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LLOYD'S

COMMENTARY

Biosecurity is a commonplace term these days among horse owners and equestrian event managers. Horse owners must take personal responsibility for reducing risks of equine infectious disease outbreaks. Newly implemented vaccination and isolation facility requirements for horse event venues are another layer of protection, but cannot take the place of an implemented farm biosecurity plan.

Biosecurity guidelines from reliable resources are readily available on the internet and in printed materials. The word "guideline" should be emphasized. Protocols and disinfectant products used in a university equine hospital that has painted concrete stalls, drains, and a cadre of well-trained personnel whose sole responsibilities are cleaning and disinfecting stalls might not be appropriate or practical for a different equine facility. The environments are different; the horses' risks are different (hospital patients vs. healthy horses) and the types of pathogens likely present are very different. The best biosecurity plan is one tailored to the facility and environment, the horses, and the risks. Risks are the types of pathogens of concern (horse show vs. a broodmare foaling barn), as well as the volume of human and horse traffic at the facility (busy horse sales venue vs. closed herd of retirees).

Obtaining biosecurity information from reliable resources is also critical. I was amazed at how much interesting (and often inaccurate) information is available regarding biosecurity.

Take the internet article on the dangers of mosquitoes to horses (true) since they can transmit West Nile virus to horses (true), and also the deadly chikungunya virus to horses (false, false, false). Chikungunya virus is not known to cause disease in horses anywhere, let alone be a "deadly disease to horses" in the U.S. Somehow I was not surprised that the origin of the article was a manufacturer of insecticides. While insect control is part of a comprehensive biosecurity program, scare tactics are not effective or ethical marketing strategies.

In another article on biosecurity, the author referred to a disinfectant type that was the "gold standard" of disinfectants. However, there is no "gold standard" of disinfectants for horse facilities. Different disinfectants have different capabilities of killing different pathogens under different environmental conditions (hard water, cold environmental temperatures, organic matter, etc.).

One of the broadest spectrum disinfectants is bleach. However, bleach is readily inactivated in the presence of organic matter (soil, manure, etc.), and is most effective on hard, nonporous surfaces that have been thoroughly cleaned and are free of organic matter. Most commercially available disinfectants with label claims for equine pathogens have been tested in 5% organic matter, which still means a very, very clean surface.

One rub rag used to polish several horses' muzzles prior to entering the show ring can be the weak link in biosecurity. Allowing show ponies to sniff noses at the entry gate "to get acquainted" is an effective way to spread respiratory disease. Common sense is the first step to effective biosecurity.

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INTERNATIONAL

First Quarter 2017

The International Collating Centre, Newmarket, United Kingdom, and other sources reported the following disease outbreaks.

African horse sickness was confirmed in all provinces in South Africa except in those of the Eastern Cape and the Western Cape. Frequency of the disease was as expected for this period of the year.

Equine influenza was reported in the UK and the USA. An isolated outbreak was recorded in the UK whereas outbreaks of the disease were confirmed in four states in the USA in which equine influenza is considered endemic.

Denmark, France, Germany, South Africa, Switzerland, and the USA reported outbreaks of strangles. The number of confirmed disease events include one in Denmark, 21 in France (mostly isolated cases of the disease), single cases on five premises in Germany, sporadic cases in South Africa in which the disease is endemic, an isolated case in Switzerland, and 58 outbreaks in 22 states in the USA in which the disease is endemic.

Diseases related to equine herpesvirus 1 (EHV-1) were recorded in France, Germany, Ireland, Japan, the UK, and the USA. Respiratory disease was diagnosed in France (three outbreaks), Germany (two outbreaks), Ireland (six outbreaks), the UK (two outbreaks), and the USA (widespread in numerous states). Cases of EHV-1 abortion were confirmed in France (seven outbreaks), Germany (single case on four premises), Japan (eleven cases involving seven premises), the USA (four cases on individual farms), and the UK (single cases on three premises). EHV-1 neurologic disease was recorded in France (single case), the UK (single case), and the USA (four outbreaks, one involving eight cases).

Respiratory disease due to EHV-4 was reported by France (eight outbreaks, mostly single cases of the disease), Germany (six cases on four premises), and the UK (a single case). EHV-4 was established as a cause of sporadic abortions in France and the UK. Infection with EHV-2 and/or -5 was confirmed in a number of states in the USA, some associated with evidence of respiratory disease.

Two cases of equine adenovirus infection were diagnosed in Kentucky, USA.

Canada, Germany, and the USA confirmed outbreaks of equine infectious anemia. The number of cases included ten in Canada, of which four were epidemiologically linked to a common source; three in Germany, all on the same premises; and two on a premises in Illinois, USA.

Equine piroplasmosis was reported by France (disease endemic), South Korea (single case of *Theileria equi* infection), and the USA (two cases of *T. equi* infection in Texas, both linked to a cluster detected in early 2016, and an isolated case in an imported horse in Florida).

Germany, South Africa, and South Korea recorded cases of contagious equine metritis. Eight cases involving six premises were confirmed in Germany, a single case in a stallion in South Africa, and 20 cases of 2,086 horses surveyed were positive in South Korea.

A single case of equine coital exanthema (EHV-3) was confirmed in Kentucky, USA.

The USA reported eleven cases of Nocardioform placentitis and abortion in Kentucky associated with *Amycolatopsis* and/or *Crossiella* spp. infection.

Equine arteritis virus was detected in frozen semen during pre-entry quarantine by Argentina.

The USA reported a limited number of cases of salmonellosis, some due to serogroup B and others serogroup C1 *Salmonellae*. Clostridial enteritis in foals was recorded by the USA. Some were caused by *C. difficile* Type A Toxin genotype or Type B Toxin genotype, others by *C. perfringens* Type A Toxin genotype. Isolated cases of *C. piliformis* (Tyzzer's disease) and *C. novyi* were also confirmed. Two cases of Coronavirus infection were recorded, neither life-threatening.

Several cases of equine proliferative enteropathy in foals were diagnosed in Kentucky and Pennsylvania, USA.

South Africa reported a reduced incidence of equine encephalosis, mostly in Gauteng and Mpumalanga Provinces compared to previous years. Cases of West Nile (22) and Middelburg virus (30) infections were detected across South Africa, mostly in Gauteng Province.

Equine Disease Quarterly

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Genetics and Genomics in Racing: Speed Isn't Everything

Genetics refers to the study of genes and the way traits or conditions are passed down from one generation to another. Genomics, on the other hand, describes the study of all genes (the genome) including interactions of genes with each other and the environment. Although much of the genetic and genomic research done in Thoroughbreds is applied to racing performance, the full breadth of application for genetic and genomic research goes beyond that of faster horses.

Genetics and genomics allow for a more complete understanding of both simple and complex diseases. From a genetic perspective, "simple" is a term used to describe a disease that follows a single gene pattern of inheritance. These diseases are controlled by one gene, with other genes and outside factors having very little influence (i.e, the presence of the gene = disease). Diseases inherited in this way are typically qualitative, where an animal either has the disease or it doesn't (e.g. lethal white foal syndrome). Complex diseases, on the other hand, are usually controlled by not one but many different genes and are often affected by environmental factors, such as nutrition and living conditions (e.g. Cervical Vertebral Stenotic Myelopathy aka Wobblers). This combination of both genetic and environmental factors results in complex or "multifactorial" diseases. Basically, three different scenarios determine the manifestation of a complex disease:

	No genetic predisposition
+	Environmental triggers
=	No clinical signs of disease
	Genetic predisposition
+	No environmental triggers
=	No clinical signs of disease
	Genetic predisposition
+	Environmental triggers
=	Highly varied clinical signs

As a result, complex genetic diseases can be extremely difficult to diagnose early and/or prevent using traditional methods such as pedigree analyses and veterinary evaluations. In some instances, a simple disease may even be classified as complex based on the inability of epidemiological studies and pedigree analyses to find common factors among cases.

Hydrocephalus, for example, is a developmental disorder that often results in stillbirth of foals and dystocia in dams. Possible causes of the defect in horses could not be proven based on field data and pedigree analyses suggested the disorder to be complex. With this in mind, a genome scan of 82 horses (13 cases, 69 controls) was performed and a small section of the genome was identified as containing the cause of the disorder. Genomic sequencing was then performed on 10 horses (4 cases, 6 controls) and the genetic cause of the disorder was pinpointed. Ultimately, 2 copies of a mutation that changed a "C" nucleotide to a "T" nucleotide (Figure 1) resulted in the disorder. Although previously believed to be a complex disease, genetic and genomic methods were able to prove that the disorder was in fact simple, leading to the development of a genetic test that can help breeders avoid the disorder. It is important to note the difference between a genetic test for a simple disease, such as hydrocephalus, and a genetic test for a complex disease (e.g. osteochondrosis). Genetic tests for simple diseases can confirm or rule out a genetic condition; however, genetic tests for complex diseases only help to determine an individual's chance of developing a genetic disorder—an important distinction when genetic tests are used to help make breeding decisions.

In either scenario, genetics and genomics in Thoroughbreds have far-reaching potential beyond that of breeding and selecting faster horses. Understanding diseases caused by a single gene as well as complex diseases caused by multiple genes and the environment can lead to early diagnosis and targeted treatments. While the list of reasons a racehorse never reaches its potential may seem endless, genetics and genomics provide an opportunity to cross certain disorders off that list, thereby helping to eliminate or reduce the occurrence of those diseases.

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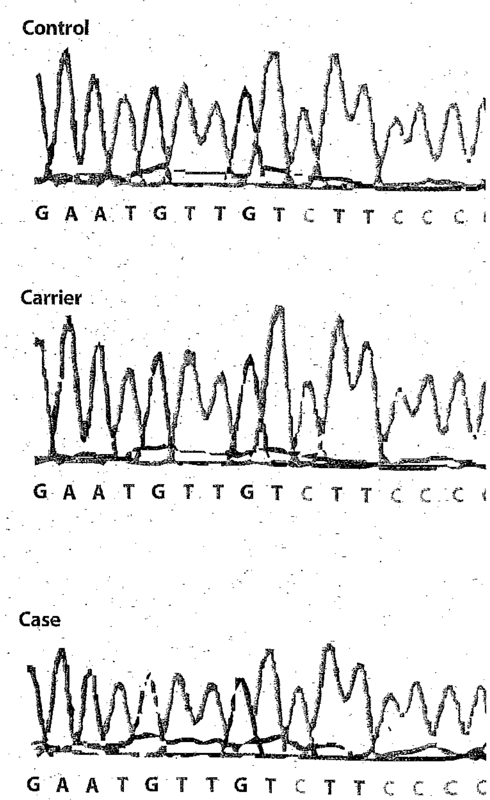

Figure 1. Two copies of a mutation that chang results in hydrocephalus.

International Horse Movements and Disease Risk

The World Organization for Animal Health (OIE) is responsible for ensuring transparency of the global animal disease situation by requiring reporting of occurrences of animal diseases of economic and public health importance by its member countries as well as safeguarding the health and safe trade of animals and animal products by setting international standards documented in the OIE Terrestrial Animal Health Code (TAHC).

Incidents of disease introduction associated with international movement of live horses are sporadically reported to the OIE for immediate notification via the OIE World Animal Health Information System (WAHIS). From 1995 to 2014, 54 incidents were reported to the OIE. The immediate notification reports from the Member Countries were reviewed in conjunction with other information available in the public domain to provide the following analysis.

Equine influenza (13 events) and contagious equine metritis (12 events) were the most frequently reported diseases.

For seven events, the infected horses were detected during post-arrival quarantine and were not released into importing countries. The 47 other events resulted in the introduction of pathogens into importing countries.

Subclinical infections remain a challenge for international trade. In 88 percent of reported events, infected horses did not show signs of clinical disease at the time of import.

In 81 percent (38/47) of the reported events, import regulations were not followed. Noncompliance consisted of illegal movement (six events), non-adherence to the national regulations of the importing country (six events), and non-adherence to OIE disease specific standards (26 events). For the other nine events, breakdown of the import procedures were presumably associated with laboratory testing (three events), management of post-arrival quarantine (two events), transportation (one event), and assessment of the situation in the country of origin (one event). Causes of two events could not be identified.

In 51 percent (24/47) of the reported events, the imported animal was responsible for transmission of a pathogen to the local population. Disease transmission to the local population was influenced by the biosecurity practices implemented by the importing countries, which included isolation of new entrants, intensified health monitoring of the resident equine population to promptly detect emergence of disease, vaccination, and surveillance programs of the resident population.

International standards and import protocols regulating international horse movements are paramount in mitigating the potential risk of disease associated with horse movements. Continuous compliance with best biosecurity and health management practices by importing countries provides an additional safeguard to mitigate residual risk of disease transmission to the local population from imported horses.

No disease event associated with live horses temporarily imported to compete at international equestrian events or races was identified. In an effort to further facilitate the safe, temporary import of this specific class of horse, the OIE together with the Fédération Equestre Internationale (FEI) and the International Federation of Horseracing Authorities (IFHA) has developed the "High Health, High Performance horses – (HHP)" concept as well as international standards (TAHC Chapter 4.16). The high health status of HHP horses is established through continual veterinary supervision and meeting harmonized health requirements combined with stringent health management practices and biosecurity procedures.

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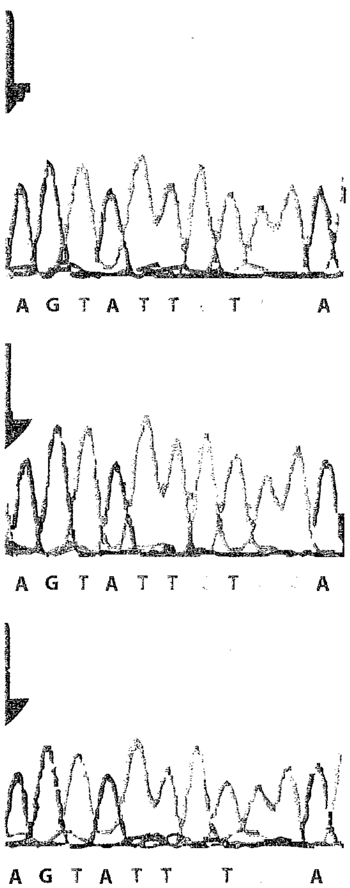

' nucleotide to a "T" nucleotide

NATIONAL

Laboratory Diagnosis of Strangles

Highly contagious equine strangles is transmitted by inhalation or ingestion of *Streptococcus equi* originating from discharges of the nose or abscess of an infected horse. Nasal shedding begins approximately 4-16 days after initial infection and continues for two to three weeks in most horses. However, survival of the organism in pus located in the guttural pouch may continue for months or years and be associated with periodic escape of the organism through the nasal passages. Persistent carrier animals may therefore serve as long-term sources of infection for naïve, susceptible horses with which they have contact. Some carrier horses may be recognized by an intermittent unilateral nasal discharge, cough, or have palpable swelling in the throatlatch area below the larynx. Numbers of viable *S. equi* in infected guttural pouches become very few and detection of carrier horses generally requires direct endoscopic examination and sampling of the pouch.

Bacteriologic Culture: Nasal swabs and nasopharyngeal washes collected two to three days after onset of fever in the acute phase of strangles and pus from abscesses usually contain abundant *S. equi*. The characteristic watery colonies are easy to recognize on appropriate selective culture media within 18 hours of incubation. Sugar fermentation assays can then be completed in three hours to confirm identity. The wide availability, low cost, and diagnostic certainty provided by demonstration of the pathogen argue strongly for inclusion of culture in strangles outbreak diagnosis. Ideally, three to five horses in a nascent outbreak should be cultured to establish presence of the pathogen and mitigate effects of poor sample quality. In contrast to its value in acute phase diagnosis, culture has low sensitivity in detection of chronic carrier horses. This is explained by massive die-off of *S. equi* in pus-filled guttural pouches in combination with infrequent drainage into the nasopharynx.

Polymerase Chain Reaction (PCR): A variety of formats and gene targets based on PCR have been shown to be at least three times more sensitive than culture in detection of *S. equi* in diagnostic samples from the nasopharynx and guttural pouch. PCR will detect DNA of *S. equi* in numbers too few to be detectable by culture and is effective in the presence of background contaminants. However, in addition to cost and limited local availability, a positive PCR reaction is not proof of presence of viable *S. equi* and hence there is risk of false positive reactions. Also, PCR is vulnerable to accidental contamination during collection and in the laboratory. Nevertheless, PCR is by far the most sensitive diagnostic aid in detection of possible guttural pouch carrier horses.

Detection of Serum Antibody: *S. equi* specific antibody responses are detectable in serum two to three weeks following exposure, persist at high levels in most horses for 10-12 weeks, and—with the exception of SeM antibodies—decline to near baseline by 30 weeks. Ideally, antibody responses to two or three proteins of *S. equi* should be measured in combination for greatest sensitivity and allow for differences in responses of individual horses. A positive level of antibody may indicate infection or vaccination within the previous six months or possibility of persistent guttural pouch carriage. Serology is especially helpful in diagnosis of occult (bastard) strangles abscesses and *S. equi* associated immune mediated vasculitis (purpura). Affected horses usually have very high antibody levels to *S. equi* proteins. Serology is also helpful in deciding whether to vaccinate. Horses with a preexisting positive level of antibody are likely to have protective immunity and a few of these will be at risk of developing purpura if vaccinated.

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Biosecurity at Equine Events

A disease-related "perfect storm" occurs when risk factors and a pathogen successfully interact, resulting in the introduction and spread of an infectious organism among a susceptible population. In the world of equine events, a perfect storm is plausible if:

1. Susceptible, stressed horses are exposed to an infectious disease agent.
2. The conditions and environment at the event support transmission and infection.
3. The pathogen rapidly spreads throughout the animal population on the premises.

In May 2011, horses that attended the National Cutting Horse Association event in Ogden, UT, were exposed to equine herpesvirus 1. A number of these horses developed equine herpesvirus 1 myeloencephalopathy. The disease likely spread due to multiple high-risk practices such as commingling horses of unknown health status, stabling horses in close proximity, horses being tied to fences outside of the arena, use of shared water sources, use of communal wash racks, and exercising horses in confined spaces. The resulting outbreak garnered national attention and serves as an example of a perfect storm that had a significant impact on the equine industry.

Most equine event venues and facility layouts allow exhibitors easy, direct access to competition/exhibition areas. Under such circumstances, many shows have inadequate or non-existent isolation facilities for horses displaying signs of disease. To address this concern, starting in December 2017 the United States Equestrian Federation

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will require that competition management have an isolation protocol for horses suspected of having an infectious disease. Isolation of a clinically affected horse is a critical first step in disease outbreak control. It is essential to identify potential areas for isolation of sick horses in an area away from the remainder of the equine population. Due to the lack of appropriate isolation areas at many events, consideration must be given to the construction of a temporary pipe corral type/isolation pen in a parking lot or an off-site area. Vacant horse stables, livestock facilities, supply sheds, or local fairgrounds may be available for use in these situations. Advanced identification of appropriate alternate stabling facilities will allow for rapid isolation of a sick horse and decrease the risk of potential disease transmission.

In addition to adequate isolation, observance of basic biosecurity practices are necessary to prevent pathogen introduction and spread. Routine biosecurity practices should limit or avoid:

- horse to horse contact
- human contact with multiple horses
- use of shared communal water sources
- use of shared equipment that has not been cleaned and disinfected between uses

Additionally, daily monitoring of horse health on the event grounds should include twice daily temperature evaluations and observation for clinical signs of disease. Horses with a temperature above 101.5° F or that exhibit clinical signs should be reported to a veterinarian and/or event official and be immediately isolated away from all other horses.

A biosecurity toolkit for equine events has been developed to provide guidance on the development and implementation of biosecurity plans and isolation protocols. The toolkit can be found at *https://www.cdfa.ca.gov/ahfss/Animal_Health/Equine_Biosecurity.html*. The toolkit provides guidance for the assessment and development of a biosecurity plan that addresses specific disease risks at a particular event and venue. Implementation of a biosecurity plan for every equine event will help protect the health of the national equine population.

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