

Two cases involving trauma were investigated. The first involved a two-year-old Welsh Mountain pony with an extensive fence rail penetration leading to laceration of the left jugular vein and severe haemothorax. The second case had a septic process that gave rise to neurological signs leading to secondary cranial trauma.

Home Counties
Nine cases were reported.

Five cases of gastrointestinal disease were reported that included individual cases of small intestinal volvulus and eosinophilic enteritis/typhlocolitis and three cases of small intestinal strangulation by pedunculated lipoma.

One presumptive neurological case, which had presented with intention tremor and episodic collapse, was investigated but no obvious abnormality was detected.

A musculoskeletal case was investigated in which chronic laminitis with pedal bone rotation was identified.

Two sudden death cases were investigated in which only presumptive diagnoses could be made; one of suspect cardiac dysrhythmia or acute intoxication and the other of presumptive septicaemia.
**Northern England**  
*Five cases were reported.*

Two gastrointestinal cases were investigated comprising one case of gastric distension with associated gastric wall fibrosis and a case of duodenal rupture in which there was no evidence of pre-existing histopathology.

Three cases of neoplasia were diagnosed, which included a squamous cell carcinoma associated with the parotid salivary gland and guttural pouch in one horse, a lymphoma in a multifocally enlarged abdominal lymph node in another animal and a large ulcerated mammary carcinoma with pulmonary metastases in a mare.

**South West**  
*Ten cases were reported.*

One aborted fetus was examined, in which placentitis was confirmed after the mare had been treated for possible placentitis/cervicitis but subsequently lost the foal at 300 days of gestation.

Six cases of gastrointestinal disease were reported in donkeys including three animals with gastric lesions that included one case with a chronic active gastric ulcer at the margo plicatus, another case with a linear, hyperaemic, superficial ulcer in the glandular part of the stomach and a third case in which a bot was identified in the non-glandular part of the stomach. One animal was found with volvulus of the distal jejunum and ileum in which there was a 360 degree twist and small intestinal loop insertion leading to distension and gas filing proximally and ischemia, odoema and non-viability of the distal jejunum. Another donkey had typhlitis and colitis associated with cyathostominosis. The third animal had fibrinous, chronic active peritonitis with fibrin tags at the serosa of the caecal body and right dorsal colon and at the cranial dorsal aspect of the left side parietal peritoneum, with fibrin tags and mineralised foci scattered all over the mesentery and the greater omentum.

Three neoplasia cases, all comprising sarcoïds, were diagnosed in donkeys. The first animal had a fibroblastic sarcoïd with a smaller adjacent occult sarcoïd at the base of the penal sheath, another donkey had an ulcerated mixed nodular-fibroblastic sarcoïd on the inner thigh and the third case had two sarcoïds, one a non-ulcerated fibroblastic lesion at the umbilicus and the second a nodular sarcoïd on the medial aspect of the right carpus.

**Scotland**  
*Fourteen post-mortem examinations were reported.*

Five gastrointestinal cases were reported comprising two histologically confirmed cases of equine grass sickness, a colonic impaction that was presumed to be also due to grass sickness, one case of eosinophilic enteritis and one case of mesenteric arteritis due to migrating strongyles.

A single liver case was examined that had suspected ragwort toxicity.

Three musculoskeletal cases were examined. One case had a traumatic radial fracture, one had osteochondrosis of both hocks and the left stifle and the other case had a chronic fracture of the right carpus.

One cardiovascular case was investigated that identified aortic valvular fibrosis.

Three neoplasia cases were reported comprising one case of presumptive lymphoma at the ileocaecoiliac junction, one case of renal carcinoma and one case of disseminated neuroendocrine carcinoma.
One neurological case involving a horse with seizures was examined in which equine herpesvirus-1 meningoencephalomyelitis was demonstrated which was positive on immunohistochemistry.

**Northern Ireland**

Three cases were reported.

A single musculoskeletal case was examined in which nutritional myopathy was diagnosed based on multifocal polyphasic myofibril reaction in the diaphragmatic musculature and loss of striations and fragmentation with hyaline degeneration and macrophage infiltration. Vitamin E and selenium levels in the liver were below normal levels.

Two respiratory cases of bronchopneumonia were diagnosed. In one case the alveolar spaces and bronchial lumens showed marked neutrophilia and Enterococcus faecium was cultured from the lung. In the other case, widespread, acute, necrotising and purulent bronchopneumonia associated with large numbers of bacteria was accompanied by pituitary pars intermedia dysfunction (PPID), marked dental pathology and cystic ovaries.
ACKNOWLEDGEMENTS

This report was compiled by the Animal Health Trust.
We are extremely grateful to the following laboratories for contributing data for this report.

All laboratories contributing to this report operate Quality Assurance schemes. These schemes differ between laboratories, however, all the contagious equine metritis testing reported was accredited by the Horserace Betting Levy Board with the exception of the AHVLA, which acts as the reference laboratory. We would also like to acknowledge the contribution of the Horserace Betting Levy Board CEMO-scheme.

Agri-Food and Biosciences Institute of Northern Ireland
Animal Health Trust Diagnostic Laboratory
Animal and Plant Health Agency
Arundel Equine Hospital
Axiom Veterinary Laboratory
Beaufort Cottage Laboratories
Biobest Laboratories
Bushy and Willesley (B & W) Equine Group Ltd.
CAPL LTD Laboratory
Capital Diagnostics, Scottish Agricultural College
Carmichael Torrance Diagnostic Services
Chine House Veterinary Hospital
Dechra Laboratories
Donkey Sanctuary
Donnington Grove Veterinary Group
Endell Veterinary Group Equine Hospital
Hampden Veterinary Hospital
IDEXX Laboratories
JSC Equine Laboratory
Lab Services Ltd
Liphook Equine Hospital
Minster Equine Veterinary Clinic
Newmarket Equine Hospital
Oakham Veterinary Hospital
The Royal Veterinary College
Three Counties Equine Hospital
Torrance Diamond Diagnostic Services (TDDS)
University of Edinburgh
University of Glasgow
Univeristy of Liverpool
Valley Equine Hospital

All laboratories contributing to this report operate Quality Assurance schemes, which differ between laboratories. However, all contagious equine metritis (CEM) testing reported was accredited by the Horserace Betting Levy Board (HBLB) with the exception of AHVLA, which acts as the reference laboratory.

The Animal Health Trust (AHT) is extremely grateful to the Horserace Betting Levy Board (HBLB), Racehorse Owners Association (ROA) and Thoroughbred Breeders’ Association (TBA) for their continued combined contribution to the AHT’s Equine Infectious Disease Service.

We would welcome feedback including contributions on focus articles and/or case reports to the following address:

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