March 2017

Redwings Strangles Survey Results: Main report

Exploring horse-owner knowledge, attitudes and practices around the prevention of strangles.

REDWINGS HORSE SANCTUARY

In collaboration with

UNIVERSITY OF LIVERPOOL

Dedication

This report is dedicated to all the Redwings staff for their professionalism throughout our strangles outbreak in 2015 and who protect our horses every day from infectious disease.

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1. Rationale for the survey

For more than 25 years, Redwings has cared for and treated horses with strangles. We have over 1,500 horses in our day-to-day care and every equine is quarantined and screened before joining our resident horses at one of our ten centres across the UK.

We have never turned a horse with strangles away despite the fact an outbreak of the disease is one of the most significant health risks to our resident horses.

We are able to nurse and treat sick horses and we are proud advocates of quarantining protocols which enable us to identify and treat 'silent' carriers of strangles. Since 2011, we have treated 87 horses with strangles (8 per cent of our intakes). Forty-seven of these cases were 'sub-clinical' carriers of the disease, which means that, without our screening protocol for new arrivals, each of these cases could have led to an outbreak situation.

In our 30-year history of taking in horses from both welfare and non-welfare backgrounds, our quarantine and screening procedure for new arrivals and 'rehoming return' horses has protected us from costly outbreaks. However, in 2015 we experienced an outbreak, which began on one of our largest farms of over 300 horses.

The outbreak required a massive investment of time and resources to contain and treat, with significant impact on our rescue, rehoming and sanctuary/veterinary activities. Despite this, and thanks to the generous help of Redwings' loyal supporters and the professionalism of our teams, the infections were limited to just 30 horses. All charity functions were back in action within six months.

Like many horse owners and equine establishments, we've therefore felt the emotional costs of strangles first-hand, both through experiencing the worry and day-to-day care of sick horses and the practical impact of measures needed when a horse is suspected to have the disease. Moreover, we have also been unfortunate enough to experience three sad losses in the last ten years due to 'bastard' strangles (Metastatic Abscessation), a fatal complication of the disease.

> *"We believe that strangles is an unnecessary disease for us to face..."*

We believe that strangles is an unnecessary disease for horse owners to face and is also one that inspires better biosecurity practices that can have benefits for the prevention and control of other contagious diseases and parasite control. In fact, experts have argued that strangles could be eradicated. It can be stopped in its tracks through consistent hygiene measures and a commitment to treat and prevent carriers of the disease.

With this in mind, we are committed to tackling the disease beyond our sanctuary fences. We call on communities of horse owners across the UK, whether it be on livery yards, in riding clubs or organising bodies, to help eradicate this disease.

To date, we've been helping vets, horse owners and equine establishments manage and prevent the disease, through the promotion of our Strangles Information Pack[1] and other education resources. In the wake of our outbreak, we are committed to going even further to equip horse owners with the knowledge and practical methods to control strangles and improve their biosecurity against infectious disease.

The survey findings reported here help us understand horse owner perspectives and experiences of the disease. The results highlight levels of existing knowledge and approaches to biosecurity and provide an insight for further research into how to improve biosecurity in practice.

This report presents the findings of the survey and statistical analysis conducted by Cherrill Bedford and Dr Claire Scantlebury of the University of Liverpool. Redwings is indebted to them for their support and that of the University of Liverpool, who provided funding for the analysis presented here. We would also like to thank stakeholders from across the industry for supporting us with piloting and promotion of the survey.

2. What is strangles?

Strangles is a highly infectious bacterial disease of the upper respiratory system. Although few horses die from strangles there are complications in approximately 10 per cent of cases, which include potentially fatal secondary diseases such as metastatic abscessation, known as '*bastard strangles',* and Purpura Haemorrhaghica.[2]

The causative agent is *Streptococcus equi subsp. equi (Strep. equi),* which can infect susceptible horses through direct or indirect contact.[3] Horses with insufficient immunity to provide protection against the disease (either through previous exposure or vaccination) are susceptible to infection.

Biosecurity measures (steps to avoid direct and indirect spread between horses) are more straightforward than with other infectious diseases such as airborne diseases because the pathway of transmission is more limited. Strangles is transmitted through

[1] Redwings Horse Sanctuary (2013) Strangles Information Pack [online] Accessed January 2017 https://www.redwings.org.uk/news-and-views/speak-out-strangles?gclid=Cj0KEQiAxeTFBRCGmIq_7rGt_r8BEiQANdPqUs8rPuz9wImI5ICZ7A94HAPCl5dwOBWA-X0uw_NdKc0aAjsn8P8HAQ

[2] Sweeney, C R., Timoney, JF., Newton, R J., Hines, M T., (2005). Streptococcus equi Infections in Horses: Guidelines for Treatment, Control and Prevention of Strangles. Journal of Veterinary Medicine; 19:123-134.

[3] Animal Health Trust (no date). *Strangles Research* [online]. Available at: http://www.aht.org.uk/cms-display/strangles.html [Accessed 18 July 2016]

physical contact with infected material (i.e. it is not airborne, transmitted by blood or other vectors such insects).

Direct contact can be prevented by avoiding nose to nose and other physical contact between unknown horses. Indirect contact, which is spread by contact with objects or people that have become contaminated with infective discharge (nasal discharge and drainage from ruptured abscesses) such as tack, transport, stabling, clothing, and people moving between horses, can be managed with consistent hygiene measures such as disinfecting equipment between horses as well as providing physical barriers or separation between diseased and healthy horses (i.e. through quarantine).

Image 1: *Strangles mucus is viscous and can be difficult to remove. Lab-based investigation suggests it can live in the external environment for over a month* [4].

Knowledge of how transmission occurs, understanding of effective biosecurity strategies and having practical facilities available are critical to preventing the spread of the disease.[5]

Disease process and infectivity

The earliest characteristic sign of strangles is an abrupt increase in rectal temperature, and this is followed by mucopurulent nasal discharge (pus) from the upper respiratory tract and swelling of submandibular and or retropharyngeal lymph nodes (**Image 2**), which may be warm and tender to the touch, due to abscess formation. Affected horses may become anorexic (reluctant to eat), and often stand with their neck extended to alleviate pain and discomfort. Coughing is not a significant feature in many cases but can occur occasionally. Rarely, and in extreme cases, symptoms can lead to obstruction of the airways due to the enlarged lymph nodes, which is where the disease gets the name 'strangles'.

[4] Sweeney, C R., Timoney, JF., Newton, R J., Hines, M T., (2005). Streptococcus equi Infections in Horses: Guidelines for Treatment, Control and Prevention of Strangles. Journal of Veterinary Medicine; 19:123-134.
[5] Animal Health Trust (2011). *Strategy to eradicate and prevent strangles* [online]. Available at: http://www.aht.org.uk/strangles.org/pdf/steps.pdf [Accessed 18 July 2016].

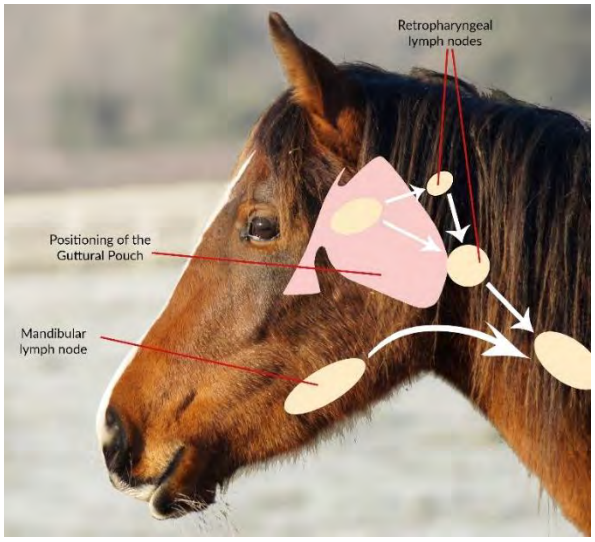


Image 2: *Position of lymph nodes and guttural pouches which are the anatomy affected by strangles.*

Fever occurs 3-4 days after exposure to the disease and persists through the maturation of abscesses. Nasal shedding of bacteria begins 2-3 days after the onset of fever and persists for 2-3 weeks (or as long as the affected horse is infected).[6] This equates to a long period of time where the horse is contagious with the potential to

Strangles, *(S.equi)* infection

DISEASE PROCESS FOR ALL HORSES		HEALTHY	INCUBATION	SIGNS	HEALTHY
			3-14 days	3-8 weeks	
INFECTIVITY	NON-CARRIERS	SUSCEPTIBLE	LATENT	INFECTIOUS	IMMUNE THEN SUSCEPTIBLE
			4-7 days	4-8 weeks	variable months or years
	CARRIERS	SUSCEPTIBLE	LATENT	INFECTIOUS	
			4-7 days	months/years	

infect other horses. In rare cases horses can persistently shed for much longer. A recovered horse may be a source of infection up to six weeks after clinical signs have resolved or even longer if they become a carrier.

Image 3: *Model showing the strangles disease process and comparing infectivity of a typical strangles case and strangles carrier case. Model adapted from The Animal Health Trust (2016)*[7]

[6] Sweeney, C R., Timoney, JF., Newton, R J., Hines, M T., (2005). Streptococcus equi Infections in Horses: Guidelines for Treatment, Control and Prevention of Strangles. Journal of Veterinary Medicine; 19:123-134.
[7] Newton, R (2016) Infectious Disease Prevention and Control: effective strategies for equine premises. BEVA webinar. June 28 2016. https://www.youtube.com/watch?v=3FGRwR_P3zQ [accessed January 2017]

Severity of the disease varies greatly depending on the immune status of the horse, consequently older horses often exhibit a milder form than younger horses.[8] Welfare-compromised horses are also particularly susceptible.

Approximately 75 per cent of horses develop enduring immunity after infection. However, a small proportion of these horses will become susceptible to a second attack within several months if they are not treated.[9]

Fatal complications: Norma

Image 4: *Norma being cared for at our quarantine yard*

Norma, three months old, arrived at Redwings quarantine yard in 2014 with the classic symptoms of strangles. She and several other foals had symptoms of strangles including fever, swellings in the head and thick yellow nasal discharge. Unlike the other cases whose abscesses were restricted to the lymph nodes of the head, an abnormal swelling in her jugular groove enlarged and was confirmed to be a bastard strangles abscess. The abscess had ruptured into her oesophagus and was causing choke-like symptoms. There are complications, including bastard strangles in Norma's case, in around ten per cent of strangles cases,[10] which are a tragic reminder of the potentially life-threatening complications of the disease.[11]

Healthy horses can be carriers of strangles

Occasionally horses are fully recovered from the disease but continue to be infectious for prolonged periods despite appearing otherwise healthy (asymptomatic). These are known as 'sub-clinical' carriers, who sporadically continue to shed the *Strep equi.*

[8] Sweeney, C R., Timoney, JF., Newton, R J., Hines, M T., (2005). Streptococcus equi Infections in Horses: Guidelines for Treatment, Control and Prevention of Strangles. Journal of Veterinary Medicine; 19:123-134.
[9] Ibid.
[10] Ibid.
[11] Ibid.

bacteria; therefore, their introduction to new herds of horses has the potential to trigger new outbreaks. This carrier state may occur in up to ten per cent of seemingly resolved strangles cases. Asymptomatic carriers play an important role in the persistence of the disease and can significantly contribute to both its spread and the perpetuation of outbreak situations[12]. The systematic identification and treatment of carriers combined with outbreak control would lead to a dramatic decrease in the spread of infection and play a significant role in the virtual eradication of strangles.

3. Strangles in the UK

Despite the fact that the equine industry has a gross output of £3.8bn and provides direct employment to 200,000 people[13], there are currently only very limited government-led biosecurity measures to prevent the spread of infectious diseases in horses, apart from African Horse Sickness which has its own specific contingency plan.[14]

Strangles is endemic in the UK horse population with an estimated 600 outbreaks each year.[15] It is also the most commonly diagnosed contagious equine disease. However, the potential to eradicate strangles has been reported for some time:

"This high incidence of infection fosters the concept that strangles is an inevitable and unavoidable hazard of horse ownership. However, an increased understanding of key aspects of disease transmission and improved diagnostics permit the implementation of basic management practices that can virtually eliminate the risk of this disease."
Andrew Waller (2011:1)[16]

Current knowledge gaps

Beyond these estimates, there is a lack of information about how prevalent strangles is within the UK. Only one study reports preliminary data on the frequency of strangles among equine populations in Ireland. Using blood tests of clinically healthy horses it concluded that 42 per cent of horses surveyed had been exposed to the disease in the

[12] Animal Health Trust (2010). *Strangles: Identification of carriers of Streptococcus equi* [online]. Available at: [Accessed 18 July 2016].
[13] Equine Sector Council Steering Group and the British Horse Industry Confederation, (2015). *Equine Sector 2015 General Election Manifesto for the Horse* [online]. Available at: http://www.bef.co.uk/repository/downloads/Horses/Equine_Sector_2015_General_Election__Manifesto_for_the_Horse_V8_3mm.pdf [Accessed 18 July 2016]
[14] Department for Environment, Food and Rural Affairs, (2012). *African Horse Sickness Control Strategy for Great Britain* [online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244348/pb13831-ahs-control-strategy-20130923.pdf [Accessed 18 July 2016].
[15] Animal Health Trust (no date). *Strangles Research* [online]. Available at: http://www.aht.org.uk/cms-display/strangles.html [Accessed 18 July 2016].

[16] Waller, A. (2011) *Strangles: Eradication hopes*. Vet Times. March 7 2011. [Accessed January 2017]

previous six months. In contrast, the National Equine Health Survey carried out by the Blue Cross (2016) indicated that strangles had occurred in 1.2 per cent of horses in the previous 12 months based on owner reports (this accounted for 58 per cent of all infectious respiratory infections)[17]. Meanwhile, based on Redwings' records between 2011 and 2017, 8 per cent of all Sanctuary intakes (87 out of 1,085) had tested positive for strangles. Although the majority of intakes are rescued 'welfare cases', 4.4 per cent of non-rescued horses admitted under exceptional circumstances were strangles-positive (all were asymptomatic carriers) whilst 11.7 per cent of the rescue/welfare cases were positive for strangles (either presenting with clinical signs or found to be carriers).

4. How can we eradicate strangles?

With a commitment to identify and treat asymptomatic carriers as well as ensuring the treatment and prevention of carriers in new infections it would be possible to eradicate strangles. However, in the absence of a centralised governmental plan for eradicating strangles in the UK, the onus currently remains with individuals and communities of horse owners to assess their own risks and the potential cost implications of an outbreak in order to create, and commit to, their own biosecurity plan.

"The introduction of quarantine procedures is probably the most effective step for preventing strangles outbreaks." ***Andrew Waller (2011:3)***[18]

> *"76% of respondents said they have no screening procedures for new arrivals…"*

Our experience upholds expert emphasis on the importance of quarantine procedures to prevent strangles outbreaks in the future. Yet, sadly, our survey findings indicate that currently too many yards in the UK do not have steps in place to reduce the risk of the spread of disease. 76 per cent of respondents said they have no screening procedures for new arrivals at their current yards, despite 50.8 per cent saying they were very likely and a further 28.8 per cent likely to want to use a yard which does have screening for new arrivals.

5. Insights from Redwings' screening and quarantine experience

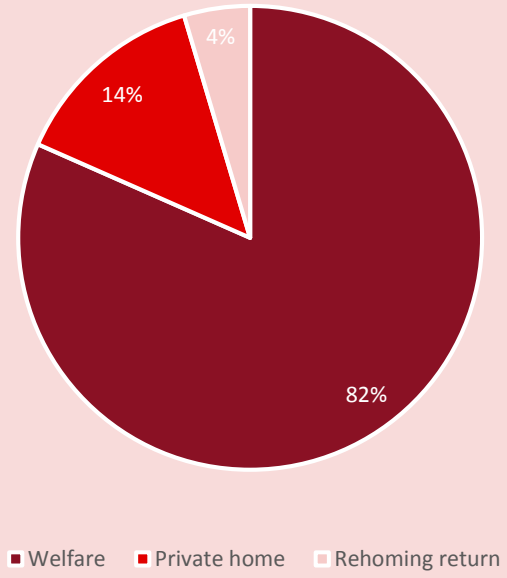
Redwings' quarantine and screening procedures for new arrivals and return horses has protected our herds despite the outbreak we experienced in 2015. In the last five years

[17] Slater, J., (2015). *National Equine Health Survey* [online]. Available at: https://www.bluecross.org.uk/nehs-2015-results [Accessed 18 July 2016].
[18] Waller, A. (2011) *Strangles: Eradication hopes*. Vet Times. March 7 2011. [Accessed January 2017]

(2011-2016), Redwings has treated 87 horses with strangles who were identified through our routine screening and quarantine (this does not include the horses affected by our outbreak).

Strangles cases by 'intake' type

Figure 1: *Proportion of all strangles cases at Redwings between 2011 and 2016 by intake type.*



The majority (82 per cent n=71) of strangles cases identified through our screening process have been rescue cases, which include abandonments and neglect cases. A much smaller proportion of strangles cases came from private homes or rehoming returns who come back into the Sanctuary from one of our guardian (loan) homes. The number of strangles cases over this five-year period accounts for over 8 per cent of the overall number of intakes (n=1085) to Redwings, which includes rescue cases and rehoming returns.

However, it is important to remember that strangles is not a disease only seen in welfare cases. In the last five years 18 per cent (n=14) of the strangles cases treated at Redwings have come from non-rescue situations where their keepers were unaware of their horse's carrier status.

Prevalence of carriers

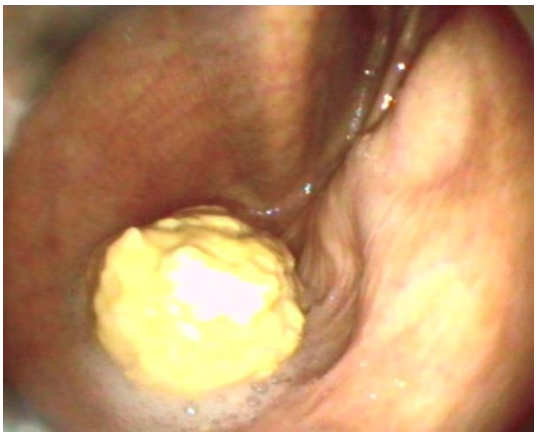
Forty-seven (55 per cent) of the strangles cases identified were sub-clinical carriers of the disease and were identified through (PCR) testing of samples collected using a procedure called guttural pouch (GP) endoscopy.

Image 5: *GP Endoscopy is a quick procedure involving a camera being inserted up the horse's nose under sedation to allow internal inspection and treatment or testing.*

Without quarantine and testing protocols in place each of these cases could have led to an outbreak situation at Redwings, compromising the health of our resident herds, risking fatal complications, and significantly impacting the day to day work of the charity.

Most carriers have chondroids present in their guttural pouches. Chondroids are congealed balls of pus, which harbour the strangles bacteria. Chondroids can exist in the GP for years and can be a source of infection for other horses.

Image 6: *A chondroid in a healthy guttural pouch.*



Unusually, nine carriers in the last five years did not have chondroids in their GP (a significantly less typical presentation of a carrier). So they had either formed a bacterial biofilm and were therefore carriers or they had recently had strangles and were in their post-recovery shedding phase. This is the period, in non-carrier situations, when the horse remains infectious but appears healthy (see Image 3).

Treatment of cases

All strangles cases are treated by nursing horses through the clinical signs, then by carrying out at least one high volume transendoscopic GP lavage (flush with copious warm water) to physically remove any remaining infected inflammatory material following the resolution of clinical signs. This is to prevent the formation of chondroids and ergo the development of carriers. Repeat GP washes between two and four weeks after treatment allow our vets to test for the presence of persistent strangles bacteria.

At Redwings, strangles-positive horses (clinical signs or sub-clinical carriers) require two consecutive negative tests by GP endoscopy before the horse can be introduced to resident herds. Any negative horse that has had strangles must have two further negative samples before being admitted into a resident herd and being declared free of disease. This is a minimum screening standard at Redwings but is above

recommended industry guidelines; it is implemented at the charity given the devastating impact the disease could have on sanctuary operations.

Generally accepted protocols allow for just one negative screening after being free of disease. Atypical strangles cases may require a more protracted period of treatment. However, just three cases have been persistent shedders of the disease over the last five years.

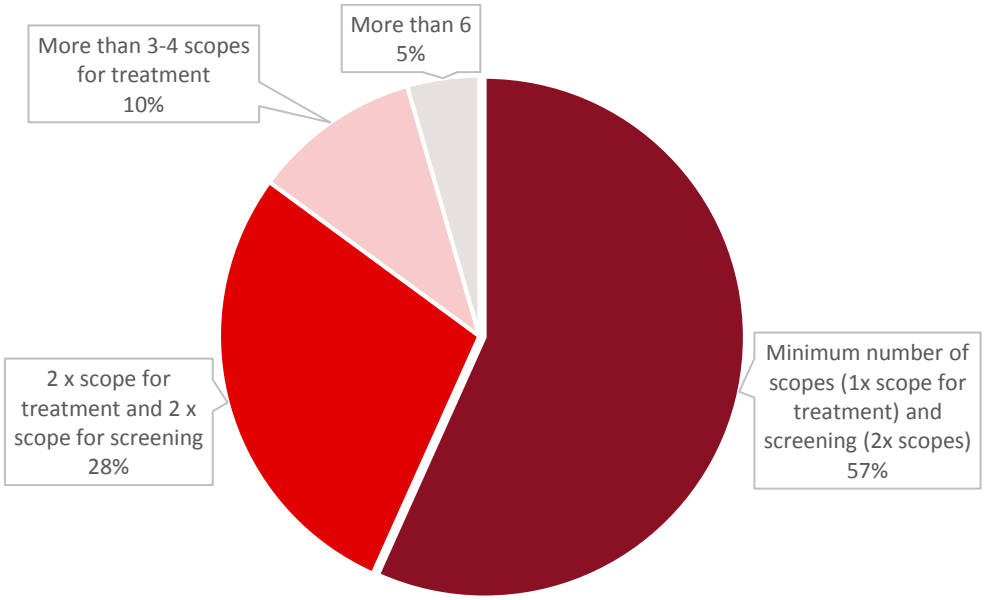


Figure 2: *Number of GP washes required to treat and screen Redwings strangles patients between 2011 and 2016 (n=86).*

Figure 2 shows that the majority of strangles cases (both carriers and clinical cases) at Redwings were treated and cleared with a minimum number of endoscopy procedures. From our experience at Redwings, almost 57 per cent of all strangles-positive horses recovered after just one GP wash to flush the pouch. Meanwhile, the majority of carriers (74 per cent) were treated with just one GP wash to remove the chondroid or strangles bacteria in the pouch plus tests to confirm the horse was negative and could be declared disease-free.

Therefore, in Redwings experience, typical cases of strangles can be treated through the physical removal of purulent material by GP wash followed by repeated endoscopy a minimum of 14 days later to test for residual bacteria. Redwings recommends a second negative test before introducing the horse to resident animals although this may not always be necessary depending on individual circumstances/veterinary advice. With this in mind, the costs of full treatment are not likely to exceed the equivalent of three vet call outs and testing.

Advice for vets

Our veterinary surgeons have dealt with a full spectrum of atypical cases as well as forging robust protocols for treating and then clearing the disease. Based on their broad practical experience in routine testing and treatment our vets have published the Redwings treatment protocol for strangles carriers for trainee veterinary surgeons, which is available online.[19]

Cost of quarantine

Prevention is better than cure. Although Redwings is a unique case study, given our size and having our own in-house veterinary surgeons, there is no reason why the value for money of day-to-day biosecurity (quarantine and screening) would not be reflected on a smaller scale. Quarantine equipment costs very little money although the space to quarantine and the tests to ensure resident horses are not carriers of strangles may warrant initial investment in order to put screening in place.

The costs of running our quarantine farm including disinfectant, overalls, diagnostic tests for new arrivals and yard staff time are a fraction of the cost of our wider sanctuary farm operations. The average monthly cost of running our quarantine yard in 2016 was £7,814 per month. Meanwhile, the total extra expenditure incurred during our outbreak was £27,000 in the first month alone (stocks and supplies, blood sampling, additional staff time and transportation - neither figure includes the cost of vet time). Whilst this was a necessary investment to minimise the extent of the outbreak and consequences to our horses and those in neighbouring areas, it demonstrates that our quarantine procedures are value for money.

Why doesn't Redwings vaccinate against strangles?

Although a vaccine is available, it is currently not a viable solution for Redwings horses inside or outside the Sanctuary. Vaccination against strangles has its pros and cons but currently at Redwings our emphasis is placed on quarantine and screening. This is because vaccination is not yet fully protective and, at this stage, requires frequent boosters to provide a good level of prevention, which need complex organisation and management. Furthermore, it is not distinguishable from natural disease which can cause a problem with diagnosis in the event of an outbreak. At this time, Redwings does not recommend strangles vaccination as a replacement for good biosecurity measures to tackle the disease. Research to support the development of strangles vaccination is underway at the Animal Health Trust. For more information about strangles vaccination please visit their website.

[19] Redwings Horse Sanctuary (2016) Treatment protocol for strangles carriers https://www.redwings.org.uk/sites/default/files/Redwings%20Strangles%20protocol%20resource%20for%20website.pdf

6. Methodology

Redwings Strangles Survey overview

A survey was designed to capture owner knowledge of strangles prevention, their attitudes to the disease and their biosecurity practices. The survey included 68 questions in a range of question types along with opportunities for respondents to expand on their answers in open text boxes.

Additional questions were included for those indicating they had strangles experience and those who kept their horse on a livery yard.

The survey was distributed online between 8th April and 8th June 2016 following piloting in March 2016, and it had a significant reach on social media. For example, on the Redwings Facebook page alone, the post about the release of the survey gained 3,800 likes, 1,420 shares and 118 comments. It was also shared by veterinary practices and on mailing lists from organisations such as South Essex Insurance Brokers, and it received press coverage in equine magazines as well as numerous local press and social media pages. A full list of supporters of the survey can be found in the acknowledgements at the end of this report.

Analysis

The online survey was built using Survey Gizmo and basic summary statistics were available through the online software. This has been integrated with the analysis reported here which includes: basic descriptive analysis and graphs, spatial/density plots and hierarchical cluster analysis. Categorical variables were analysed using Chi squared test statistics and a cut-off p-value of <0.05 was considered significant. Where numbers among groups were too small (an expected value less than 5 from the chi-squared test) Fisher's exact test was used. The Kruksal-Wallis test was used for comparisons involving non-parametric data (for example, number of horses owned). Detailed association analysis is presented in data tables in **Appendix 1 to 3**.

Questions explored in analysis of the data

This analysis aimed to provide a detailed description of the respondents and their knowledge, attitudes and approaches to biosecurity.

Profiling:

- Who completed the survey? Where were they from? Other demographic indicators such as age, gender and involvement in equestrian activities.
- What were respondents' experiences of strangles?

- How can this data be grouped to explore the main demographic characteristics of people who completed the survey?

Following analysis to describe the core groups of respondents based on their responses to key questions including yard type, and experience of strangles, a range of questions were explored within the data to examine if there were key differences between the core groups in their attitudes and approaches to biosecurity.

The data were also examined to investigate people's views on strangles carriers:

- What are the views of horse owners on clearing carriers?
- Who do people think should be responsible for clearing carriers?
- What steps are currently being taken by horse owners to clear carriers? How does this differ among horse owners?

Data quality and limitations

As with all surveys, there are a number of caveats that need to be considered when assessing the evidence presented here. For instance, the survey responses may have been affected by selection bias; as the survey was advertised as a strangles survey, those with personal experience of strangles may have been more inclined to take part. However, judging by the number of respondents reporting personal experience of strangles cases (43 per cent), there was an acceptable split of those with, and those without strangles experience, thereby minimising this potential source of bias. Meanwhile, the demographics of respondents were found to be comparable to previous mailed surveys among horse owners and this further reduces the potential effect of selection bias. It should be noted that all answers are owner-reported and therefore veterinary information has not been confirmed.

Strengths of the survey:	Potential weaknesses:
39 per cent completion rate with an average time of 45 minutes. Large number of respondents representing a broad cross-section of the equestrian industry.	Number of partial respondents could possibly be due to the length of the survey, however, the largest drop off was at the beginning of the survey and therefore may indicate that these people were not committed to give time to the survey. As the drop off proportions later on in the survey were small this suggests respondent fatigue was minimal.
Responses were gained from a wide range of horse owners with similar demographics found by other studies, improving confidence in results.	Gender bias; the vast majority of respondents were female, however this a common feature of other surveys of the equine-owning population.
This was a novel survey – and from the number of people starting the survey and sharing on social media, this was clearly a topic of interest.	A mix of question types were used throughout the survey which may have presented some challenges to the respondents. However, the drop off from the survey was steady after the first two questions and did not show a sharp drop for any

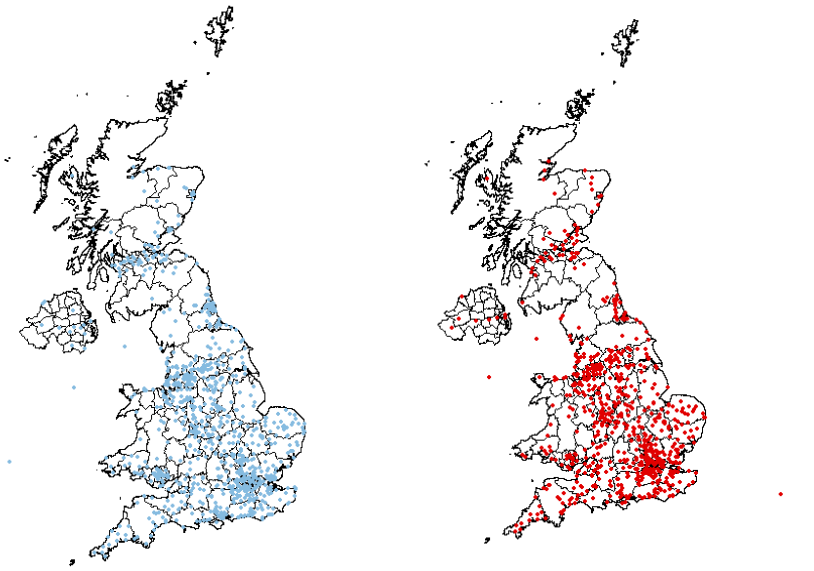
	particular question throughout the survey, so it is anticipated that this was not a major obstacle to respondents.
A sizable proportion of survey respondents who reported personal experience of strangles indicated willingness to take part in further research.	The survey was very broad in focus as it was the first of its kind to our knowledge and aimed to get a general picture of knowledge attitudes and practices. The large volume of qualitative information was unexpected and would benefit from greater investigation.

7. Survey findings

7.1 Redwings Strangles Survey overview

In all, 4,994 people started the survey with 252 initially disqualified as being ineligible to complete it (due to being under 18 and/or did not currently care for a horse). Three respondents answered in a later question that they had no horses in their care and were therefore removed from the dataset.

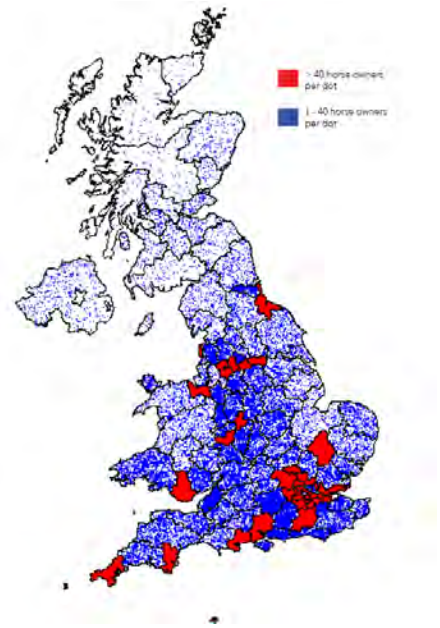
Figure 3: *Location of 2619/4739 (55.3%) partial respondents in blue and 1953/4739 (41.2%) complete respondents in red. A further 167/4739 (3.5%) responses contained no geographical data and were not plotted. Any respondents that completed the last question were considered complete respondents. Eligible respondents that started to complete the survey but did not answer the last question were considered partial respondents.*



Of the 4,739 eligible respondents, 2,002 answered the final question and were considered 'complete respondents'. A total of 2,737 did not reach the end of the survey and were considered 'partial responders'. It should be noted that no questions were compulsory so there was occasionally missing data from individual questions. As the questions on demographics were towards the end of the survey it is hard to accurately analyse the type of respondent who was unable/unwilling to complete the survey. However data

from a question towards the start of the survey indicates that strangles was still a concern for this group.

The geographical distribution of the respondents is shown in **Figure 3** with partial responses in blue and complete responses in red. **Figure 4** is a density distribution map of the location of UK horse-owners according to the National Equine Database (2015). It is provided here as an illustration to compare regions where respondents to this survey originated compared to regions of high horse-owning density. The regions of highest respondent and horse-owning density appear to map well onto each other, providing some evidence that this survey successfully targeted the horse-owning population across the UK.



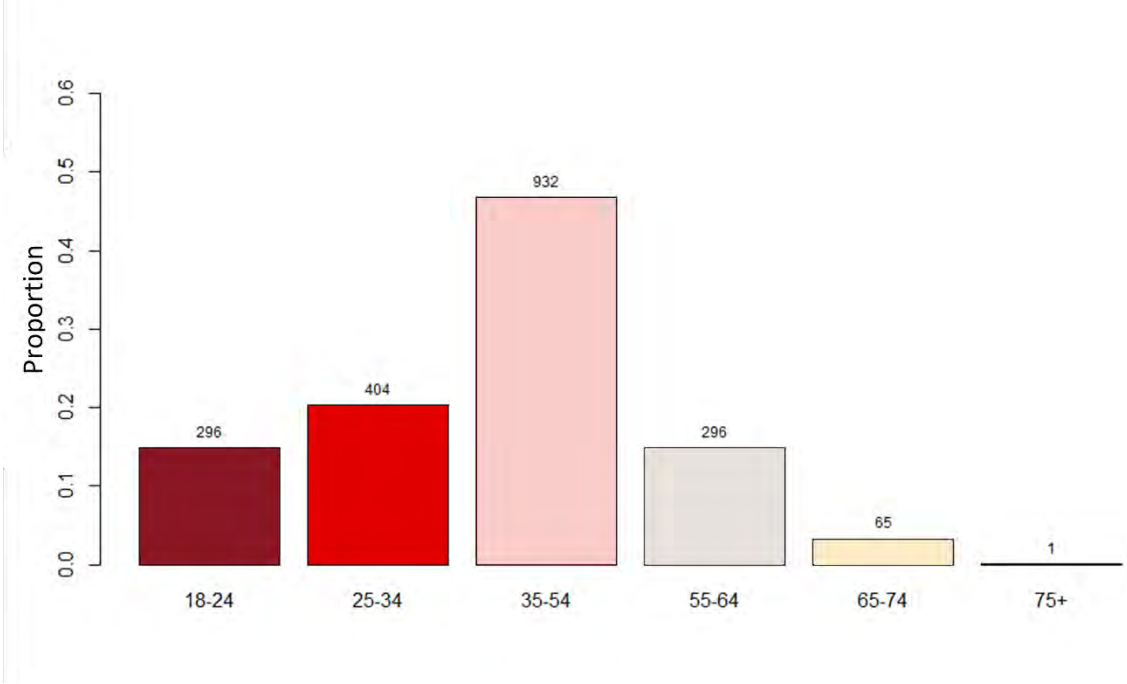
For a more in-depth look at the survey only the data from the complete responses were used. All analysis reported from this point onward is based upon data from the 2,002 complete responses. Denominators (n=) vary in size due to the questions not being compulsory, and therefore, there is missing data for most questions.

Figure 4: *Distribution of horse owners across the UK. Source: Equine Sector 2015 General Election Manifesto for the Horse/National Equine Database.*

7.2 Respondent demographics and horse-keeping practices

In terms of the demographics of those who completed the survey 1901/1,996 (95.2 per cent) were female with only 95/1,996 male respondents. The modal age group was 35-54 for both male and female respondents (**Figure 5**).

Figure 5: *Age of respondents of either gender.*



The proportion of new horse owners (defined as those owning a horse for less than one year) was relatively small (20/1,450 (1.4 per cent)) with the majority having owned a horse for greater than one year (1,259/1,450 (86.8 per cent)) and 171/1450 (11.8 per cent) reported always having had horses in their family or that they had grown up around horses (shown in **Figure 6**).

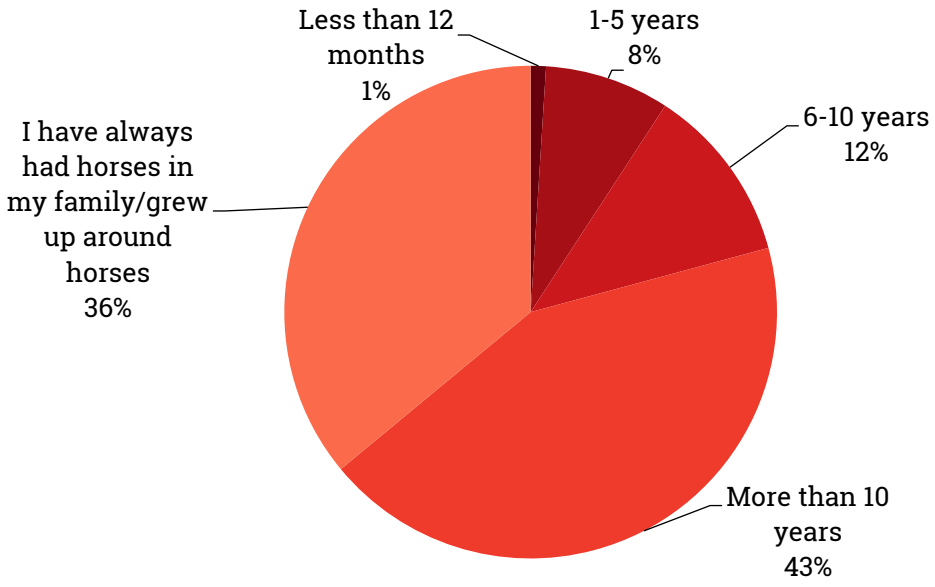
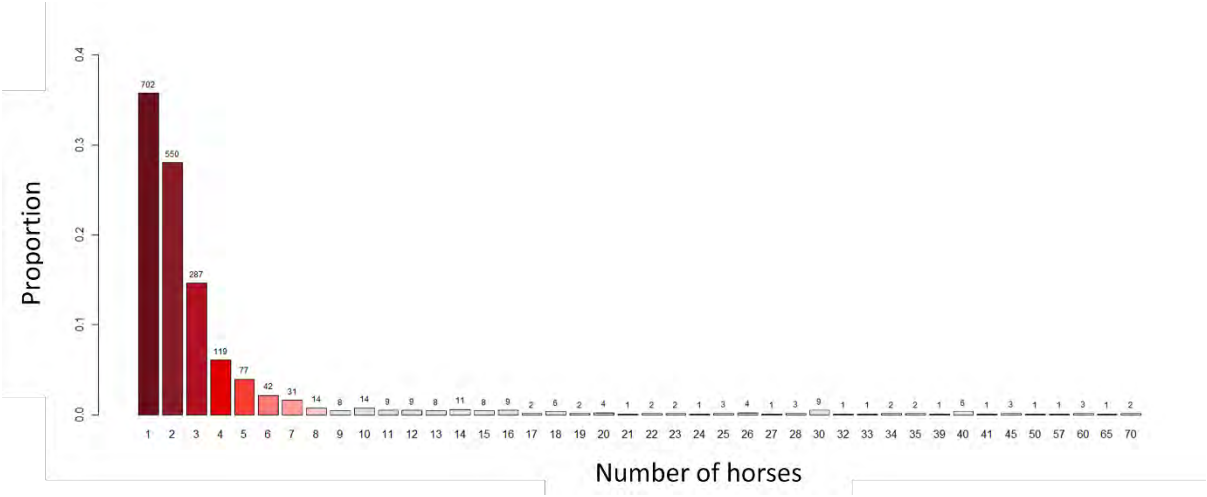


Figure 6: *Period of horse ownership n=1,994*

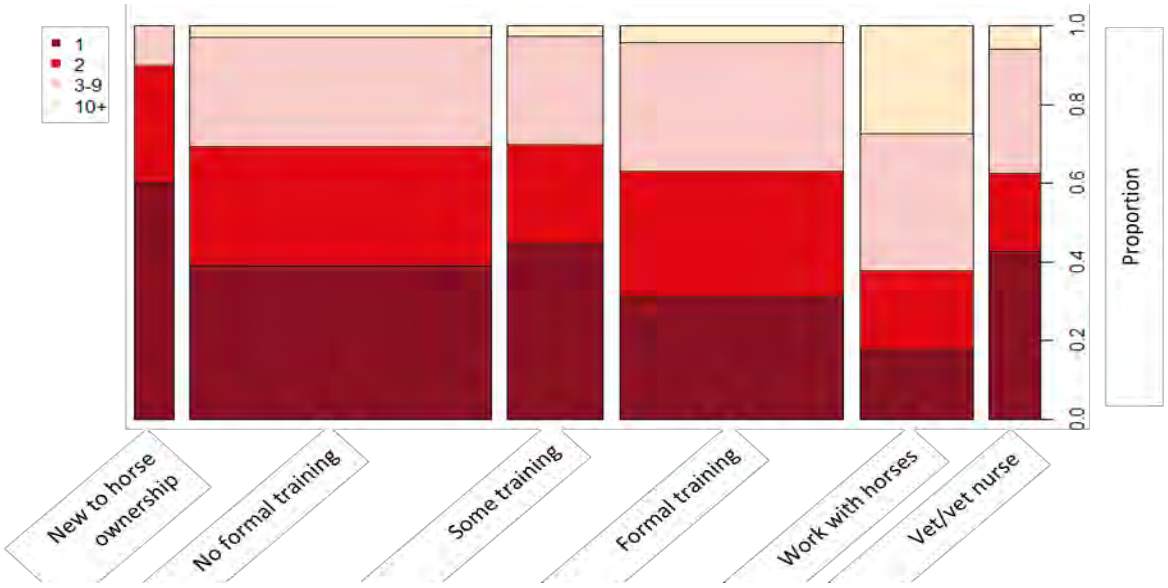
On average, respondents had a mean of 3.7 horses in their direct care with a range of 1-70 and a median of 2.00 horses; most frequently, people tended to own one horse (702/1963 (35.8 per cent)) (see **Figure 7**).

Figure 7: *Number of horses in the direct care of respondent. The frequency of each category is indicated in numerals above the bar chart, the vertical axis represents the proportion of responses among 1963 horse owners.*



The following spine plot shows the level of training of respondents compared to the number of horses in their direct care (**Figure 8**).

Figure 8: *Spine plot of level of training compared to number of horses in the direct care of respondent. Question options were given with examples. 'Formal training' included BHS qualifications, Pony Club Tests or equine studies qualifications (n=532). 'Some training' was described as having had training but no formal certificates (n=231) and 'no formal training' was described as "no formal training but have always had horses" (n=709).*



Respondents were asked where they took their last horse on from, with the most popular option being obtained from a friend 451/1,985 (22.7 per cent) (**Figure 9**).

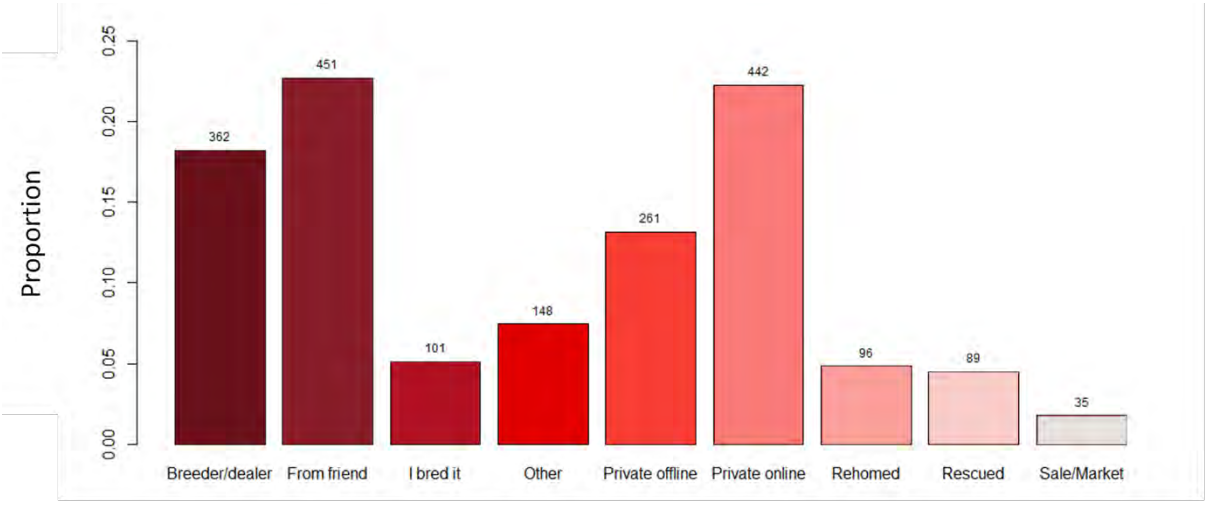


Figure 9: *Origin of last horse. Frequencies are indicated in numerals at the top of each column, and the proportion of respondents is indicated by the vertical axis.*

1,772/1,989 (89.1 per cent) respondents indicated that their horse/s were up to date with the flu vaccination. This is much higher than the national average for which estimates suggest that coverage is in the region of 30-40 per cent nationwide.

Leisure, hacking and competitive events were the three most popular activities indicated by horse owners. The chart in **Figure 10** indicates the range of activities that respondents were involved in. Respondents could select up to three maximum responses.

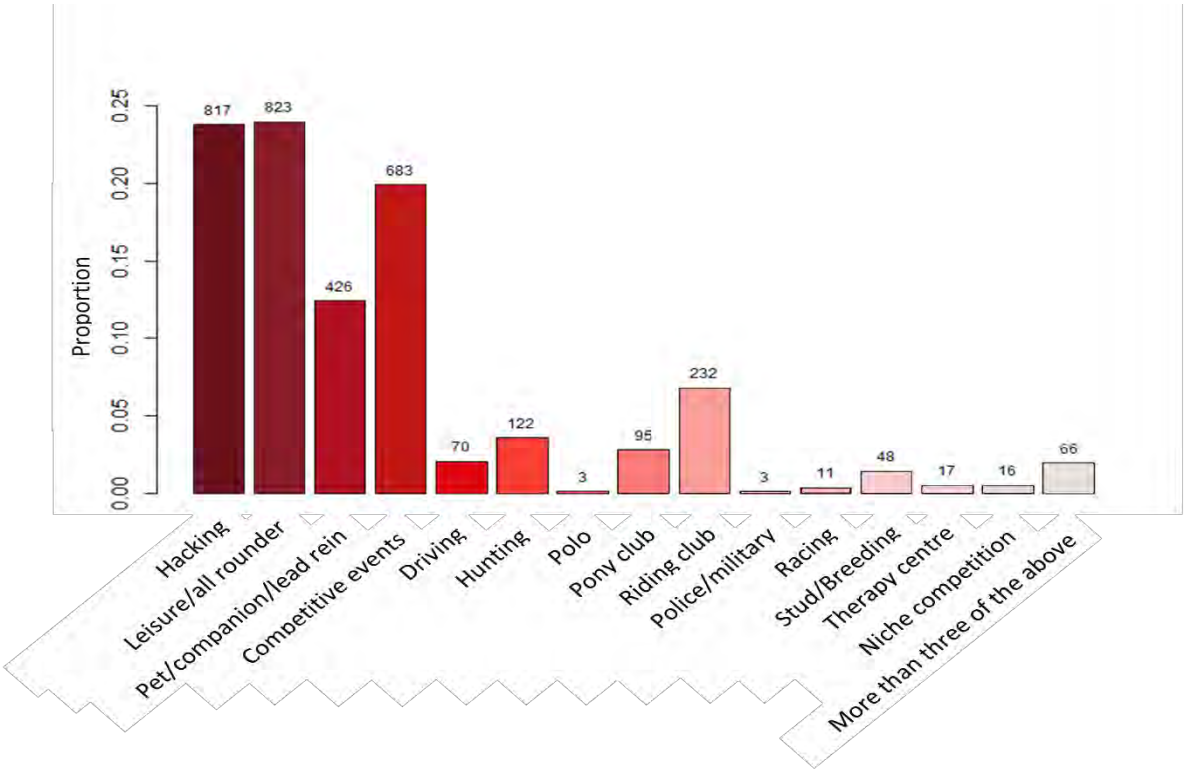


Figure 10: *Bar chart showing frequency of responses for a range of equestrian activities. Frequencies are indicated in numerals at the top of each column, and the proportion of respondents is indicated by the vertical axis. The category labelled 'Leisure/all-rounder' was described as "Leisure/non-competitive all-rounder (riding club/occasional local show)", the category labelled 'more than three' indicates respondents who selected more than three types of equestrian activity. The pet/non-ridden category includes young and retired horses.*

Respondents were asked where their horse/s were kept with the following five categories as options defined as: 'own home with no other owners' horses', 'commercial yard environment (such as livery competition yard, stud or riding school)', 'private land shared with other owners' (renamed as private-mixed), 'private land with no other owners' (renamed as private – closed), and 'other' (**Figure 11**). Most respondents kept their horse at a commercial yard (799/1,964 (40.7 per cent)) and on land with other horse owners 1,296/1,964 (66.0 per cent), grouped as commercial and private-mixed.

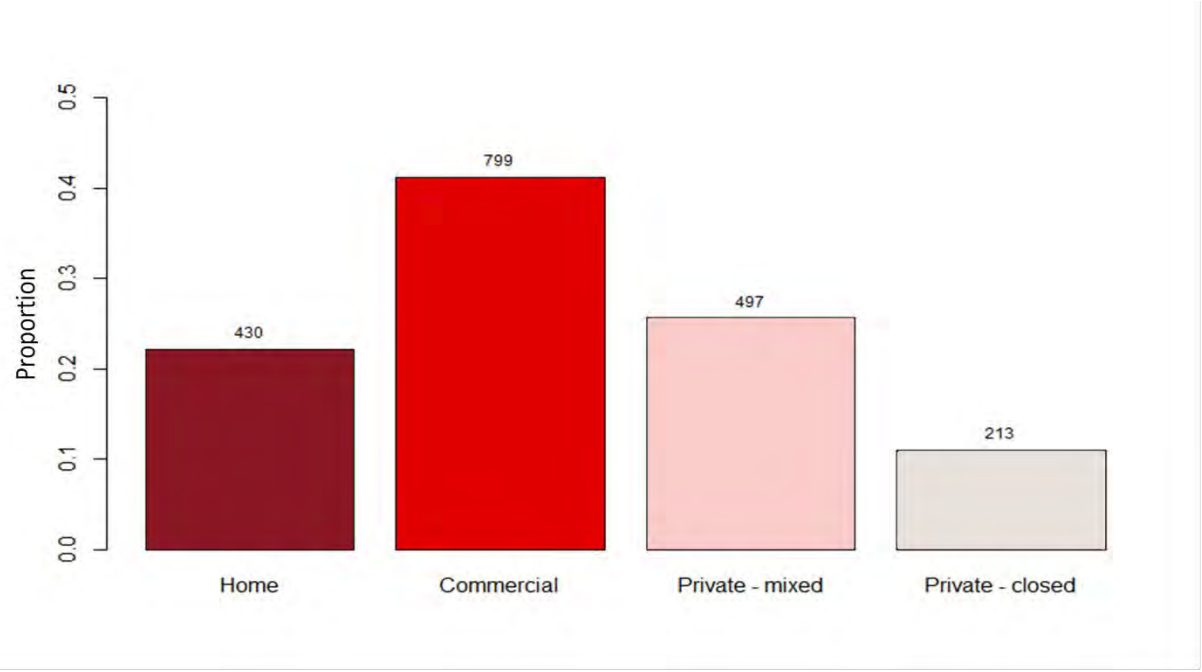


Figure 11: *Bar chart demonstrating where horse owners kept their horse. Numerals at the top of each column indicate the numbers, and the vertical axis indicates the proportions for each category.*

Respondents were asked how often they travelled with their horse off their yard to shows or competitions. Nearly half, 886/1,984 (44.7 per cent), indicated that they travelled off yard at least once a month, a further 387/1,984 (19.5 per cent) kept their horse at a yard where others would travel to shows or competitions.

The following spine plot (**Figure 12**) compares the frequency of attending events off yard and yard type. Although there was movement off yard among all yard types, the yard types indicating the most movement off yard tended to be the 'commercial premises' and 'private-mixed yards', however, these groups also had the largest proportions of respondents who indicated that 'they never move off yard whereas

others do' highlighting the mixed nature of exposure among this group. It is worth considering that although many on commercial yards may not travel, contact with horses that travel regularly still poses a risk regarding the introduction of infectious disease. Among respondents indicating frequent movement off yard (i.e. every other week and every week), it was the 'private-mixed' yard type that had the largest representation. Perhaps unsurprisingly, the largest group for 'never moving their horse off-yard' was represented by those keeping their horses at home.

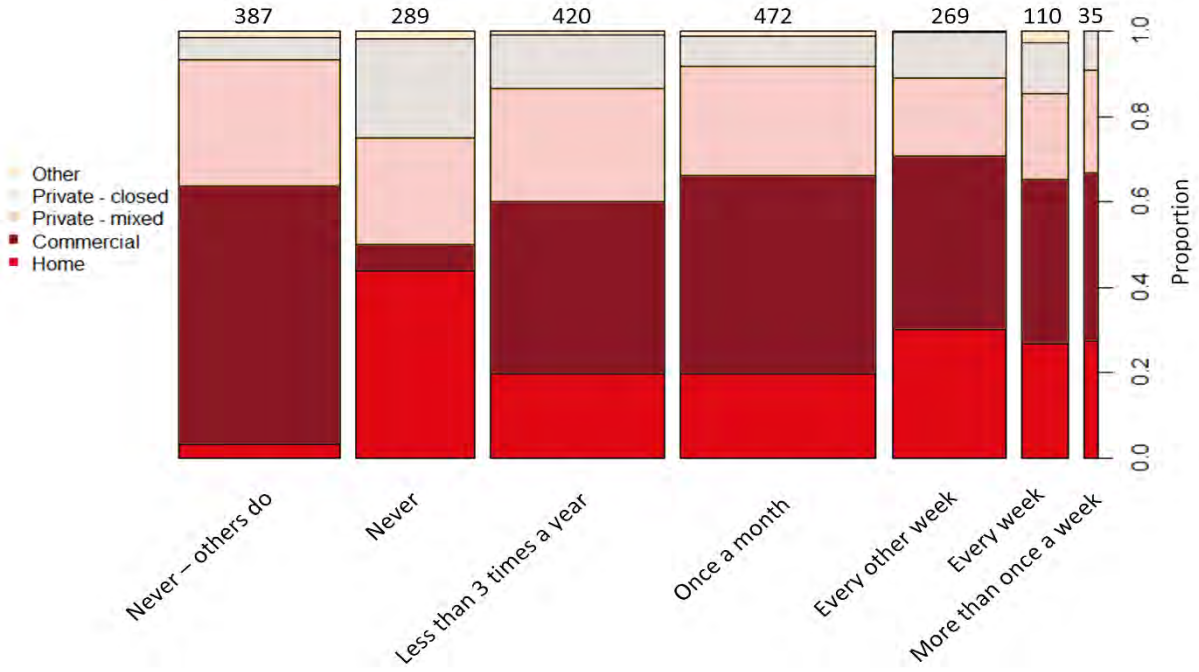


Figure 12: *Bar chart demonstrating where horse owners kept their horse compared to frequency of travel. Numbers at the top of each column indicate the numbers, and the vertical axis indicates the proportions for each category.*

From their responses only 148/2,002 (9.19 per cent) are potentially at minimal risk of exposure to strangles These respondents never took their horse off the yard, kept their horse in a closed herd with no other owners' horses and participated in hacking or kept their horses as a pet/companion/lead-rein (non-ridden) pony. This means that almost 90 per cent of respondents had some level of risk of exposure to strangles infection based on whether they kept their horse in an 'open herd' environment or travelled their horse to events.

Personal experience of strangles

In total, 857/1,991, 43 per cent, of respondents indicated that they had previous experience of strangles that was either suspected, or confirmed by a vet in their own horse, at their yard or at their place of work. 886/1,991 (44.5 per cent) said that they had

never had direct experience of strangles and 248/1,991 (12.5 per cent) ticked 'other' and were not included in the density maps. In total, 208/852 (24.4 per cent) respondents indicated they had experienced strangles recently i.e. within the last 12 months. Those experiencing strangles longer than 12 months ago had strangles cases reported 'between 12 months and 5 years ago' and 'over 5 years ago' and were grouped together as historic cases (n=636/852 (74.6 per cent)). Only eight (0.9 per cent) respondents answered this question with 'sorry I'd prefer not to answer' and were not included in the density maps. A total of 832 respondents listed the county in which the case occurred, where 207/832 (24.9 per cent) were reported as recent cases within the last 12 months, and 625/832 (75.1 per cent) reported as historic cases, or longer than 12 months ago. The spatial distribution of owner reported recent and historic strangles cases are illustrated in **Figures 13 and 14**.

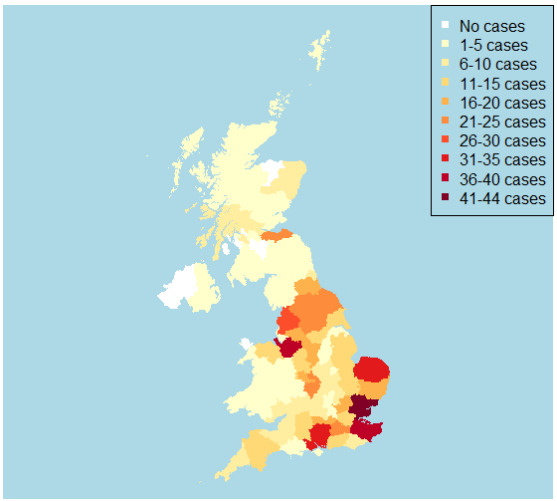


Figure 13: *Density map of historic (greater than 12 months ago) cases of strangles (these data include confirmed and suspected cases of strangles).*

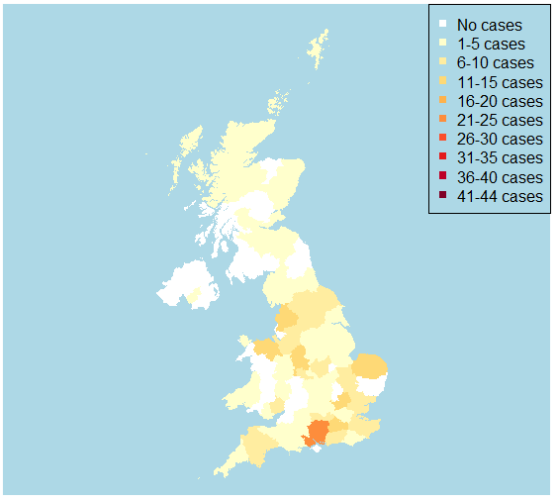


Figure 14: *Density map of recent (within last 12 months) cases of strangles (these data include confirmed and suspected cases of strangles).*

Figure 15 is a spatial plot illustrating the counties where the respondent reported that their horse had experienced a case of strangles that was confirmed by a veterinary surgeon, totalling 385/832 (46.3 per cent) respondents. These confirmed cases were split as 315 (81.8 per cent) historic and 70 (18.2 per cent) recent cases, within 12 months. The breakdown of the 70 recent cases per region was as follows: 13 regions with one case, 12 regions with two cases, seven regions with three cases and three regions with four cases. Note that this county data is based on the current address of respondents and therefore may not directly indicate the exact location of where the horse was stabled at the time of their confirmed strangles infection.

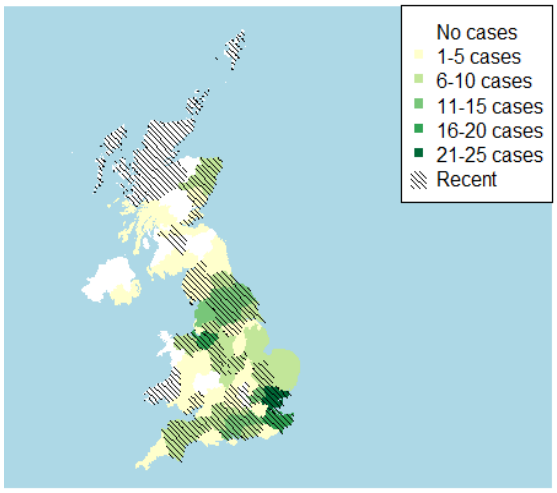


Figure 15: *Spatial plot indicating confirmed cases of strangles, plotted by current county of residence of respondent. The plot combines recent and historic confirmed strangles cases, with the regions where recent strangles cases have been confirmed by a veterinary surgeon within the last 12 months indicated by hatched lines.*

Origin of advice

Respondents were asked where they usually accessed horse care advice in normal circumstances, compared to where they would go in the event of an outbreak of disease. Whilst their vet was the most popular category in both situations, the proportion rose from 72.1 per cent (1,444/2,002) normally to 93.6 per cent (1,875/2,002) in the event of an outbreak (**Figure 16**).Meanwhile, in almost all other categories the proportion of respondents drops considerably, emphasising the important role of vets during an outbreak situation. Although reduced, internet search retains importance in comparison to advice from friends with horses.

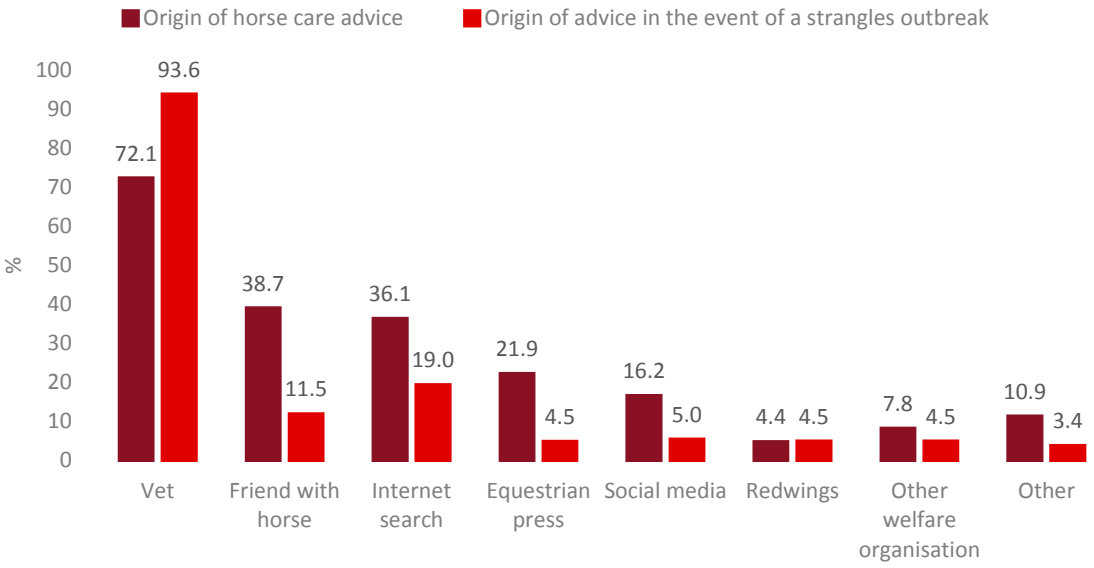


Figure 16: *Grouped bars showing the proportion of completed respondents (n=2002) who reported main information source for horse care advice (burgundy) and in the event of a strangles outbreak (red). Respondents could select more than one answer n=4,167.*

Awareness of existing advice and guidance was variable (**Figure 17**). All completed respondents received copies of this guidance following the survey.

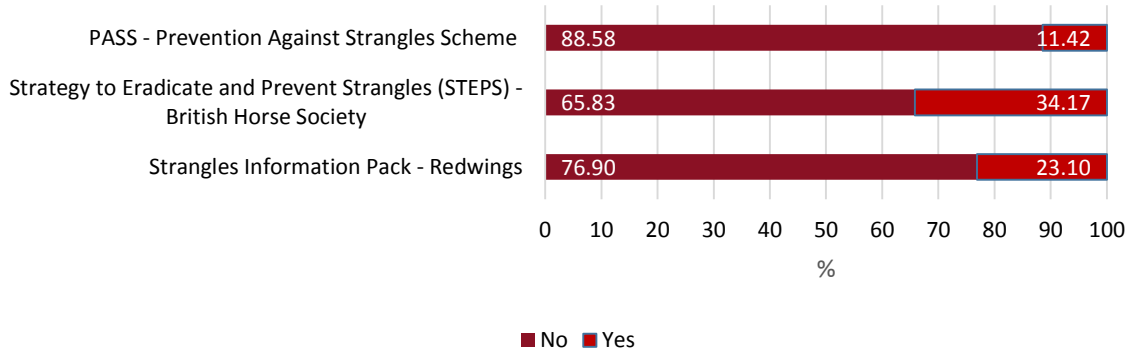


Figure 17: *The proportion of respondents who reported awareness of existing strangles educational information.*

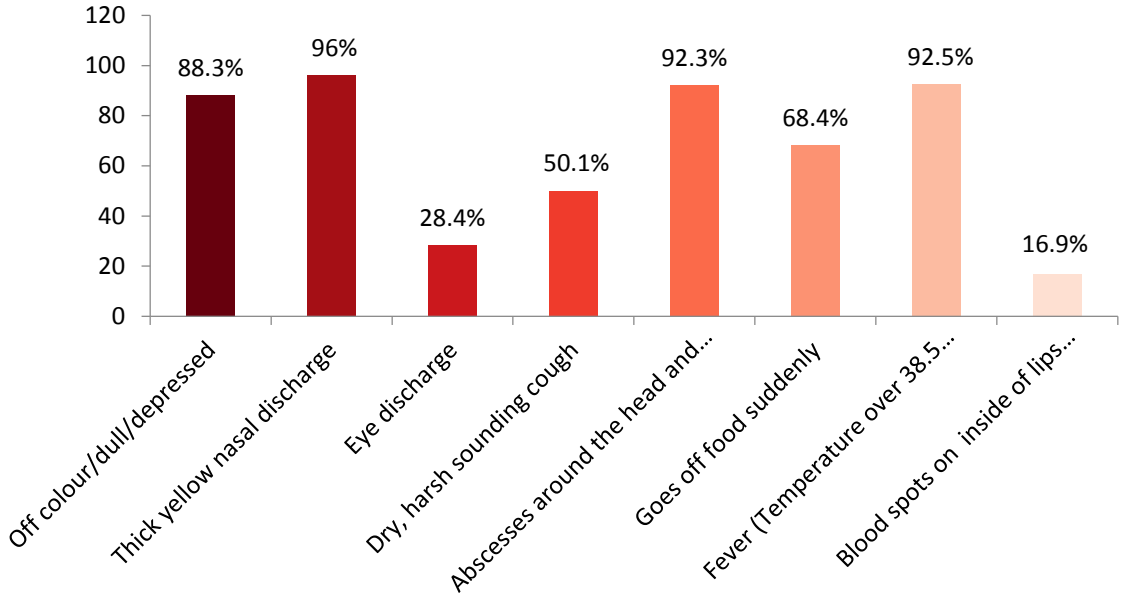
Respondents were asked a simple yes or no question as to whether they knew what was meant by a 'red, amber and green' quarantine approach to outbreak management which is widely recommended in available horse owner advice and in both the Redwings and BHS publications. 50.8 per cent (683/1,345) reported to be aware while 49.2 per cent (662/1,345) reported not to know of this approach to outbreak management.

7.3 Knowledge, attitudes and biosecurity practices

Clinical signs

Overall there was good identification of the symptoms **(Figure 18)** including identification of the earliest signs of disease, with 92.5 per cent correctly identifying fever and 96.0 per cent identifying the classic, but later, clinical sign of thick yellow nasal discharge. A minority of respondents selected two signs that are less commonly associated with strangles, with ocular discharge (28.4 per cent) being more frequently selected than blood spots on gums (16.9 per cent).

Figure 18: *To "Which of these clinical signs can typically be caused by strangles?" respondents could tick as many as apply (n=1919).*



Disease process and infectivity

In a list of true and false statements, over a third of respondents (36.04 per cent) thought that strangles is an 'airborne disease (like flu)' a misconception that may lead to people thinking that it is more difficult to prevent.

True or false question	Correct answer	Correct (%)	Incorrect (%)	Unsure (%)	n=
Strangles is an airborne disease (like flu)	F	59.16	36.04	4.80	1,981
Strangles usually has an incubation period of 14 days (the period of time between exposure to the disease and when symptoms appear)	T	79.14	8.61	12.24	1,985
After a horse has had strangles, it is immune to all future infections of strangles (similar to chickenpox in humans)	F	62.93	17.62	19.45	1,969
Horses that have recovered from strangles without veterinary help could still infect other horses in the future	T	71.20	11.55	17.25	1,965
Strangles can have serious, potentially fatal, complications	T	98.17	0.97	0.86	1,967
The strangles disease cannot survive outside the horse's body for more than a few minutes	F	70.34	7.54	22.12	1,976
Strangles is a viral respiratory disease	F	20.52	70.30	9.18	1,983

Table 1: *Comparison of correct, incorrect and unsure responses to true or false questions.*

There was greatest uncertainty regarding whether strangles can live outside the horse's body with 22 per cent of respondents selecting 'don't know' to this question. Respondents were aware and most sure (98.17 per cent) that strangles can have serious complications.

The vast majority of respondents (79.1 per cent) correctly identified that the usual incubation period is 14 days and just 12.2 per cent of respondents said they did not know. However when asked for the ideal minimum period of time for quarantine only 56 per cent chose the correct duration[20].

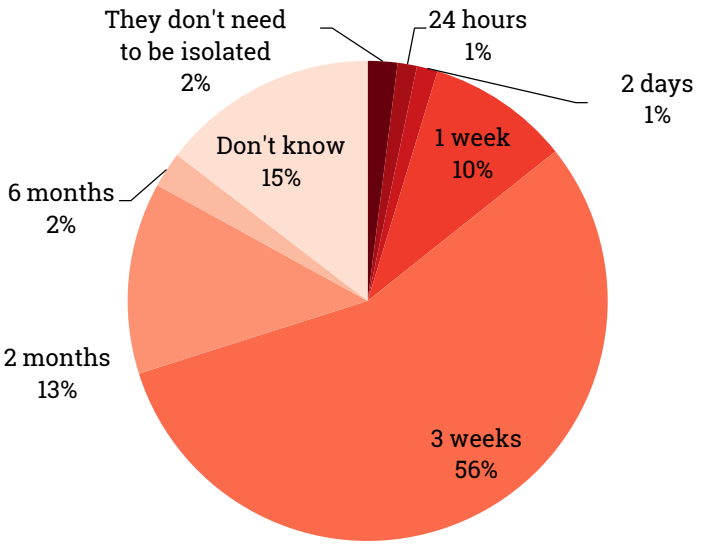


Figure 19: *Respondents were asked do you know the ideal minimum period of time a horse should be isolated and monitored for strangles after having contact with other horses? (e.g. after events) n=1997.*

Carriers[21]

Almost a third (29 per cent, 566/1,965) of respondents were incorrect or unsure about whether a horse that had recovered from strangles without veterinary help could go on to infect other horses in the future. 71.2 per cent correctly answered 'True' to this question (**Table 1**). In contrast, a much higher proportion reported to know what a carrier was with 82.6 per cent (1,625/1,965) responding yes to whether they knew what a carrier was. 4.4 per cent (87/1,965) said no and the remainder were unsure (12.9 per cent 257/1,965).

A range of questions explored people's views about conducting confirmatory tests about the carrier status of the animal. Just over half (1,126/1,989 (56.6 per cent)) of the respondents thought sellers should be obliged to prove that the horse was not a strangles carrier prior to closing the sale (**Figure 20**).

[20] In Figure 19 3 weeks was the correct option. Although the current recommended quarantine period is 14 days, the actual incubation period is now thought to be longer based on Redwings' outbreak experience.

[21] 'Carrier' means the horse was potentially infectious to other horses whilst being outwardly healthy/not displaying clinical signs

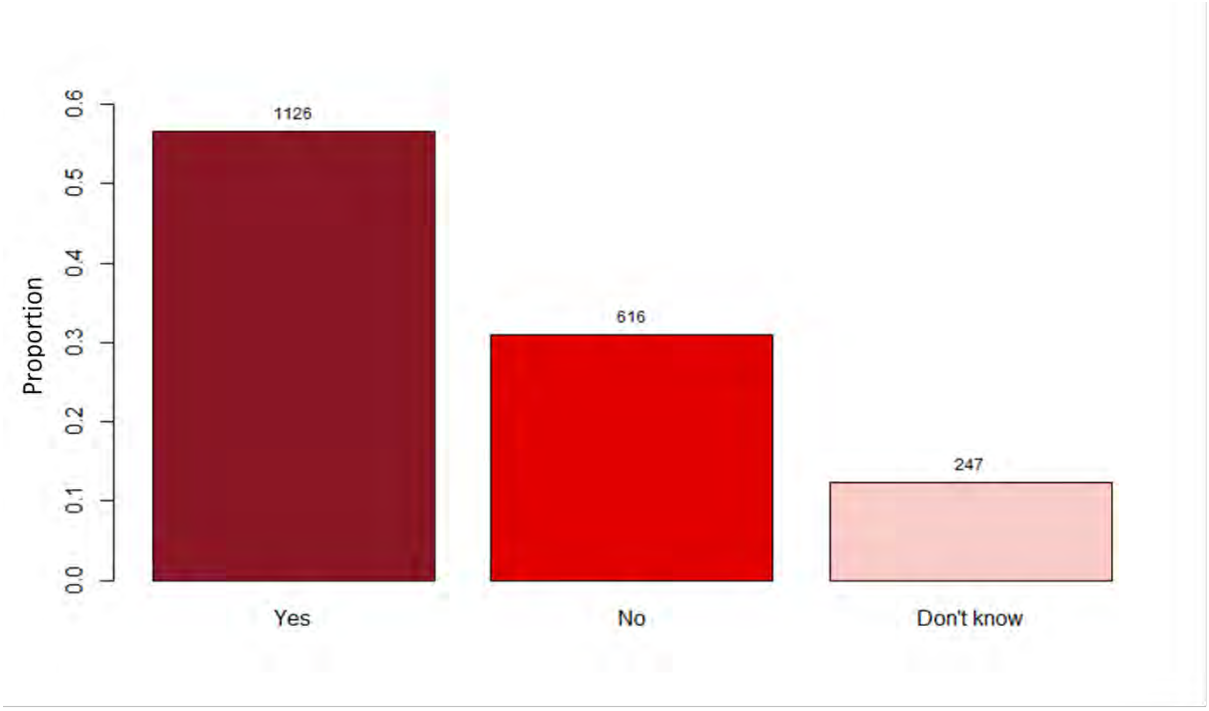


Figure 20: *Responses to 'Should sellers be obliged to confirm to the buyer that the horse is not a strangles carrier?'*

In the event that their horse had strangles, most people indicated that they would pay for a call out with a large proportion indicating they would be willing to pay for three or more call outs in order to confirm that their horse had not become a carrier (**Figure 21**).

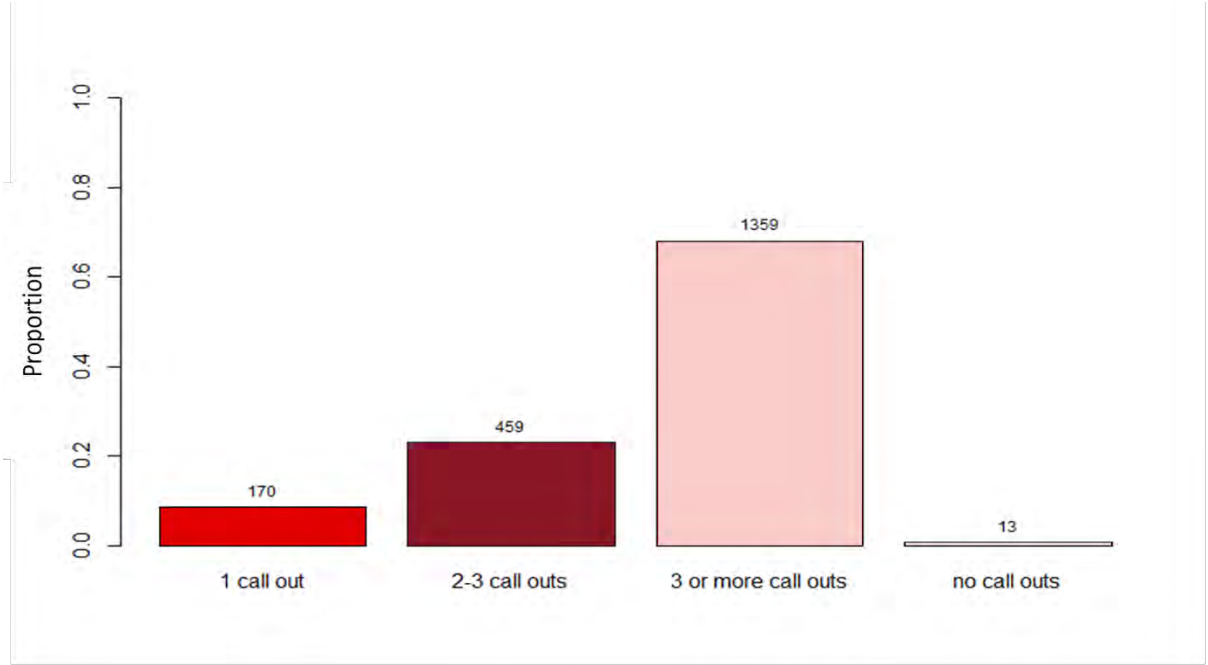


Figure 21: *Number of vet call outs respondents would be prepared to pay for in the event that their horse had strangles infection.*

Those who listed that they kept their horse at a livery yard (e.g. commercial or rented/private yard with other owners (totalling 1,296/1,964 (66.0 per cent)) were asked a further set of questions about the biosecurity practices at their yard.

The majority (1007/1345 (74.9 per cent)) said that horses were not screened for strangles on arrival (**Figure 22**).

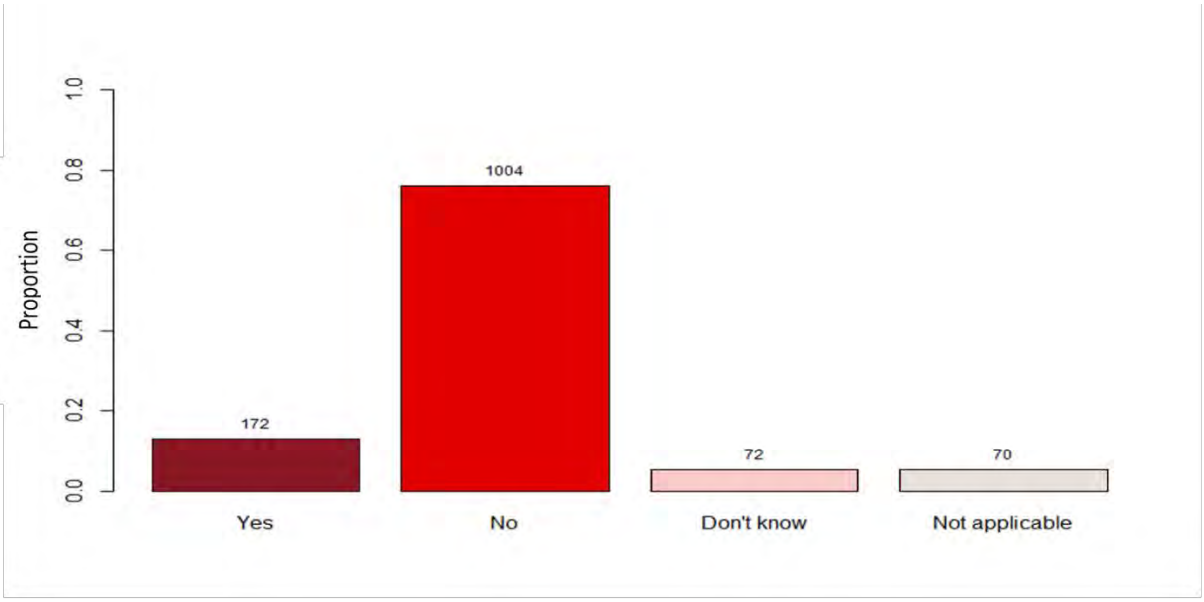


Figure 22: *Screening for strangles of new arrivals to yard.*

A free text comments box was given with this question and 121 respondents (9 per cent) left a comment.

Table 2: *Highlighting some of the key themes that appeared frequently in comments box relating to question of whether they had screening at their yard*

Theme	Number of respondents	Description of theme
Isolation	35	Indicating that their yard has an isolation or quarantine procedure. Duration of quarantine reported to range from 24hrs (worming mentioned as a reason) to two or three weeks.
None	32	No current practices at the yard with a range of reasons provided including: no arrivals to their yard, arrivals only of horses with a trusted history, screening not commercially viable/feasible, no yard policy of screening, screening a waste of time/money.
Testing	19	Testing done on arrival, often blood tests.
Change	19	Suggestions of a change in procedure due to recent outbreaks of strangles on the yard/in the area leading to an introduction of testing or quarantine. A popular response to the question "are new arrivals to your yard screened for strangles?" was "They are now".
Wish	14	Desire for a better system to be in place at their yard, complaints of different standards for different people.

Monitoring	1	Without quarantining
Vaccination	1	"They are all vaccinated"

Despite this rather stark statistic, half (549/1,079 (50.9 per cent)) of those asked said that they would be more likely to want to use a yard that had a policy of screening new arrivals when choosing somewhere to keep their horse (**Figure 23**). Nearly 80 per cent

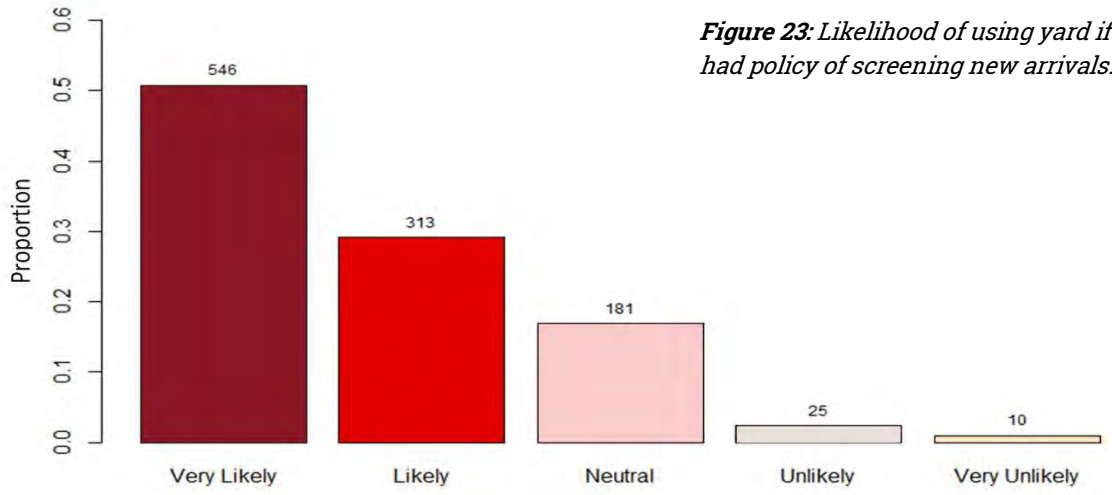


Figure 23: *Likelihood of using yard if it had policy of screening new arrivals.*

(855/1,078) responded that they would even be prepared to prove that their horse was not a carrier of strangles in order for their yard to introduce an improved biosecurity policy that included a requirement for screening new arrivals (**Figure 24**).

Of those who attend events, 82 per cent (974/1,187) reported that they do not quarantine or monitor the health of their horse after mixing with unknown horses. A minority of respondents who attend events quarantine and/or monitor their horse when they

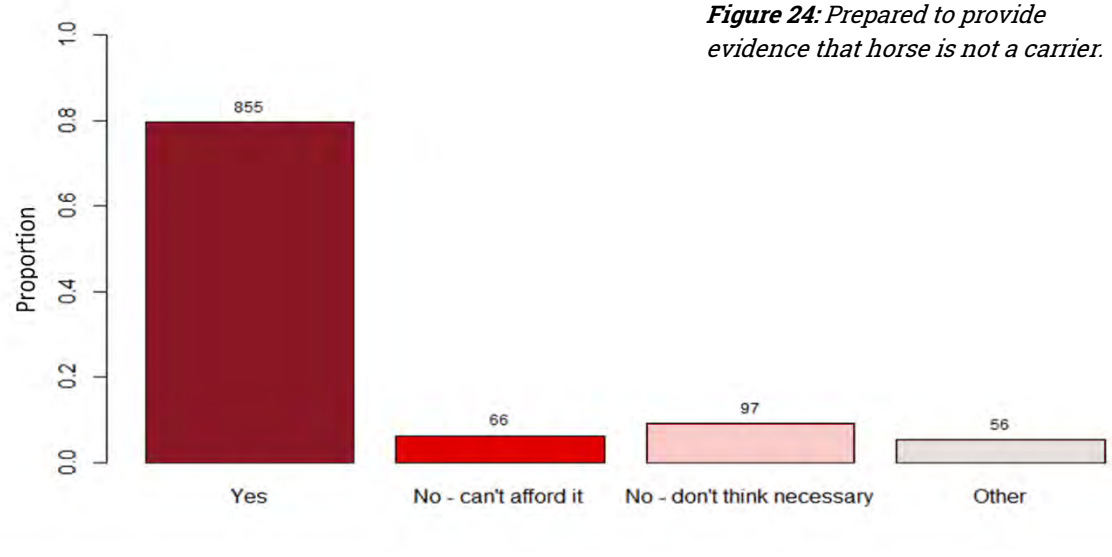


Figure 24: *Prepared to provide evidence that horse is not a carrier.*

return from all or some events (17.9 per cent, 213/1,187). These respondents were asked to report the length of time they usually separate their horse for. Most respondents reported a period of two weeks (71/210) whilst 52/210 respondents reported a period of up to two days. Less than half (42 per cent) reported a minimum of two weeks or more.

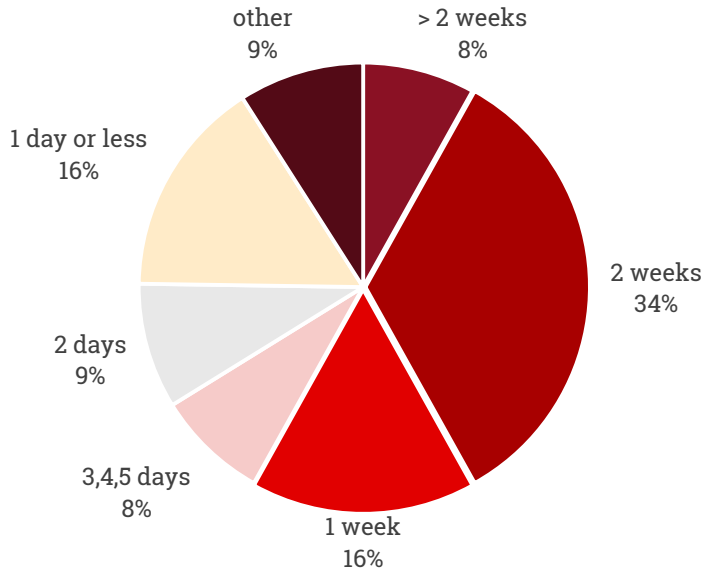


Figure 25: *How long is your horse normally in isolation from other horses after returning from an event? (Open response question n=210). Chart shows the frequency respondents reported the respective period of time. Other' includes responses that did not distinguish between days or weeks or fell outside the categories listed here, e.g. "a few hours".*

The 1,399 (71.2 per cent) of respondents who answered true to the true or false question regarding whether untreated/screened horses could cause future infections were compared to the other 566 who thought the statement was false or didn't know the answer in order to see trends regarding knowledge of what a carrier is.

Those who selected "true" tended to have more formal training, have worked with horses or were vets/vet nurses. They tended to be less likely to have no formal training or be new to horse ownership. They tended to be more aware of Redwings' Strangles Information Pack, the STEPS and PASS advice (349/1,934 (18 per cent)).

Those who selected "true" tended more often to use yards where new arrivals were screened for strangles, and tended to be more keen to pay for 3+ vet call outs in the event of their horse catching strangles. This suggests that there may be a correlation between knowledge of carriers and better biosecurity decision-making, i.e. the use of screening and commitment to full treatment to ensure a horse with strangles does not become a carrier.

The results of statistical analysis comparing these responses are available in **Appendix 3**.

Due to the central importance of screening horses for strangles after recovery from clinical signs, respondents with previous experience of a strangles outbreak were asked if the horse had been confirmed clear of being a carrier of the disease by a vet. **Figure 26** shows that under two thirds of respondents confirmed that they could be confident the horse(s) were not carriers of the disease. Meanwhile 18% did not know.

19% knew that the horse had not been screened and could therefore be a carrier (and therefore cause future outbreaks).

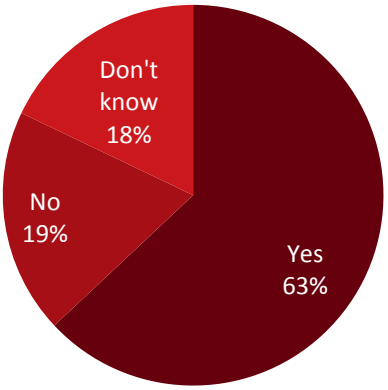


Figure 26: *Chart showing responses to 'Was the horse cleared of being a carrier of the disease? (Confirmed by a vet)' n= 837*

Ability to isolate/quarantine

Respondents were asked if they could set up a quarantine area if they wanted to and if not why not. 462/1,987 (23.3 per cent) answered that they couldn't isolate their horse if they wanted to.

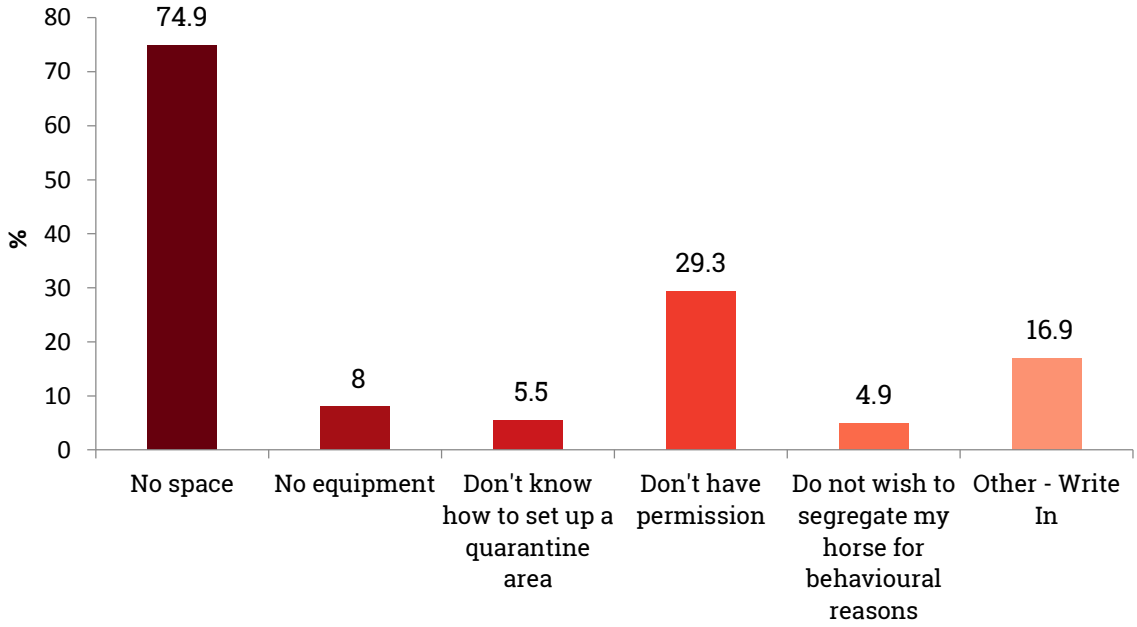


Figure 27: *Reasons respondents felt unable to set up a quarantine area. Respondents could select more than one answer (n=629).*

The free text responses given as 'other reasons' are detailed in **Table 3**. The following key themes occurred frequently:

Theme	Number of responses	Description of Theme
Yard facilities	40	No facilities and the yard's layout were cited as factors restricting the possibility of setting up an isolation area.
Yard management	23	Yard management was often referred to as a barrier to setting up isolation including a lack of preparation, no yard isolation policy, or not allowing an isolation area to be established.
Space	17	Space was considered to be a major challenge for setting up an isolation area including problems of horses walking past other stables, separation distance between an isolation stable and other stables. The location of stables in a row or where horses can touch noses was also mentioned as a problem when trying to set up an isolation area.
Others	13	Problems with other people or horses including horses in neighbouring fields, public rights of way, riding school clients, other owners/livery clients. Opinions that everyone needs to cooperate to successfully isolate a horse.
Possible	8	Responses that isolation would be possible; "something probably could be worked out" perhaps suggesting the absence of a yard policy in place.
Logistics	6	Logistical problems with access to some fields through other fields.
Stables	6	Yards with no spare stables were mentioned.
Barn stabling	5	Barn stabling was mentioned as a reason for not being able to isolate.
Field	4	Horse/s kept in fields with no access to a stable; perceptions that it is not practical to separate in field.
Herd	4	Herd living cited as a reason for not being able to isolate.
Livery yard	4	Comments consisting of "livery yard"
Infection	2	Recollections of intentionally infecting all horses during an outbreak of strangles, one suggested this was recommended by the vet.
Futility	1	The idea of isolation being futile; "if one horse gets it they all will".

***Table 3**: Comments surrounding the ability to isolate their horse should the need arise.*

The survey investigated to what extent different equipment and facilities were shared at home and at events in order to identify possible high risk fomites (**Table 4**). Transport was the most commonly shared suggesting horse transport providers may be a key target audience for further research and education regarding biosecurity practices.

At home, water tanks and muck clearing equipment were found to be the most commonly shared items. Particular attention to muck clearing equipment which is easily moveable throughout a yard would be advisable on this basis. Buckets and basic tack were least shared overall at events and where respondents keep their horses.

	Responses (%)					
	Yes (BOTH where I keep my horse and events)	**Yes** (ONLY at events)	**Yes** (ONLY where my horse is kept)	**No** (I don't share equipment)	**Not Applicable** (I don't go to events or have anyone to share equipment with)	**Count**
Haynets/feeders	7.12	3.44	10.76	15.42	10.97	1,979
Buckets (water or feed)	5.49	4.97	9.23	16.10	11.33	1,977
Basic tack and/or grooming kit (such as headcollars, lead ropes)	5.19	3.06	9.85	16.03	10.88	1,974
Wheelbarrow and muck-clearing equipment	14.54	5.74	19.92	9.77	9.53	1,930
Grazing at events	23.89	28.11	7.90	10.30	20.94	1,918
Stables/shelters	9.50	18.93	10.96	13.23	10.70	1,903
Shared water tanks	11.42	8.22	19.60	9.50	9.80	1,893
Transport (e.g. trailer, lorry or horsebox)	22.85	27.53	11.79	9.66	15.87	1,902

Table 4: *Respondents were asked which equipment they shared with other horse owners at home and at events. Figures show the most commonly shared equipment or facilities as a proportion of response option.*

Perspectives on the equine industry

The questionnaire explored people's opinions on the role of the equine industry and where the focus of responsibility should be for preventing strangles. 90.8 per cent (1,806/1,990) of respondents felt strangles should be more of a priority within the equine industry. 7.2 per cent did not know and 2.1 per cent selected no.

Respondents thought that responsibility should lie with the following sectors (placed in order from most responsible to least, figures in brackets are median ranks for each of the sectors): horse owners (1), dealers/sales/markets (3), livery yard managers (3), event organisers (4), vets (5), instructors (7), equine charities (7), dentists (7), farriers (7) (illustrated in **Figure 28**).

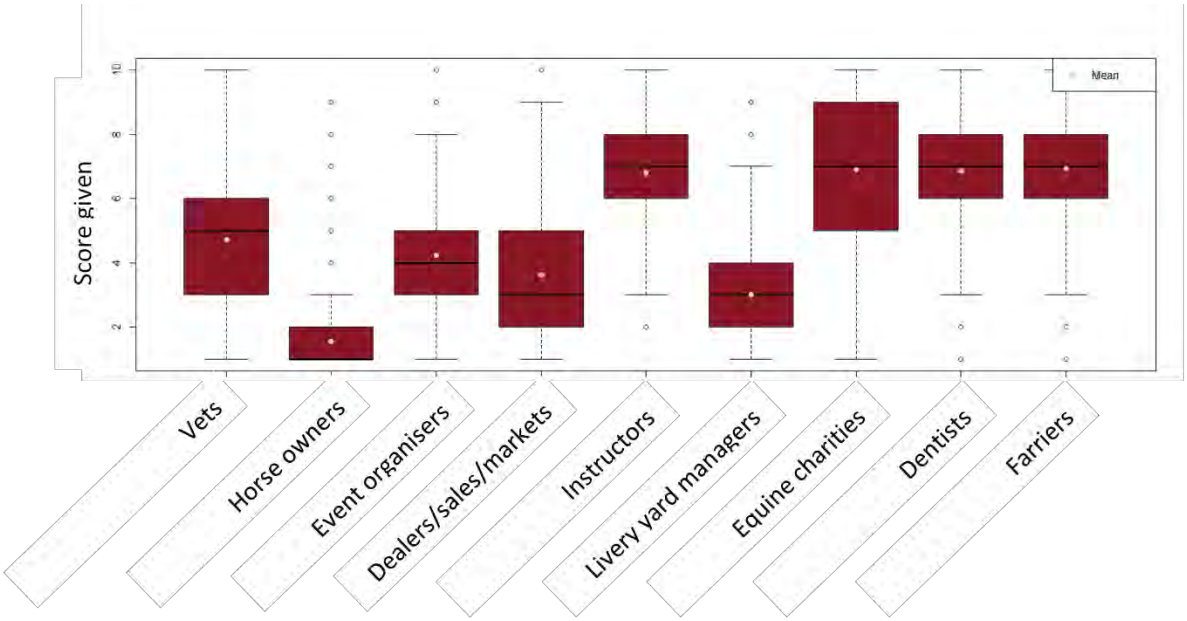


Figure 28: *Box and whisker plot illustrating the distribution of responses to which sectors have the most responsibility in preventing the spread of strangles. Responsibility is indicated on a scale where 1 = the most responsibility through to 10 = the least responsibility. The median response is indicated by a solid black line in the middle of the box, and the mean value is indicated by a red point.*

Respondents were also asked about their thoughts on the efforts made by a range of sectors of the equine industry in their approach to biosecurity. **Figure 29** indicates the responses about the biosecurity efforts of dealers and horse sales, where 88.1 per cent (1,723/1,956) were of the opinion that efforts should be increased by this sector.

Figure 29: *Views of respondent of dealers'/horse sales' approaches to biosecurity.*

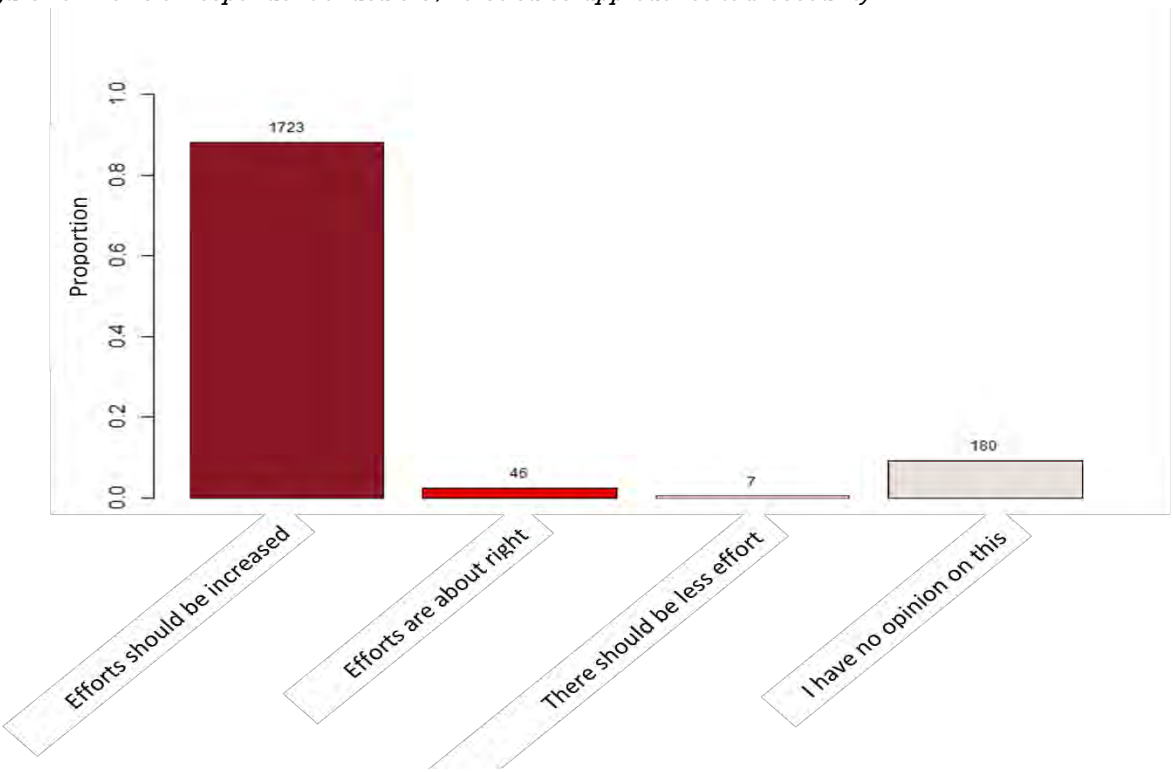


Table 5: *Views of the efforts made to improve biosecurity by different sectors of the equine industry.*

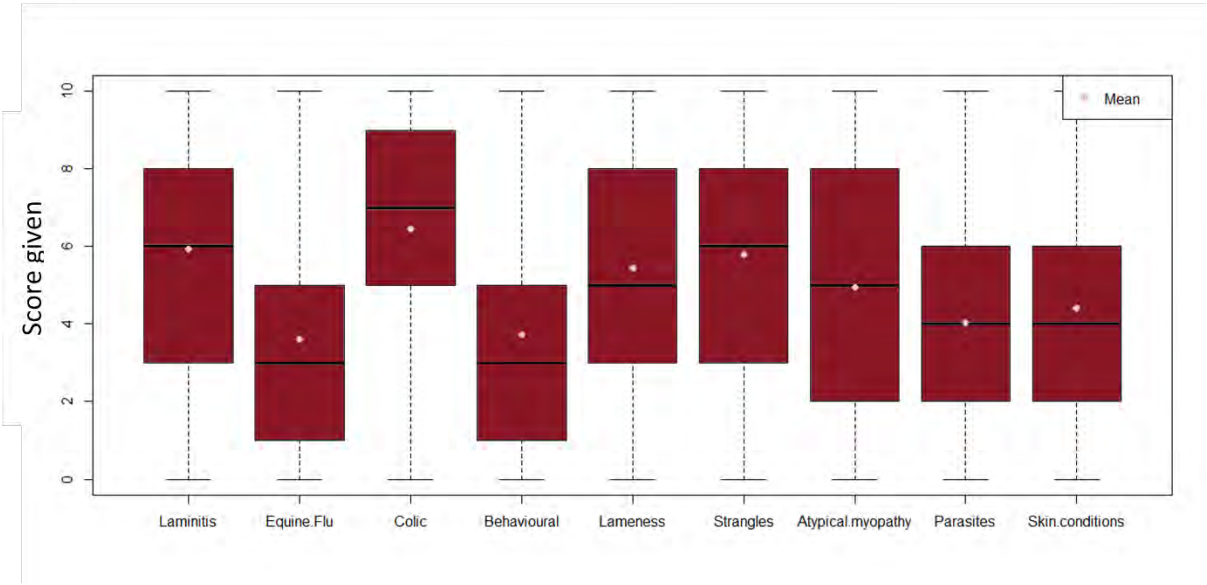
	Efforts should be increased	**Efforts are about right**	**There should be less effort placed on biosecurity**	**I have no opinion on this**
Dealers/horse sales	1723 (88.1%)	46 (2.4%)	7 (0.4%)	180 (9.2%)
Horse owners	1565 (80.5%)	273 (14.4%)	5 (0.2%)	102 (5.2%)
Amateur show and event organisers	1417 (71.7%)	296 (15.0%)	4 (0.2%)	259 (13.1%)
Professional show and event organisers	1164 (58.6%)	392 (19.7%)	7 (0.4%)	423 (21.3%)
Farrier	1115 (57.6%)	626 (32.3%)	8 (0.4%)	188 (9.7%)
Other allied professionals	1109 (57.5%)	537 (27.9%)	12 (0.6%)	270 (14.0%)
Dentist	961 (49.4%)	754 (38.8%)	8 (0.4%)	222 (11.4%)
Vets	729 (37.3%)	1053 (53.8%)	5 (0.2%)	169 (8.6%)
Horse charities	678 (34.9%)	884 (45.6%)	8 (0.4%)	370 (19.1%)

Feelings about strangles

Respondents were asked to place diseases in rank order in terms of those of most to least concern to them. The median scores for concern about a range of equine diseases are illustrated in **Figure 30**, and were ordered as follows:

1. colic (7)
2. laminitis (6), strangles (6)
3. lameness (5)
4. atypical myopathy (5)
5. parasites (4)
6. skin conditions (4)
7. equine influenza (3)
8. behaviour (3)

Figure 30: *Level of concern about a range of equine diseases among 2002 complete respondents. The boxes represent the upper and lower quartile with the central line representing the median (most frequent) response. The 'whiskers' represent the minimum and maximum values; the red dot represents the mean score given. Where a score of 1 indicates least concern and 10 indicates most concern.*



Respondents were asked about their feelings towards strangles by picking their level of agreement with two opposing statements (**Table 6**). The modal view tended towards thinking of strangles as: something that is worried about, considered life-threatening, expensive to manage an outbreak, and yet something owners can easily prevent. This outcome could explain the emotive response to strangles. On the one hand alarmist views increase fear of the disease, whilst on the other there is a lack of understanding regarding the endemic nature of the disease. Strangles is easy in practical terms to prevent through consistent hygiene and screening but the existence of carriers means that outbreaks can occur despite confidence in biosecurity measures.

The tendency for respondents to consider strangles as 'difficult to treat' stands in opposition to the experience of Redwings where the majority of cases (over 70 per cent of strangles carriers and 57 per cent of all cases between 2011 and 2017) were treated with only one GP lavage and testing two weeks later. The survey did not go into more detail to understand relative perspectives on ease of treatment, however more respondents aligned to the view that strangles cannot be eradicated. This pessimism about the disease has a counterproductive impact as respondents also reported that this attitude undermined confidence in their own biosecurity (**Figure 33**, later in the document).

Table 6: *Highlighting responses to semantic differential questions showing views on strangles. Respondents selected whether they completely or partly agreed with either one of the opposing phrases or if they were neutral in their opinions.*

	Completely agree	**Partly agree with this**	**Neutral** (neither agree nor disagree with either)	**Partly agree with this**	**Completely agree with this**	
A minor health concern	14	119	175	889	720	Life-threatening
Easy to treat	44	238	281	865	425	Difficult to treat
Expensive to manage an outbreak	625	679	245	245	83	Cheap to manage an outbreak
Something owners can easily prevent	169	633	423	479	94	Something that is impossible for owners to prevent
Something that I rarely worry about my horse catching	162	526	379	545	201	Something I frequently worry about my horse catching
Something that can be eradicated from the UK	124	362	416	639	237	Something that cannot be eradicated
Something that is in my mind when attending events	380	677	325	295	122	Not something I think about when attending events

Table 7: *Highlighting responses to semantic differential questions showing views if their horse was suspected of having strangles. Respondents selected whether they completely or partly agreed with either one of the opposing phrases or were neutral in their opinions.*

	Completely agree with this	**Partly agree with this**	**Neutral** (neither agree nor disagree with either statement)	**Partly agree with this**	**Completely agree with this**	
WORRIED about telling other people	206	353	101	474	759	NOT WORRIED about telling other people
NOT CONFIDENT that I could	116	352	144	739	581	CONFIDENT I'd be able to prevent

prevent spread to other horses						spread of the disease to other horses
CONFIDENT in my vet's advice and treatment	1,191	505	61	72	66	NOT CONFIDENT in my vet's advice and treatment
UNWILLING to restrict movement of my horse	19	23	34	186	1,647	WILLING to restrict movement of my horse
ABLE to restrict contact with other people and horses	1,135	369	58	221	108	UNABLE to restrict contact with other people and horses

Respondents were asked to rank a list of factors that could 'interfere' with strangles prevention. **Table 8** presents the findings in order of importance, with one being the factor that respondents identified as the most important barrier and eight being the least. Respondents prioritised awareness raising over practical and financial barriers. Cost of veterinary treatment and biosecurity ranked the lowest, which reflects the general willingness to pay for biosecurity that is also seen in the level of treatment they would hypothetically be willing to pay for, reported above.

Overall Rank	Factor/barrier to strangles prevention
1	Lack of knowledge and understanding by horse owners
2	Lack of knowledge and understanding by those running equine establishments
3	Lack of willingness to act by horse owners
4	Lack of willingness to act by equine establishments
5	Stigma (negative attitudes) against horse owners and establishments that may suffer an outbreak
6	The practical feasibility of biosecurity measures as part of the day to day management of horses
7	Cost of vet treatment and testing
8	Cost of biosecurity (e.g. equipment, grooms/yard staff time)

Table 8: *Ranked factors that undermine prevention of strangles according to respondents n=1,927.*

7.4 Comparative analysis of different respondent groups

Further in-depth analysis aimed to highlight core groups of respondents to describe populations and explore their knowledge, attitudes and practices for the purpose of developing targeted educational messages. There were a variety of different ways in which the data could be grouped. The analysis presented here includes:

1) The type of yard they kept their horse/s on
   It was hypothesised that this could link to potential exposure to strangles, e.g. whether it was a closed or open herd with new arrivals, or there was frequent transport on and off yard.
2) Their personal experience of strangles
   It was hypothesised that previous experience of strangles might lead to altered biosecurity practices and increased knowledge of the disease.

7.4.1 Findings based on yard type

Respondents were grouped by the type of yard they kept their horse on as follows:

- Home: own home with no other owners' horses (430/1,939 (22.2 per cent))
- Commercial: commercial yard environment (799/1,939 (41.2 per cent))
- Private – mixed: private/rented yard/land shared with other owners' horses (497/1,939 (25.6 per cent))
- Private – closed: private/rented yard/land with a consistent group of horses and no other owners (213/1,939 (11.0 per cent))

The following questions were analysed to examine and compare responses from those based at different yard types: whether new arrivals to their yard were screened, personal experience of strangles and comparing prioritisation of strangles with other diseases.

Screening of new arrivals to their yard

Only those who answered that they kept their horse/s either in a commercial yard or on private/rented land with other owners were asked if new arrivals to their yard were screened for strangles and there was no significant difference among these groups (Chi-squared p = 0.110).

Personal experience of strangles

Personal experience of strangles did however differ between the four yard types, Chi-squared, p = 0.002 (**Table 9**). Although individual experience of strangles was similar for each of the four yard types, it was those who kept their horse at a commercial yard who

tended to report they had experienced suspected outbreaks on their yard. Those who kept their horse at home tended to have less experience of strangles where they kept their horse.

	Yes, had confirmed case of strangles in own horse	Yes, had a suspected but unconfirmed case of strangles in own horse	Yes, had suspected but unconfirmed case at own yard	Yes, has suspected but unconfirmed case at work	No, never experienced strangles
Home	24.66	0	8.13	9.76	57.45
Commercial	21.73	1.14	23.72	8.66	44.74
Private - mixed	23.01	1.14	16.17	7.06	52.62
Private - closed	23.63	1.1	10.99	8.24	56.04

Table 9: *Comparing proportions of those with direct and indirect experience of strangles on each of four yard types.*

Potential risk of exposure to strangles by yard type

Certain yard types could be hypothesised to have higher levels of potential risk of exposure to strangles due to having multiple owners with horses on their yard; they also tended to have different levels of personal experience of strangles.

Table 10: *Potential risk status of yard types compared to the average response.*

Yard type	Variable	Trends among different yard arrangements
Home	Yard type	Tends to be only respondent's horse/s on the yard
	Personal experience of strangles	Less likely to have experience of strangles
Commercial	Yard type	Tends to keep horse/s on yards with horses owned by others
	Personal experience of strangles	More likely to have some experience of strangles More likely to have experience of strangles on yard
Private – mixed	Yard type	Tend to keep horses with horses owned by others on yard
	Personal experience of strangles	No statistical significance

Private – closed	Yard type	Tends to be only respondent's horse/s kept on these yards
	Personal experience of strangles	No statistical significance

Trends: Demographics

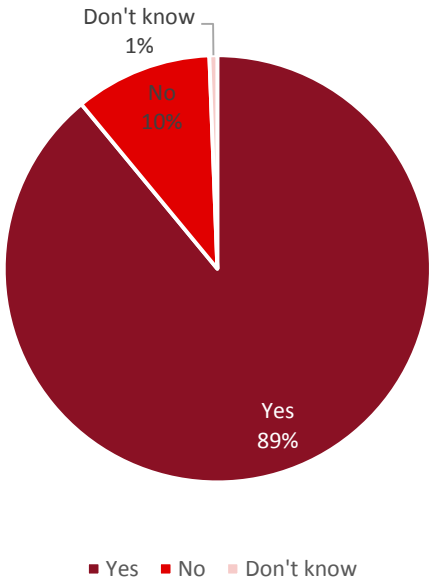
Yard type was compared with a range of demographic factors to build a profile of those who keep their horse/s on each type of yard. There was an association between frequency of attending events and yard types, with those who kept their horse/s at home or on private yards with other owners (hereafter referred to as private yards (mixed)) tending to attend events every other week more frequently than other groups. Those from commercial yards tended to attend events 'once a month'. Those from private closed yards (i.e. with no other owners) indicated they travelled off yard 'once a month' less often than the other groups. As can be expected, events tended to be held at commercial yards more than the other yard types.

There was no association with gender and current yard type, but there was an association with age, with those who kept their horse/s at home tending to be among the 55-75 age group more often and less frequently between the ages of 18-34. Those from commercial yards tended to be among the 18-34 age group more often than the 35-54 and 65-74 age groups. Those from private yards (mixed) tended to be among the 35-54 age group. Those who kept their horse/s at home tended to have more lifelong experience of caring for horses compared to those from commercial yards who tended to have experience of greater than a year.

With regards to the amount of training that respondents had, those who kept their horse/s at home or on private yards (closed) tended not to be 'new to horse ownership'. Those from private yards (mixed) selected that they had 'formal training' less often than the other yard types.

There was an association between yard type and the number of horses under the care of the respondent; both those who kept their horse/s at home or on private yards (closed) tended to have more than one horse in their care with those who kept their horse/s at home generally owning 3-5 horses and those from private yards (closed) tending to own between 3 and 9 horses. These respondents also tended to rescue, or rehome more frequently. Respondents with only one horse tended to keep their horse at commercial or private (mixed) yards.

Figure 31: *Proportion of respondents who reported being up to date with their flu vaccinations n=1,987*



Those who kept their horse/s at home were less likely to have acquired their last horse from a friend or from a private seller advertising online. In contrast, those from commercial yards tended to rescue, rehome or breed their own horse less often but tended to acquire a horse from a friend more often.

With regards to vaccinations, those from commercial yards tended to be more up-to-date with flu vaccinations compared to those who kept their horse at home.

Trends: Confidence in biosecurity practices

Those who kept their horse/s at home or on private yards (closed) tended to be more confident in their biosecurity practices, where as those from commercial yards tended to be less confident.

Trends: Knowledge of strangles

While there was no association found between yard type and general knowledge of strangles, there tended to be a trend in which those from commercial yards tended to be more confident in their knowledge and more correct than those from other yard types. Those from private yards (closed) tended to be less sure of their knowledge about strangles; those from private (mixed) yards tended to think, incorrectly, that strangles is airborne more frequently than the other yard types.

When asked about ideas of the minimum time that horses should be isolated for if they have potentially come into contact with strangles, respondents from private (closed) yards and commercial yards tended not to know, with those from commercial yards indicating that isolation should only be of two days duration more frequently than other yard groups.

There was variation in people's knowledge of what a carrier was, with those from private (mixed) yards tending not to know, while those from commercial yards answered that they were aware of what a carrier was. There was an association

between yard type and awareness of the Redwings Strangles Information Pack with those from commercial yards tending to be less aware of the pack than other yard users suggesting a need to target information materials towards yards of this type.

Figure 32: *Respondent confidence in their own biosecurity where they keep their horse and at events. Respondents used a slider scale to rank their confidence from 0 (no confidence at all) to 10 (100% confident) at home n=1,906, at events n=1,423.*

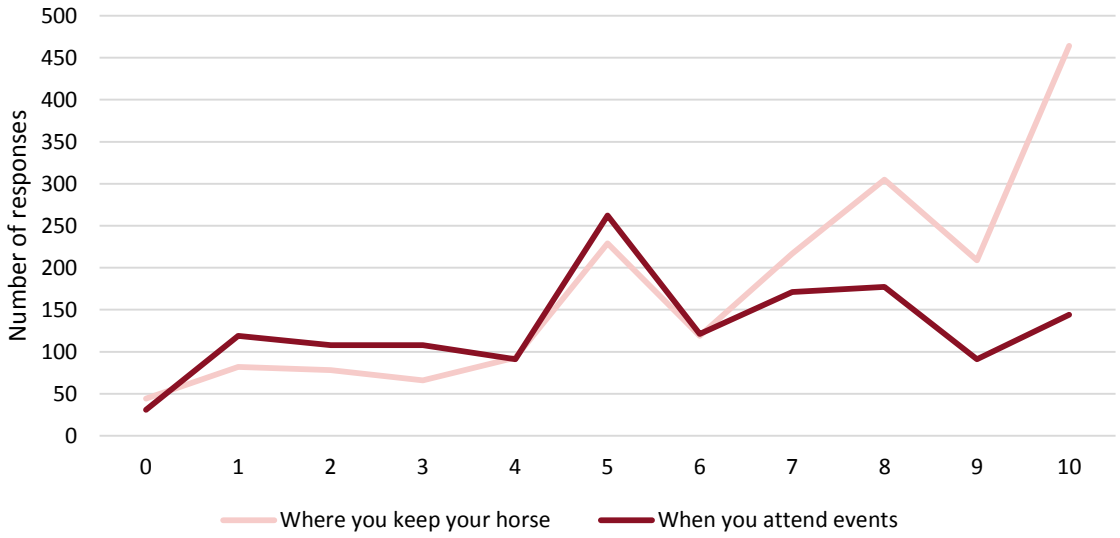
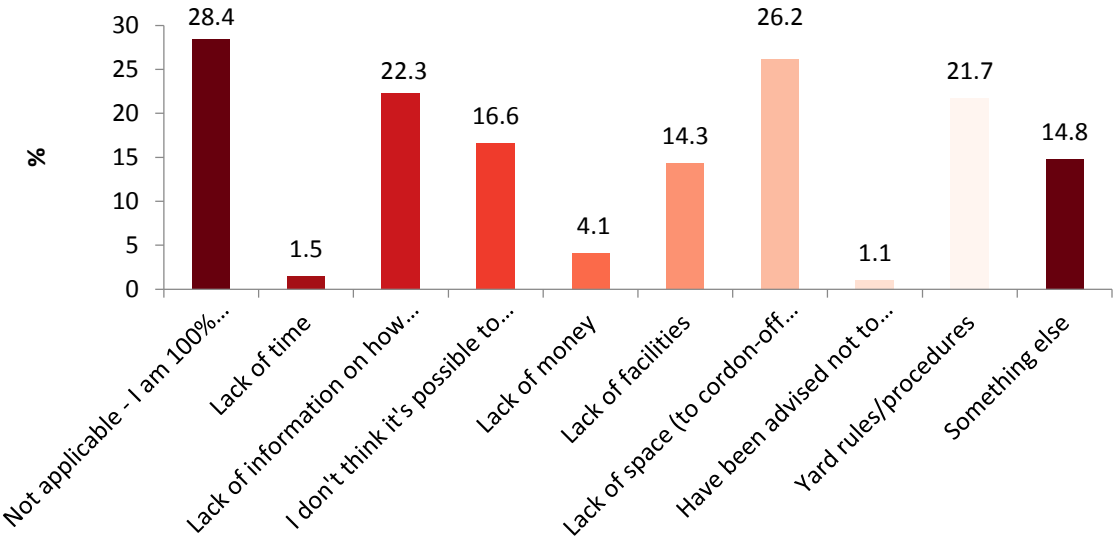


Figure 33: *Reasons that undermine confidence in biosecurity. Respondents could choose more than one option n=2936.*



Trends: Management of horse/yard

Respondents were asked if they felt confident in setting up an isolation area. Those who keep their horse/s at home tended to feel the most confident about setting up an isolation area. In contrast, those from commercial yards tended to be less confident.

With regards to being able to set up an isolation area if the need arose, those who kept their horse/s at home or on private yards (closed) tended to be able to set up an isolation area. In contrast, those on commercial yards reported that they couldn't or were unsure if they could set up isolation areas, and also tended to report that they didn't routinely isolate after returning from events more frequently than other groups. Frequent travel could potentially make precautionary quarantine a challenge for horses returning from events.

Hypothetical scenarios

A range of hypothetical scenarios were presented to the respondents and analysis examined how the different yard types responded. For example, the following situation was put to them; if they suspected that their horse had strangles when did they think steps should be taken to prevent it spreading to other horses? Those keeping their horse at their home premises tended to more frequently select that they would act when they thought their horse had been exposed to strangles, and a slightly higher proportion of those from private mixed yards indicated they would act after noticing a change.

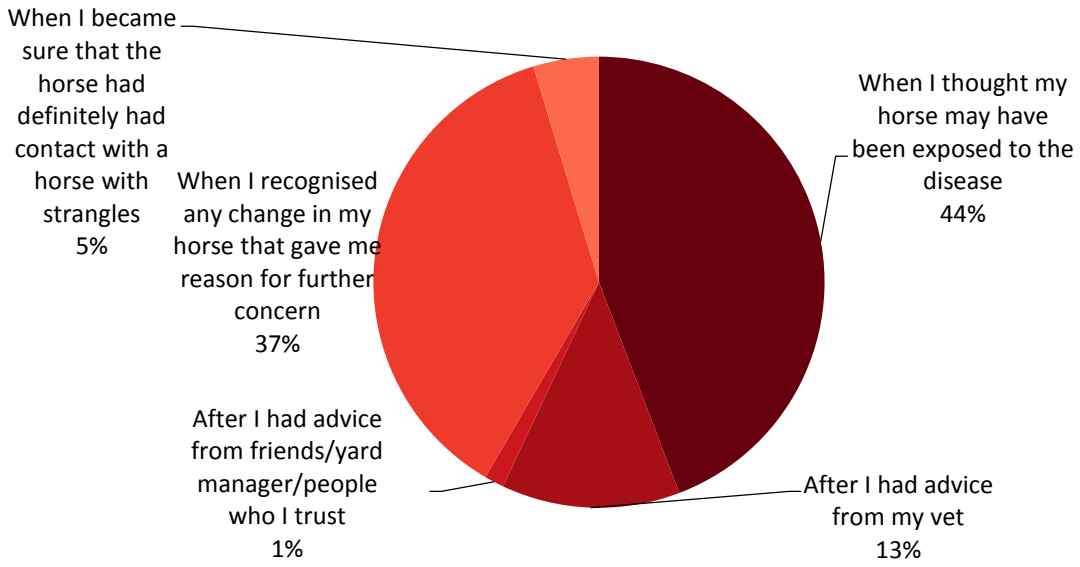


Figure 34: *Chart showing when respondents would take steps to prevent spread of strangles if they suspected their horse had become infected n=1996.*

The next question asked was, 'In the event of your horse coming into contact with a strangles-positive horse, how likely would you be to take precautionary steps to prevent the spread to other horses?' In general, those who kept their horse/s at home or on private (closed) yards tended to select that the measures weren't relevant to their situation more frequently than the other groups. Although all groups tended to indicate that they would disinfect equipment and prevent contact with other horses, those who kept their horse/s at home tended to indicate this less frequently than the other groups. Those from private (closed) yards tended to be more likely to raise awareness via social media and inform local equine establishments.

	Likely (%)	**Unlikely (%)**	**Not relevant to my situation (%)**	**Count**
Disinfect all tack, equipment and rugs	91.11	5.58	3.32	1990
Store and dispose of muck separately (e.g. burning or disposing away from horses)	57.46	31.75	10.79	1984
Tell the yard manager/inform other livery clients or horse owners where you keep your horse	85.72	0.96	13.32	1975
Raise awareness via social media	56.66	37.47	5.87	1959
Attempt to prevent all contact with your horse(s) by other horses and owners on the yard	89.52	1.37	8.71	1975
Restrict your horse's movements off the yard/its home until a vet had cleared him/her of the disease	95.91	0.97	3.12	1958
Inform local equine establishments	65.58	26.04	8.39	1955

Table 11: *Responses to questions asking if it was likely or unlikely that a respondent would take biosecurity measures if they thought their horse had come into contact with a horse with strangles.*

Those from commercial yards tended to be less likely to dispose of muck separately, raise awareness via social media and inform local equine establishments. They also tended to be more likely to inform others on their yard, prevent contact with their horse and restrict its movements. Those from private (mixed) yards tended to be more likely to dispose of muck separately, prevent contact with their horse, restrict its movements and inform others on their yard and other equine establishments.

A full set of results from the statistical analysis are available in **Appendix 1**.

7.4.2 Findings based on strangles experience

The data was grouped by respondents' personal experience of strangles as follows:

- No experience of strangles in their own horse, on their yard or at work n = 886
- Recent experience (in the last 12 months) of strangles in their own horse (confirmed by a vet) n = 71
- Historic experience (greater than 12 months ago) of strangles in their own horse (confirmed by a vet) n = 321

NB: Those who selected that strangles was only suspected (but not confirmed) in a horse on their yard or at work, or reported a case of strangles in their own horse that was not confirmed by a vet, were not included in this analysis.

Potential risk of exposure to strangles

Those with no experience of strangles tended to indicate that they didn't travel regularly with more responding that they never travelled. Those reporting historic experience of strangles tended to travel more often (e.g. more than once a week), whereas those with recent experience of strangles (within the past 12 months) tended to keep their horse/s on commercial yards more often.

Trends: Demographics

There was no significant association with either gender or age, although those with no experience of strangles tended to be in the 18-24 age bracket compared to those with historic experience. Furthermore, those with no experience tended to indicate they were new to horse ownership whereas those with historic experience tended to have a lifelong association with horses and tended to work with horses more often than those with no experience of a strangles outbreak.

The 'no experience' group tended to look after one or two horses compared with the 'Historic experience' group who tended to look after three to ten+ horses. The 'No experience' group also tended to have rehomed their last horse or taken it on from a friend on more occasions than the 'Historic experience' group who tended to have bred their last horse more often. The 'No experience' group also tended to have their horse vaccinated for equine influenza more than the 'Historic experience' group.

Trends: Concern about strangles

The group with no experience of strangles tended to think that strangles was life-threatening more than those with recent or historic experience; in contrast, those with

recent experience tended to partially agree with strangles being a minor health concern and those with historic experience tended to partially agree or be neutral.

Respondents with recent experience of strangles tended to agree that strangles was easy to treat, whereas those with no experience painted a bleaker picture indicating they thought it was difficult to treat and, along with those with recent experience, partially agreed that an outbreak would be expensive to manage. People with no direct experience of strangles tended to think that strangles was something owners can easily prevent, but those with recent and historic experience felt that it was impossible for owners to prevent the disease and those with recent experience tended to worry about their horse catching strangles compared to those with no experience.

This trend continued with views on the ability to eradicate strangles from the UK as those with no experience were more optimistic than those with recent or historic experience, who thought that it would not be possible to eradicate strangles. Experience of strangles also had an impact on people's awareness of transmission at events as those with historic experience tended to be more concerned about strangles when attending events that those with no experience. However, experience also boosted confidence, as those with recent and historic experience indicated more confidence in their biosecurity practices on their yard compared to those with no experience.

Question	**No experience** n = 886	**Experience (recent & historic, confirmed by a vet)** n = 392
Accurate knowledge about strangles carriers	↓	↑
Report good biosecurity practices	↓	↑
Level of treatment willing to pay for	An answer not including screening	An answer that included screening to avoid carriers
Perspectives on the disease	'Life-threatening'	'Minor health concern'
Perspectives on treatment	'Difficult to treat'	'Easy to treat'
Report higher confidence in their own biosecurity	↓	↑

Table 12: *Table summarising the trends in knowledge and attitudes to strangles between respondents with experience of strangles and respondents with no prior experience of the disease. Arrows describe whether the cluster group were more (↑) or less likely (↓) correlate with questions. Text, e.g. "An answer not including screening", summarises the response that they were statistically more likely to select than the other clusters.*

Trends: Knowledge of strangles

As may be expected, those with no experience of strangles gave more incorrect answers to the general knowledge about strangles questions compared to those with recent and historic experience of strangles. The same was true with knowledge of the length of time to isolate a horse, and understanding of the term 'strangles carrier' with those with recent or historic experience tending to be more sure and more often correct compared to those with no experience.

Encouragingly, those with recent or historic experience tended to know more about red, green and amber zones and the STEPS and Protection Against Strangles Scheme (PASS) information than those with 'no experience' although there was no association with the groups and knowledge of the Redwings Strangles Information Pack. Respondents who completed the survey received copies of these publications.

Trends: Management of horse/yard

Respondents with recent or historic experience of strangles tended to be more confident in their ability to set up an isolation area compared to those with no experience who tended to indicate less certainty, in that they were 'quite confident'. Those with historic experience tended to state that they were able to isolate their horse should they want to more frequently than other groups. Interestingly, those with recent experience tended to state that new arrivals were screened on admission to their yard more than those with no experience, although the majority of respondents still indicated that new arrivals were not routinely screened on arrival.

Sharing equipment also varied between groups as well as the types of equipment that were shared and in which situations, detailed findings are presented within **Appendix 2.**

Trends: Attitudes towards the equine industry and biosecurity

There was an association with views about dealers'/horse sales' responsibility towards biosecurity with the historic experience group tending to be of the opinion that dealers should increase their efforts towards biosecurity. Notably, those with historic experience tended to be less confident in their vet's advice and treatment compared to those with no experience.

Trends: Hypothetical scenarios

Should they suspect their horse had strangles, those with historic or recent experience tended to be more confident about being able to prevent the spread of strangles to other horses such as their ability to restrict contact with other people and horses compared to those with no experience.

One way to reduce the risk of spreading strangles is to reduce the sharing of equipment, however respondents with historic experience of strangles often stated that it was impossible to prevent sharing of equipment such as haynets, basic tack, wheelbarrows/muck clearing equipment and shared water, and those with recent experience tended to state that they were unlikely to be able to stop sharing haynets. The importance of robust hygiene including the use of disinfectant between horse uses will be important where sharing cannot be avoided. Those with no experience were more likely to say it was possible for them to stop sharing haynets and basic tack/grooming kit.

When asked, 'If strangles was suspected, at what point would steps be taken to prevent the spread?', respondents with no experience of strangles tended to be more likely to act after the advice of a vet compared to those with historic experience, who tended to be more likely to act upon recognising a change in the horse.

With regards to the steps that they would take if they thought their horse had come into contact with a strangles-positive horse, respondents with recent experience tended to be more likely to inform others at their yard and prevent contact with other horses/owners than other groups.

In a situation where their top show-winning horse had potential signs of strangles those with no experience tended to be more likely to call the vet in the first instance, whereas those with either recent or historic experience would be more likely to make a decision themselves to not attend the event and monitor the horse.

When asked about their willingness to pay for veterinary treatment, the majority of respondents indicated that they would be willing to pay for between two and three vet call outs and treatment. However, interestingly those with recent experience of strangles were more likely to pay for full veterinary treatment to ensure the horse did not become a carrier.

The results of statistical analysis examining the impact of personal experience of strangles are presented in **Appendix 2**.

8. Key findings

- There is good knowledge of the signs of strangles, including recognition of fever as the first sign of infection, but respondents may delay taking preventative steps until they see later signs.

- Knowledge of disease transmission was not as good. Over a third of respondents incorrectly thought that strangles was 'airborne (like flu)' and may therefore overestimate the difficulty of prevention and management of outbreaks.

- Owners tend to have more confidence in their biosecurity practices where they keep their horse rather than at events, however there is more sharing of equipment and communal facilities at home compared with at events.

- Reasons that owners gave for not taking more steps to prevent strangles were: Space for separation of horses, lack of permission on yards, lack of information about how to prevent strangles and pessimistic attitudes which leave owners feeling that their efforts are fruitless.

- Three out of four yards do not screen new arrivals for strangles at all despite respondents indicating preference for this, and the approach to screening varies at the minority of yards where this is put in place (13 per cent).

- Owners are willing to take 'collective responsibility' in the fight against strangles. 80 per cent of respondents reported a willingness to pay for their horse to be tested in order to know its carrier status so the yard manager could confidently introduce routine screening for new arrivals (in the knowledge that no current resident horses were carriers).

- Twenty per cent of respondents with experience of strangles indicated the carrier status of the horse was not tested, and a further 18 per cent did not know if these tests had been performed. This is despite 68 per cent of respondents saying they were willing to pay for three or more vet visits to treat a horse with strangles to ensure it didn't become a carrier. Previous experience of strangles increased the likelihood that the respondent would be willing to pay for full treatment.

- Experience of strangles played an important role in people's knowledge and perceptions of strangles as respondents with experience of strangles were more likely than people without experience to:

    - Be correct in their knowledge of strangles
    - Have confidence in their biosecurity practices including their ability to set up a quarantine area

  - Be willing to prevent contact with a horse if they thought it may have strangles
  - Be willing to restrict horse movements
  - Be willing to inform other owners on their yard if they had a case of strangles

- Owners without experience of strangles tend to think strangles is difficult to treat in contrast to owners with experience of strangles who thought it was easy to treat. Explaining what horse owners can expect from screening and treatment should be promoted to allay fears.

- Vets are a key source of advice for owners on preventative biosecurity and not only for diagnosis and treatment during an outbreak.

- Respondents who reported having experienced an outbreak of strangles in the past tended to keep their horses on commercial yards at the time of completing the survey (though this may not have been where the outbreak was experienced).

- Cost and economics of preventative biosecurity measures and treatment were not reported to be a significant barrier to preventative action, however this is difficult to interpret within a questionnaire where respondent bias may be introduced into questions about economics.

9. Industry recommendations

90.6 per cent of respondents felt prevention and management of strangles should be more of a priority within the equestrian industry.

To avoid stigmatising individuals, which undermines the clear and open communication needed for effective biosecurity, the focus should be on cultivating a collective responsibility to tackle the disease.

"90.6% of respondents felt prevention and management of strangles should be more of a priority…"

- Target 'communities of horse owners' rather than individuals to engage them in biosecurity, including promotion of full treatment and testing of strangles cases and screening tailored to their individual management situation and constraints. For example, livery yards, riding clubs, show and event organising bodies etc.

- Promote the eradicable nature of strangles and challenge despondent, apathetic and pessimistic attitudes which may reduce motivation to act on advice.

- An important aspect of disease control that vets should promote, and horse owners should seek to know, is to demonstrate that a horse that has suffered from strangles is clear of being a strangles carrier.

- Work with yards to develop tailored disease control strategies including strangles screening and quarantine protocols for the identification and treatment of strangles carriers (80 per cent of respondents on yards were willing to pay to have their horse tested if that meant the manager could introduce screening of new arrivals). This would be supported by:

    - Raising horse owner awareness of the potential for horses to become carriers and perpetuate the spread of disease.
    - Promoting screening interventions (and recommend routine screening for new arrivals) and encourage them that horse owners would be positive about this based on the findings from this survey.
    - Removing perceived barriers to treatment through education (respondents with experience see strangles as easy to treat whilst respondents without experience tend to think it is difficult to treat).

- Promote a better understanding of biosecurity, its purpose and limitations i.e. what is gold standard and subsequent measures if this is not possible. For example, advice regarding space required for quarantine should be given alongside an emphasis on minimising contact and what are risky forms of contact rather than the size of the quarantine area, which was perceived as a significant barrier by respondents.

- Industry advice related to strangles should promote early action on suspicion of infection to discourage delayed quarantine. This could include the following minimum steps:

    - Inform others
    - Commit not to move horse(s)
    - Minimise contact with shared equipment and communal facilities
    - Monitor daily for fever (2 x per day with vigilance for other signs)
    - Carry out routine hygiene using disinfectant (communal equipment, facilities and people)

- Vets should promote biosecurity to horse owners by:

    - Modelling good biosecurity practices themselves

- Providing proactive advice on appropriate screening and biosecurity measures
- Incentivising the importance of identification and treatment of subclinical carriers e.g. client evenings on strangles, yard support on biosecurity, discounts on screening (ideally, guttural pouch endoscopy).

- Messages targeting commercial yards should be appropriate for the demographic of horse owners who tend to be:

    - younger (18-35 years/'millennial' generation)
    - more likely to be new to horse ownership
    - less confident in their biosecurity than owners keeping their horse in private mixed yard environments
    - less likely to quarantine on return from events than other horse owners on other yard types.

- Contractors and yard owners should be consulted with a view to developing advice on how to make practical adaptations to yards that will promote less mixing of high and low risk horses critically including management and screening of new arrivals.

Appendices

Appendix 1 – Cluster analysis by 'yard type'

Not including: questions that were only displayed to those who keep their horse/s on a commercial yard or a private yard with other owners, multiple choice questions and those involving ranking or slider position.

Topic		Home	Commercial	Private (mixed)	Private (closed)	P value	Comments
Demographics							
Frequency of attending events	At least once a week	38 (8.9%)	55 (6.9%)	30 (6.1%)	16 (7.5%)	<0.001	
	Every other week	81 (19.0%)	109 (13.7%)	50 (10.2%)	28 (13.1%)		
	Once a month	91 (21.4%)	216 (27.2%)	118 (24.0%)	32 (15.0%)		
	Less than 3 times a year	81 (19.0%)	166 (20.9%)	109 (22.2%)	52 (24.4%)		
	Never	135 (31.7%)	248 (31.2%)	184 (37.5%)	85 (39.9%)		
Gender						0.477	No association
Age	18-24 years	42 (9.8%)	148 (18.6%)	75 (15.1%)	24 (11.3%)	<0.001	
	25-34 years	63 (14.7%)	199 (25.0%)	93 (18.7%)	40 (18.9%)		
	35-54 years	207 (48.3%)	328 (41.3%)	258 (51.9%)	112 (52.8%)		
	55-64 years	94 (21.9%)	105 (13.2%)	52 (10.5%)	31 (14.6%)		
	65-74 years	23 (5.4%)	14 (1.8%)	19 (3.8%)	5 (2.4%)		
	75+ years	0	1 (0.1%)	0	0		
Length of time caring for horses	Less than a year	0	10 (1.3%)	7 (1.4%)	1 (0.5%)	<0.001	
	Greater than a year	228 (53.3%)	556 (69.7%)	306 (61.7%)	133 (62.7%)		
	Lifelong	200 (46.7%)	232 (29.1%)	183 (36.9%)	78 (36.8%)		

Level of training	New to horse ownership	11 (2.6%)	46 (5.8%)	23 (4.7%)	3 (1.4%)	0.049	
	Formal training	132 (30.8%)	216 (27.1%)	116 (23.5%)	62 (29.2%)		
	Some training	47 (11.0%)	88 (11.0%)	64 (13.0%)	21 (9.9%)		
	No formal training	157 (36.6%)	265 (33.2%)	186 (37.7%)	87 (41.0%)		
	Vet or vet nurse	11 (2.6%)	14 (1.8%)	6 (1.2%)	3 (1.4%)		
	Work with horses	51 (11.9%)	120 (15.0%)	66 (13.4%)	24 (11.3%)		
	Other	20 (4.7%)	49 (6.1%)	33 (6.7%)	12 (5.7%)		
Number of horses owned						0.0164	Kruskal-Wallis test used
Confidence that latest horse purchased was clear						0.488	No association
Origin of last horse purchased	Breeder/ dealer	88 (20.6%)	156 (19.6%)	84 (17.1%)	29 (13.6%)	<0.001	
	From friend	81 (19.0%)	198 (24.9%)	121 (24.6%)	43 (20.2%)		
	I bred it	24 (5.6%)	30 (3.8%)	30 (6.1%)	15 (7.0%)		
	Other	28 (6.6%)	58 (7.3%)	40 (8.1%)	19 (8.9%)		
	Private seller – offline	42 (9.8%)	124 (15.6%)	60 (12.2%)	26 (12.2%)		
	Private seller – online	97 (22.7%)	172 (21.6%)	114 (23.2%)	44 (20.7%)		
	Rehomed	30 (7.0%)	23 (2.9%)	17 (3.5%)	19 (8.9%)		
	Rescued	30 (7.0%)	20 (2.5%)	18 (3.7%)	16 (7.5%)		
	Sale/market	7 (1.6%)	14 (1.8%)	8 (1.6%)	2 (0.9%)		
Horse vaccinated for 'Flu	Yes	353 (82.7)	746 (93.6%)	433 (88.4%)	185 (86.9%)	<0.001	
	No	73 (17.1%)	44 (5.5%)	56 (11.4%)	26 (12.2%)		
	Don't know	1 (0.2%)	7 (0.9%)	1 (0.2%)	2 (0.9%)		

Events held where horse is kept	Yes	15 (3.5%)	285 (35.9%)	49 (10.0%)	12 (5.7%)	<0.001	
	No	409 (96.5%)	500 (63.1%)	431 (87.8%)	200 (94.3%)		
	Don't know	0	8 (1.0%)	11 (2.2%)	0		
Attitudes: Concern							
Confidence to stop spread of strangles if it occurred						0.355	No association
Confidence in biosecurity practices at home	0	4 (1.0%)	26 (3.4%)	9 (1.9%)	2 (1.0%)	<0.001	52 answered that this was not applicable to their situation and were not included in this analysis.
	1	8 (2.0%)	47 (6.2%)	21 (4.4%)	5 (2.4%)		
	2	8 (2.0%)	52 (6.8%)	16 (3.4%)	1 (0.5%)		
	3	4 (1.0%)	41 (5.4%)	16 (3.4%)	2 (1.0%)		
	4	8 (2.0%)	50 (6.6%)	27 (5.7%)	7 (3.4%)		
	5	18 (4.4%)	113 (14.8%)	70 (14.8%)	21 (10.2%)		
	6	16 (3.9%)	50 (6.6%)	35 (7.4%)	14 (6.8%)		
	7	40 (9.8%)	86 (11.3%)	60 (12.7%)	25 (12.1%)		
	8	65 (16.0%)	121 (15.9%)	76 (16.0%)	34 (16.5%)		
	9	62 (15.2%)	73 (9.6%)	44 (9.3%)	20 (9.7%)		
	10	174 (42.8%)	102 (13.4%)	100 (21.2%)	75 (36.4%)		
Confidence in biosecurity practices at events						0.886	502 answered that this was not applicable to their situation and were not included in this analysis. No association
Knowledge							
Knowledge quiz	Airborne disease (F) – True	144 (16.8%)	272 (17.2%)	205 (20.8%)	63 (15%)	<0.001	
	- False	260 (30.4%)	496 (31.3%)	260 (26.3%)	129 (30.7%)		
	- Don't know	22 (2.6%)	24 (1.5%)	28 (2.8%)	17 (4.0%)		
	Incubation period of 14	328 (38.4%)	643 (40.6%)	402 (40.7%)	150 (35.7%)	0.019	

	days (T) – True						
	- False	44 (5.1%)	62 (3.9%)	39 (4.0%)	22 (5.2%)		
	- Don't know	57 (6.7%)	86 (5.4%)	53 (5.4%)	39 (9.3%)		
	After infection, immune to future infections (F)					0.508	No association
	Recovered horse can infect others (T)					0.176	No association
	Serious/ fatal complications (T)					0.796	No association
	Disease cannot survive outside body more than a few minutes (F)					0.082	No association
	Viral disease (F)					0.299	No association
Symptoms quiz						0.0127	Respondents coded as correct/incorrect depending on whether they correctly identified all the symptoms as symptoms of strangles. No association
Length of time to isolate horse if it potentially has been exposed to strangles	24 hours	2 (0.5%)	12 (1.5%)	8 (1.6%)	3 (1.4%)	0.031	
	2 days	1 (0.2%)	19 (2.4%)	4 (0.8%)	3 (1.4%)		
	1 week	33 (7.7%)	89 (11.2%)	52 (10.5%)	18 (8.5%)		
	3 weeks	256 (59.5%)	456 (57.1%)	270 (54.4%)	105 (49.5%)		
	2 months	58 (13.5%)	81 (10.2%)	68 (13.7%)	33 (15.6%)		
	6 months	11 (2.6%)	16 (2.0%)	14 (2.8%)	4 (1.9%)		
	Don't know	63 (14.7%)	107 (13.4%)	71 (14.3%)	40 (18.9%)		

	They don't need to be isolated	6 (1.4%)	18 (2.3%)	9 (1.8%)	6 (2.8%)		
Knowledge of the term carrier	Yes	348 (82.3%)	676 (86.0%)	384 (78.9%)	170 (81.7%)	0.010	
	No	14 (3.3%)	24 (3.1%)	32 (6.6%)	12 (5.8%)		
	Don't know	61 (14.4%)	86 (10.9%)	71 (14.6%)	26 (12.5%)		
Knowledge of red, green, amber zones						0.331	No association
Awareness of Strangles Information Pack	Yes	105 (24.7%)	157 (19.9%)	120 (24.7%)	59 (27.8%)	0.036	
	No	320 (75.3%)	632 (80.1%)	366 (0.8%)	153 (72.2%)		
Awareness of STEPS						0.606	No association
Awareness of PASS						0.143	No association
Management							
Confidence in setting up an isolation area	Very confident	192 (45.7%)	263 (33.8%)	178 (36.3%)	93 (44.3%)	<0.001	
	Quite confident	171 (40.7%)	345 (44.3%)	196 (39.9%)	88 (41.9%)		
	Neither	41 (9.8%)	73 (9.4%)	60 (12.2%)	19 (9.0%)		
	Not very confident	15 (3.6%)	86 (11.1%)	45 (9.2%)	10 (4.8%)		
	Very unconfident	1 (0.2%)	11 (1.4%)	12 (2.4%)	0		
Able to isolate horse	Yes	373 (88%)	449 (56.5%)	350 (70.7%)	192 (86.5%)	<0.001	
	No	47 (11.1%)	265 (33.3%)	115 (23.2%)	26 (11.7%)		
	Don't know	4 (0.9%)	81 (10.2%)	30 (6.1%)	4 (1.8%)		
Do you routinely isolate after events	Yes all events	29 (11.0%)	25 (5.0%)	28 (10.2%)	14 (12.2%)	0.011	768 answered that they don't attend events and weren't included in this analysis
	Yes only certain events	28 (10.6%)	42 (8.3%)	29 (10.6%)	13 (11.3%)		

	No	206 (78.3%)	437 (86.7%)	217 (79.2%)	88 (76.5%)		
Industry							
View on whether strangles should be more of a priority in the industry						0.381	No association
Views of the efforts of following groups:	Professional events					0.180	No association
	Amateur events					0.234	No association
	Vets					0.418	No association
	Dealers					0.742	No association
	Owners: - Efforts should be increased	334 (80.1%)	637 (81.9%)	389 (80.5%)	160 (77.7%)	0.041	
	- Efforts about right	50 (12.0%)	109 (14.0%)	73 (15.1%)	30 (14.6%)		
	- Less effort	2(0.5%)	0	1 (0.2%)	2 (1.0%)		
	- No opinion	31 (7.4%)	32 (4.1%)	20 (4.1)	14 (6.8%)		
	Charities: - Efforts should be increased	147 (35.4%)	244 (31.4%)	198 (41.3%)	66 (31.7%)	0.007	
	- Efforts about right	197 (47.5%)	358 (46.0%)	204 (42.6%)	99 (47.6%)		
	- Less effort	1 (0.2%)	2 (0.3%)	1 (0.2%)	2 (1.0%)		
	- No opinion	70 (16.9%)	174 (22.4%)	76 (15.9%)	41 (19.7%)		
	Farriers: - Efforts should be increased	259 (62.7%)	428 (54.8%)	280 (59.1%)	110 (53.1%)	0.041	
	- Efforts about right	109 (26.4%)	271 (34.7%)	153 (32.3%)	72 (34.8%)		
	- Less effort	3 (0.7%)	1 (0.1%)	3 (0.6%)	1 (0.5%)		

	- No opinion	42 (10.2%)	81 (10.4%)	38 (8.0%)	24 (11.6%)		
	Dentists					0.521	No association
Views on whether strangles should be notifiable						0.382	No association
Hypothetical							
Responses to horse coming into contact with strangles	After advice from friends	2 (0.5%)	20 (2.5%)	5 (1.0%)	0	0.026	
	After advice from vet	56 (13.1%)	93 (11.7%)	76 (15.3%)	25 (11.8%)		
	After noticing change	150 (35.0%)	283 (35.5%)	196 (39.5%)	81 (38.2%)		
	If sure contacted horse with strangles	18 (4.2%)	43 (5.4%)	19 (3.8%)	13 (6.1%)		
	If may have been exposed	203 (47.3%)	359 (45.0%)	200 (40.3%)	93 (43.9%)		
Measures taken if horse comes into contact with positive horse	Disinfect: - Likely	377 (88.1%)	731 (91.9%)	458 (92.5%)	195 (92.4%)	<0.001	
	- Unlikely	24 (5.6%)	51 (6.4%)	26 (5.3%)	6 (2.8%)		
	- Not relevant to me	27 (6.3%)	13 (1.6%)	11 (2.2%)	10 (4.7%)		
	Correct disposal of muck - Likely	252 (59.2%)	409 (51.6%)	313 (63.2%)	131 (62.7%)	<0.001	
	- Unlikely	89 (20.9%)	331 (41.7%)	150 (30.3%)	45 (21.5%)		
	- Not relevant to me	85 (20.0%)	53 (6.7%)	32 (6.5%)	33 (15.8%)		
	Inform others at yard - Likely	237 (56.3%)	771 (97.5%)	475 (96.0%)	160 (76.6%)	<0.001	
	- Unlikely	3 (0.7%)	11 (1.4%)	3 (0.6%)	2 (1.0%)		
	- Not relevant to me	181 (43.0%)	9 (1.1%)	17 (3.4%)	47 (22.5%)		

	Raise awareness: - Likely	227 (55.4%)	422 (53.7%)	288 (58.3%)	136 (64.8%)		
	- Unlikely	140 (34.1%)	342 (43.5%)	178 (36.1%)	57 (27.1%)		
	- Not relevant to me	43 (10.5%)	22 (2.8%)	27 (5.5%)	17 (8.1%)		
	Prevent contact with other horses: - Likely	296 (71.0%)	770 (97.7%)	474 (96.3%)	175 (92.8%)	<0.001	
	- Unlikely	2 (0.5%)	14 (1.8%)	7 (1.4%)	4 (1.9%)		
	- Not relevant to me	119 (28.5%)	4 (0.5%)	11 (2.2%)	32 (15.2%)		
	Restrict movements: - Likely	386 (93.0%)	770 (98.0%)	473 (96.5%)	194 (92.8%)	<0.001	
	- Unlikely	2 (0.5%)	7 (0.9%)	6 (1.2%)	4 (1.9%)		
	- Not relevant to me	27 (6.5%)	9 (1.1%)	11 (2.2%)	11 (5.3%)		
	Inform local equine centres: - Likely	279 (66.9%)	475 (60.7%)	335 (68.6%)	150 (72.1%)	<0.001	
	- Unlikely	82 (19.7%)	259 (33.1%)	118 (24.2%)	38 (18.3%)		
	- Not relevant to me	56 (13.4%)	49 (6.3%)	35 (7.2%)	20 (9.6%)		
Action taken if horse in show-winning state shows symptoms						0.311	No association
Amount to pay for a vet in the event of a case						0.464	No association
Views on whether sellers should expected to						0.103	No association

clear horses of strangles							

Appendix 2 – Cluster analysis by strangles experience

Topic		1: No experience of strangles		2: Recent confirmed experience		3: Historic confirmed experience		P value	Comments
Potential risk of exposure to strangles									
	Response	n=	%	n=	%	n=	%		
Frequency of attending events	More than once a week	10	1.1	2	2.8	10	3.2	0.035	
	Every week	42	4.8	7	9.9	17	5.4		
	Every other week	107	12.2	13	18.3	44	13.9		
	Once a month	192	21.8	14	19.7	77	24.3		
	Less than 3 times a year	186	21.1	13	18.3	74	23.3		
	Never - others at yard do	188	21.4	16	22.5	54	17.0		
	Never	155	17.6	6	8.5	41	12.9		
Where horse/s are keep	Commercial	315	36.6	43	60.6	109	34.7	0.013	
	Home (no other horses)	212	24.7	11	15.5	79	25.2		
	Private yard – no other horses	102	11.9	5	7.0	37	11.8		
	Private yard – other owners' horses	231	26.9	12	16.9	89	28.3		
Events held where horse is kept								0.979	No association
Activity groups: ABC								0.099	No association

Topic		1: No experience of strangles		2: Recent confirmed experience		3: Historic confirmed experience		P value	Comments
Demographics									
Gender	Response	n=	%	n=	%	n=	%	0.421	No association
Age	18-24	151	17.1	12	17.1	18	5.6	<0.001	
	25-34	171	19.3	14	20.0	66	20.6		
	35-54	414	46.8	34	48.6	168	52.5		
	55-64	118	13.3	10	14.3	53	16.6		
	65-74	29	3.3	0	0.0	15	4.7		
	75+	1	0.1	0	0.0	0	0.0		
Length of time looking after horses	Less than a year	15	1.7	0	0	0	0	<0.001	
	Greater than a year	594	67.3	47	66.2	175	54.7		
	Lifelong	273	31.0	24	33.8	145	45.3		
Level of training	New to horse ownership	58	6.6	3	4.2	3	0.9	<0.001	
	Formal training	225	25.6	22	31.0	82	25.8		
	Some training	118	13.4	7	9.9	34	10.7		
	No formal training	337	38.3	25	35.2	128	40.3		
	Vet or vet nurse	10	1.1	1	1.4	2	0.6		
	Work with horses	78	8.9	10	14.1	54	17.0		
	Other	54	6.1	3	4.2	15	4.7		
Number of horses in direct care								<0.001	Kruskal Wallis
Origin of last horse purchased	Breeder/ dealer	142	16.1	19	26.8	56	17.7	0.01	
	From friend	210	23.9	15	21.1	54	17.1		
	I bred it	38	4.3	5	7.0	24	7.6		
	Other	71	8.1	5	7.0	19	6.0		

	Private seller – advertised offline	111	12.6	5	7.0	46	14.6		
	Private seller – advertised online	204	23.2	18	25.4	81	25.6		
	Rehomed	52	5.9	2	2.8	9	2.8		
	Rescued	37	4.2	0	0.0	17	5.4		
	Sale/market	15	1.7	2	2.8	10	3.2		
Horse vaccinated for 'flu	Yes	794	89.9	64	90.1	263	83.2	0.006	
	No	83	9.4	7	9.9	53	16.8		
	Don't know	6	0.7	0	0.0	0	0.0		
Type of livery*								0.604	No association

Attitudes: Concern

Semantic differential questions: 1 = completely agree with first statement, 2= partly agree with first statement, 3= neutral, 4= partly agree with second statement, 5= completely agree with second statement.

	Score	No experience		Recent experience		Historic experience		P value	Comment
	Response	n=	%	n=	%	n=	%		
Minor health concern - Life threatening	1	3	0.3	2	3.0	4	1.3	<0.001	
	2	31	3.6	9	13.6	29	9.6		
	3	62	7.2	6	9.1	36	12.0		
	4	407	47.4	29	43.9	137	45.5		
	5	355	41.4	20	30.3	95	31.6		
Easy to treat - Difficult to treat	1	16	2.0	6	8.8	11	3.8	<0.001	
	2	71	8.7	13	19.1	58	19.9		
	3	114	13.9	9	13.2	49	16.8		
	4	407	49.8	25	36.8	132	45.4		
	5	210	25.7	15	22.1	41	14.1		
Expensive to manage an outbreak - Cheap to manage an outbreak	1	245	29.8	36	52.9	98	32.6	0.004	
	2	326	39.7	18	26.5	106	35.2		
	3	113	13.8	2	2.9	41	13.6		
	4	99	12.1	9	13.2	45	15.0		
	5	38	4.6	3	4.4	11	3.7		
Something owners can easily prevent -	1	83	10.6	9	13.2	13	4.5	<0.001	
	2	273	34.8	11	16.2	99	34.5		
	3	197	25.1	13	19.1	66	23.0		

Impossible for owners to prevent	4	200	25.5	27	39.7	81	28.2		
	5	31	4.0	8	11.8	28	9.8		
Something I rarely worry about my horse catching - Something I frequently worry about my horse catching	1	73	9.0	4	6.5	21	7.3	0.008	
	2	249	30.8	17	27.4	79	27.6		
	3	181	22.4	5	8.1	67	23.4		
	4	223	27.6	19	30.6	84	29.4		
	5	83	10.3	17	27.4	35	12.2		
Something that can be eradicated from the UK - Something that cannot be eradicated	1	67	8.5	3	4.6	14	5	<0.001	
	2	165	20.9	15	23.1	46	16.4		
	3	207	26.2	7	10.8	64	22.9		
	4	274	34.7	21	32.3	103	36.8		
	5	77	9.7	19	29.2	53	18.9		
Something in the mind when attending events - Not something thought about when attending events	1	164	20.8	19	28.8	58	20	0.044	
	2	265	33.6	19	28.8	119	41.0		
	3	175	22.2	7	10.6	46	15.9		
	4	126	16.0	15	22.7	46	15.9		
	5	58	7.4	6	9.1	21	7.2		
Confidence in biosecurity practices at home	0	18	2.2	2	2.9	6	2.0	0.046	
	1 (not confident)	45	5.4	3	4.3	8	2.6		
	2	38	4.6	5	7.1	10	3.3		
	3	31	3.7	1	1.4	5	1.7		
	4	45	5.4	3	4.3	12	4.0		
	5	118	14.1	8	11.4	32	10.6		
	6	62	7.4	3	4.3	17	5.6		
	7	102	12.2	8	11.4	26	8.6		
	8	119	14.3	14	20.0	54	17.8		
	9	78	9.3	6	8.6	38	12.5		
	10 (very confident)	179	21.4	17	24.3	95	31.4		
Confidence in biosecurity	0 (not confident)	15	2.5	0	0	4	1.7	0.048	
	1	66	11.0	4	7.7	15	6.3		

practices at events	2	51	8.5	1	1.9	14	5.9		
	3	57	9.5	2	3.8	16	6.7		
	4	39	6.5	3	5.8	15	6.3		
	5	98	16.3	14	26.9	51	21.4		
	6	47	7.8	7	13.5	13	5.5		
	7	68	11.3	3	5.8	27	11.3		
	8	74	12.3	6	11.5	31	13.0		
	9	30	5.0	7	13.5	19	8.0		
	10 (very confident)	57	9.5	5	9.6	33	13.9		
Ever been advised against biosecurity									<20 answered this question

Knowledge									
	Score	No experience		Recent experience		Historic experience		P value	Comment
	Response	n=	%	n=	%	n=	%		
Strangles knowledge quiz	Airborne disease (F) – True	363	41.3	16	22.9	117	36.8	<0.001	
	- False	452	51.4	54	77.1	192	60.4		
	- Don't know	65	7.4	0	0.0	9	2.8		
	Incubation period of 14 days (T) - True	662	75.4	64	90.1	274	86.2	<0.001	
	- False	55	6.3	6	8.5	27	8.5		
	- Don't know	161	18.3	1	1.4	17	5.3		
	After infection immune to future infections (F) - True	119	13.7	22	31.0	20	6.3	<0.001	
	- False	514	59.1	46	64.8	214	67.5		
	- Don't know	236	27.2	3	4.2	83	26.2		
	Recovered horse can infect others (T) - True	532	61.1	57	82.6	248	78.7	<0.001	

	- False	121	13.9	6	8.7	38	12.1		
	- Don't know	217	24.9	6	8.7	29	9.2		
	Serious/ fatal problems (T)							0.476	No association
	Disease cannot survive outside body more than a few minutes (F) - True	62	7.9	7	9.9	23	7.2	<0.001	
	- False	452	57.6	58	81.7	254	79.9		
	- Don't know	271	34.5	6	8.5	41	12.9		
	Viral disease (F) - True	636	72.4	46	64.8	27	8.5	0.004	
	- False	143	16.3	22	31.0	70	22.0		
	- Don't know	100	11.4	3	4.2	221	69.5		
Strangles symptoms quiz								0.79	No association
Length of time to isolate horse if it potentially has been exposed to strangles	24 hours	11	1.2	1	1.4	4	1.2	<0.001	
	2 days	13	1.5	1	1.4	5	1.6		
	1 week	103	11.7	1	1.4	30	9.3		
	3 weeks	417	47.2	51	71.8	195	60.7		
	2 months	107	12.1	10	14.1	46	14.3		
	6 months	21	2.4	1	1.4	10	3.1		
	Don't know	199	22.5	5	7.0	23	7.2		
	They don't need to be isolated	13	1.5	1	1.4	8	2.5		
Knowledge of the term carrier	Yes	638	73.5	69	97.2	286	89.9	<0.001	
	No	68	7.8	0	0.0	3	0.9		
	Not sure	162	18.7	2	2.8	29	9.1		
Knowledge of the term carrier – corrected for answer to "recovered horse can infect others"	Yes	453	52.2	58	81.7	239	75.2	0.009	
	No	68	7.8	0	0.0	3	0.9		
	Not sure	162	18.7	2	2.8	29	9.1		
	Incorrect	185	21.3	11	15.5	47	14.8		

Knowledge of red, green, amber zones*	Yes	226	40.9	42	76.4	111	55.5	<0.001	
	No	327	59.1	13	23.6	89	44.5		
Awareness of Strangles Information Pack								0.075	No association
Awareness of STEPS	Yes	229	26.3	29	42.0	124	39.6	<0.001	
	No	641	73.7	40	58.0	189	60.4		
Awareness of PASS	Yes	72	8.3	10	14.5	44	14.1	0.007	
	No	789	90.7	60	87.0	266	85.0		
Management									
	Score	No experience		Recent experience		Historic experience		P value	Comment
Confidence in setting up an isolation area	Very confident	217	25.0	48	67.6	171	54.8	<0.001	
	Quite confident	375	43.2	20	28.2	115	36.9		
	Neither	141	16.2	2	2.8	14	4.5		
	Not very confident	115	13.2	1	1.4	11	3.5		
	Very unconfident	21	2.4	0	0.0	1	0.3		
Able to isolate horse	Yes	592	67.3	56	78.9	256	80.3	<0.001	
	No	214	24.3	14	19.7	53	16.6		
	Don't know	74	8.4	1	1.4	10	3.1		
Screening of new arrivals to yard*	Yes	56	10.1	12	21.8	29	14.4	0.013	
	No	423	76.6	41	74.5	158	78.6		
	Don't know	37	6.7	2	3.6	7	3.5		
	Not applicable	36	6.5	0	0.0	7	3.5		
Routinely isolate on return from an event	Yes, all events	37	7.6	3	6.8	23	11.0	0.038	
	Yes, some events	37	7.6	5	11.4	29	13.9		
	No	413	84.8	36	81.8	157	75.1		

Industry						
	Score	No experience	Recent experience	Historic experience	P value	Comment

View on whether strangles should be more of a priority in the industry								0.435	No association
Views of the efforts of following groups:	Pro event organisers							0.14	No association
	Amateur event organisers							0.373	No association
	Vets							0.057	No association
	Dealers/ horse sales – Efforts should be increased	739	85.2	62	88.6	282	92.2	0.04	
	Efforts are about right	23	2.7	1	1.4	7	2.3		
	Less effort	3	0.3	0	0.0	1	0.3		
	No opinion	102	11.8	7	10.0	16	5.2		
	Owners							0.237	No association
	Charities							0.244	No association
	Farrier							0.067	No association
	Dentists							0.075	No association
Views on whether strangles should be notifiable	Yes	800	90.7	50	70.4	262	81.9	<0.001	
	No	31	3.5	14	19.7	42	13.1		
	Don't know	51	5.8	7	9.9	16	5		

Hypothetical

If horse was suspected of having strangles - semantic differential questions: 1 = completely agree with first statement, 2= partly agree with first statement, 3= neutral, 4= partly agree with second statement, 5= completely agree with second statement.

	Score	No experience		Recent experience		Historic experience		P value	Comment
	Response	n=	%	n=	%	n=	%		
Worried about telling other people - Not worried about telling other people								0.055	No association

Not confident that I could prevent spread to other horses - Confident that I could prevent spread to other horses	1	64	7.5	4	5.8	17	5.4	<0.001	
	2	202	23.8	5	7.2	38	12.1		
	3	80	9.4	3	4.3	15	4.8		
	4	313	36.9	21	30.4	120	38.3		
	5	190	22.4	36	52.2	123	39.3		
Confident in my vet's advice and treatment - Not confident in my vet's advice and treatment	1	547	63.2	45	65.2	176	56.8	0.008	
	2	238	27.5	16	23.2	87	28.1		
	3	24	2.8	4	5.8	15	4.8		
	4	36	4.2	1	1.4	10	3.2		
	5	21	2.4	3	4.3	22	7.1		
Unwilling to restrict the movement of my horse - Willing to restrict the movement of my horse								0.301	No association
Able to restrict contact with other people and horses - Unable to restrict contact with other people and horses	1	464	54.1	56	80	218	69.6	<0.001	
	2	181	21.1	7	10	59	18.8		
	3	33	3.9	3	4.3	7	2.2		
	4	125	14.6	4	5.7	16	5.1		
	5	54	6.3	0	0	13	4.2		
Confidence to stop spread of strangles if it occurred	Very confident	169	19.1	47	66.2	187	58.3	<0.001	
	Quite confident	472	53.3	20	28.2	115	35.8		
	Neither	138	15.6	4	5.6	9	2.8		
	Not very confident	88	9.9	0	0.0	9	2.8		
	Not confident at all	19	2.1	0	0	1	0.3		
Sharing equipment	Haynets/ feeders							0.35	No association

with other owners	Buckets – No	540	72	49	44.1	229	81.5	0.012	
	- Yes only events	16	2.1	0	0.0	4	1.4		
	- Yes only yard	171	22.8	9	8.1	45	16.0		
	- Yes both	23	3.1	4	3.6	3	1.1		
	Basic tack/ grooming kit – No	546	72.7	49	77.8	218	76.8	0.017	
	- Yes only events	6	0.8	0	0.0	4	1.4		
	- Yes only yard	181	24.1	8	12.7	57	20.1		
	- Yes both	18	2.4	6	9.5	5	1.8		
	Muck clearing equipment							0.168	No association
	Grazing at events							0.445	No association
	Stables – No	472	64.8	34	57.6	172	66.4	0.014	
	- Yes only events	28	3.8	8	13.6	17	6.6		
	- Yes only yard	199	27.3	12	20.3	62	23.9		
	- Yes both	29	4.0	5	8.5	8	3.1		
	Shared water							0.624	No association
	Transport							0.325	No association
Likelihood of being able to stop sharing equipment if there was a risk of horse catching strangles	Haynets/ feeders – impossible	33	15.8	4	26.7	27	31.0	0.021	
	- Unlikely	10	4.8	3	20.0	7	8.0		
	- Neither	9	4.3	1	6.7	3	3.4		
	- Likely	25	12.0	1	6.7	8	9.2		
	- Definitely	132	63.2	6	40.0	42	48.3		
	Buckets							0.104	No association
	Basic tack/ grooming kit - impossible	29	15.1	3	23.1	26	32.9	0.032	
	- Unlikely	11	5.7	2	15.4	4	5.1		
	- Neither	7	3.6	0	0.0	2	2.5		
	- Likely	24	12.5	2	15.4	4	5.1		
	- Definitely	121	63.0	6	46.2	43	54.4		

	Muck clearing equipment – impossible	46	15.1	6	33.3	28	26.7	0.018	
	- Unlikely	38	12.5	3	16.7	8	7.6		
	- Neither	40	13.1	1	5.6	5	4.8		
	- Likely	44	14.4	1	5.6	11	10.5		
	- Definitely	137	44.9	7	38.9	53	50.5		
	Grazing at events – impossible	56	19.6	8	32	24	23.3	0.029	
	- Unlikely	36	12.6	4	16	21	20.4		
	- Neither	38	13.3	4	16	4	3.9		
	- Likely	50	17.5	1	4	13	12.6		
	- Definitely	105	36.8	8	32	41	39.8		
	Stables							0.11	No association
	Shared water – impossible	66	19.3	5	23.8	46	38.3	0.005	
	- Unlikely	63	18.4	5	23.8	13	10.8		
	- Neither	53	15.5	2	9.5	12	10.0		
	- Likely	42	12.3	4	19.0	16	13.3		
	- Definitely	118	34.5	5	23.8	33	27.5		
	Transport							0.392	No association
At what point would steps be taken if own horse was suspected of having strangles	After advice from friends/ yard manager/ trusted people	15	1.7	2	2.8	1	0.3	0.016	
	After advice from vet	136	15.4	7	9.9	31	9.7		
	After recognising a change in horse that gave reason for concern	310	35.1	29	40.8	144	44.9		
	When sure that the horse had definitely had contact with a horse with strangles	43	4.9	2	2.8	14	4.4		

	When horse may have been exposed to the disease	380	43.0	31	43.7	131	40.8		
Measures taken if horse comes into contact with positive horse	Disinfect all equipment							0.165	No association
	Storage/disposal of muck							0.639	No association
	Inform others at yard – likely	733	83.6	70	98.6	263	84.6	0.001	
	- Unlikely	6	0.7	0	0.0	5	1.6		
	- Not relevant to me	138	15.7	1	1.4	43	13.8		
	Raise awareness via social media							0.205	No association
	Prevent contact with your horse – likely	769	88.3	71	100	280	89.7	0.006	
	- Unlikely	8	0.9	0		5	1.6		
	- Not relevant to me	94	10.8	0		27	8.7		
	Restrict horse's movements : - Likely	824	94.7	70	98.6	301	97.7	0.049	
	- Unlikely	6	0.7	0	0.0	3	1.0		
	- Not relevant to me	40	4.6	1	1.4	4	1.3		
	Inform local equine establishments: - Likely	593	68.3	44	62.0	195	62.9	0.007	
	- Unlikely	192	22.1	22	31.0	97	31.3		
	- Not relevant to me	83	9.6	5	7.0	18	5.8		

Action taken if horse in top show-winning shape is suspected of having strangles	Ask for advice on social media	3	0.3	1	1.4	0	0	<0.001	
	Go anyway, most horses get strangles	0	0.0	1	1.4	1	0.3		
	Do not go, monitor	488	55.4	48	67.6	226	70.6		
	Go as planned	0	0.0	0	0.0	1	0.3		
	Call vet	367	41.7	15	21.1	80	25.0		
	Go but extra precautions and vet check on return	14	1.6	3	4.2	10	3.1		
	Call yard manager for advice	9	1.0	3	4.2	2	0.6		
Number of vet call outs prepared to pay for in the event of horse suffering from strangles	1 call out	68	7.7	4	5.6	33	10.3	<0.001	
	2-3 call outs	223	25.2	6	8.5	70	21.8		
	3 or more call outs	593	67.0	59	83.1	214	66.7		
	No call outs	1	0.1	2	2.8	4	1.2		
Views on whether sellers should expected to clear horses of strangles	Yes	542	61.5	52	73.2	146	46.1	<0.001	
	No	213	24.2	16	22.5	132	41.6		
	Don't know	126	14.3	3	4.2	39	12.3		
Likelihood of using a yard that had a policy of screening all new arrivals for strangles*								0.068	No association
Likelihood of using a yard that had a policy of isolating all horses returning from events*								0.802	No association

Views of the yard managers authority to inform other yard uses of an outbreak*								0.601	No association
Prepared to provide evidence that horse is not a carrier in the event of yard manager improving biosecurity*								0.897	No association
More likely to prove horse not a carrier in the event of an outbreak*								0.082	No association
Level of agreement with the following statements*	Speak to someone not managing appropriately							0.055	No association
	Responsibility of yard manager							0.054	No association
	Owner share updates							0.334	No association
Views on who should cover the cost of an outbreak*	Owner of horse being tested	438	82.3	45	83.3	169	88.5	0.027	
	Owner of strangles positive horse	63	11.8	2	3.7	15	7.9		
	Yard manager	31	5.8	7	13.0	7	3.7		

Appendix 3: Cluster analysis by knowledge that horses that have recovered from strangles without veterinary help could become subclinical carriers (infect other horses in the future)

* Questions only asked to those who kept their horse/s on open yards (commercial yards and private/rented yards with other owners).
** Questions only asked to those who had personal experience of strangles.

Topic		Don't have this knowledge n = 567		Have knowledge n = 1400		P value	Comments
Level of training	New to horse ownership	42	7.4	45	3.2	<0.001	
	Formal training	124	21.9	402	28.9		
	Some training	77	13.6	147	10.6		
	No formal training	229	40.5	470	33.8		
	Vet or vet nurse	3	0.5	31	2.2		
	Work with horses	59	10.4	206	14.8		
	Other	31	5.5	90	6.5		
Confidence that latest horse purchased was clear**						0.153	No association
Knowledge of the term carrier	Yes	349	62.54	1249	90.8	<0.001	
	No	55	9.86	30	2.2		
	Not sure	154	27.60	97	7.0		
Awareness of Strangles Information Pack	Yes	103	18.4	344	24.9	0.002	
	No	456	81.6	1036	75.1		
Awareness of STEPS	Yes	131	23.5	525	38.3	<0.001	
	No	426	76.5	847	61.7		
Awareness of PASS	Yes	46	8.3	172	12.6	0.007	
	No	508	91.7	1194	87.4		
Screening of new arrivals to yard*	Yes	32	9.4	137	15.5	0.002	
	No	279	82.3	706	79.9		
	Don't know	28	8.3	41	4.6		

Number of vet call outs prepared to pay for in the event of horse suffering from strangles	1 call out	62	11.0	104	7.4	<0.001	
	2-3 call outs	157	27.7	294	21.0		
	3 or more call outs	340	60.1	996	71.1		
	No call outs	7	1.2	6	0.4		
View on whether sellers should expected to clear horses of strangles	Yes	336	59.7	766	55.1	0.003	
	No	146	25.9	464	33.4		
	Don't know	81	14.4	161	11.6		
Likelihood of using a yard that had a policy of screening all new arrivals for strangles*						0.966	No association
Prepared to provide evidence that horse is not a carrier in the event of yard manager improving biosecurity *						0.431	No association

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Thank you all for joining our campaign to Stamp Out Strangles!