High health, high performance (HHP) horses: risk mitigation strategies and establishment of specific health requirements

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Content

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Summary

To address impediments to international competition horse movements and for more countries/regions to be able to benefit from the expansion of the sport horse industry while safeguarding the equine health status of the receiving country, the competing horses, and the equine health status of their home country on their return, the World Organisation for Animal Health (OIE) together with the Fédération Equestre Internationale (FEI) and the International Federation of Horseracing Authorities (IFHA), has developed the "High Health High Performance horse – (HHP)" concept.

The concept to establish a high health status subpopulation of horses applies solely to competition horses for temporary entry and not to those used for breeding, or for permanent residency. It is based on the principles of **compartmentalisation** as defined and described in the *Terrestrial Animal Health Code* Chapters 4.3 and 4.4.

The goal of the OIE in defining such a subpopulation is to provide a rational and scientifically acceptable basis for national animal health authorities to harmonize their entry requirements with respect to the temporary importation of this class of horses. Facilitation of international horse movements is indeed predicated on reducing the number of infectious diseases that horses need to be screened for in transiting from one performance event to another. Such a goal is only achievable, however, if it can be accomplished with **minimal risk of dissemination of disease** at the event and even more importantly, of introducing an infectious agent into a naïve resident horse population.

To qualify as a high health status subpopulation, horses should undergo a specified qualification period. The high health subpopulation is established by the application, at all times, of stringent **health management practices** and **biosecurity procedures** to create and maintain a functional separation between horses within the defined subpopulation and all other equids.

These standard HHP conditions (i.e. health management practices and biosecurity procedures) are intended to mitigate the risk of disease dissemination for many of the OIE listed diseases, as well as for other diseases of importance for the equine industry. However, for the following six OIE listed diseases, a risk of disease dissemination was identified, albeit at a variable level, notwithstanding observance of the HHP standard conditions: African horse sickness, equine influenza, equine infectious anaemia, equine piroplasmosis, glanders, and Venezuelan equine encephalomyelitis. **HHP specific health requirements** have therefore been defined to establish the high health status of the subpopulation with respect to these six diseases. These consist of specific laboratory testing requirements, treatments and vaccinations and are included in the HHP Veterinary Certificate.

From a qualified high health status subpopulation, individual horses can be selected for travel in accordance with **HHP Veterinary Certification**. A HHP horse can travel to multiple destinations using multiple issues of a HHP Veterinary Certificate, within a maximum of 90 days, before returning to its country of usual residence.

The HHP concept offers a harmonized universally applicable alternative to protocols currently in place for temporary horse movement. It provides **opportunities for developing countries/regions with equestrian and racing interests** to engage in international competitions based on simplified certification requirements for the temporary importation of horses of high health status and for their return to their country of origin.

Keywords

Diseases – HHP – High health high performance – Horses – International movement – Risk.

Background

Over the past decades, the sport horse industry (equestrian sport and racing) has seen a significant growth, with associated job creation and socio-economic benefits for national economies, the horse industry, the agricultural sector and other stakeholders. However, this growth has been largely limited to the historically recognized horse sport regions and well established race-circuits. Other regions have undergone growth on a reduced scale. This could be partly due to difficulties in moving horses within these regions and to other regions. This may be attributable to differing health status for specific equine diseases, the lack of temporary import regulations, differing sanitary regulations for laboratory testing and vaccination, quarantine periods that interfere with training, etc.

To address impediments to international competition horse movements and to enable more regions to benefit from the current expansion in the sport horse industry while safeguarding the health status of the receiving country, the World Organisation for Animal Health (OIE) together with the Fédération Equestre Internationale (FEI) and the International Federation of Horseracing Authorities (IFHA) has developed the "High Health High Performance horse – (HHP)" concept, outlined in the OIE *Terrestrial Animal Health Code* (Chapter 4.16).

The concept to establish a high health status sub-population of horses applies solely to competition horses for temporary entry and not to those used for breeding or permanent stay. It is based on the principles of compartmentalisation as defined and described in the *Terrestrial Animal Health Code* Chapter 4.3 and 4.4. The subpopulation ("compartment") is established by the continuous application of documented biosecurity procedures to create and maintain a functional separation between horses within the defined subpopulation and all other equids. Each horse in the compartment is subjected to specific health requirements to establish its health status (laboratory tests, treatments and vaccinations appropriate to the disease status of the horse´s region of origin, regions visited and the regions that it will visit). From a qualified HHP compartment, individual horses can be selected and travel in accordance with HHP Veterinary Certification.

This document presents the HHP disease risk mitigation strategies. It demonstrates how the continuous observance of the HHP health and biosecurity practices allows for simplification of the list of diseases for which HHP horses should be certified with respect to their temporary importation for competition purposes.

The HHP disease risk mitigation strategies

The primary goal of the HHP concept is to prevent the dissemination of disease agents that could trigger an outbreak at an event venue and result in a widespread disease outbreak in the country hosting the event (importing country) or on return to the countries of usual residence of the horses under consideration (exporting countries).

The HHP risk mitigation strategies rely on four pillars:

- Biosecurity measures
- Health management practices
- Specific health requirements
- Contingency planning

Biosecurity measures

The fully documented, continuous application of HHP biosecurity measures aims at mitigating the risk of disease introduction or transmission by: horses from outside of the subpopulation, other animals, people, vehicles, equipment, feed, water, pests. The risk of venereal transmission is also addressed by the prohibition of breeding activities in the subpopulation.

Importantly, the risk of airborne transmission, vector-borne transmission or transmission between horses within the subpopulation are not fully addressed by the HHP standard biosecurity measures. That is one of the factors that was taken into consideration when assessing the need for the establishment of HHP specific health requirements.

Health management practices

The HHP health management practices aim at the **rapid detection of any sign of disease**, so that in conjunction with sound contingency planning, appropriate measures can be taken to minimize the risk of spread. Standard health management practices include continuous veterinary supervision and a daily observation and a twice daily temperature check and prompt isolation of any horse in the subpopulation that may develop clinical signs of disease.

Specific health requirements

A prerequisite to mitigating the risk of disease dissemination in the context of international movements of HHP horses whilst reducing the number of infectious diseases that they need to be screened for in transiting from one performance event to another was the need to **identify those diseases of greatest risk of spread** under the HHP general condition.

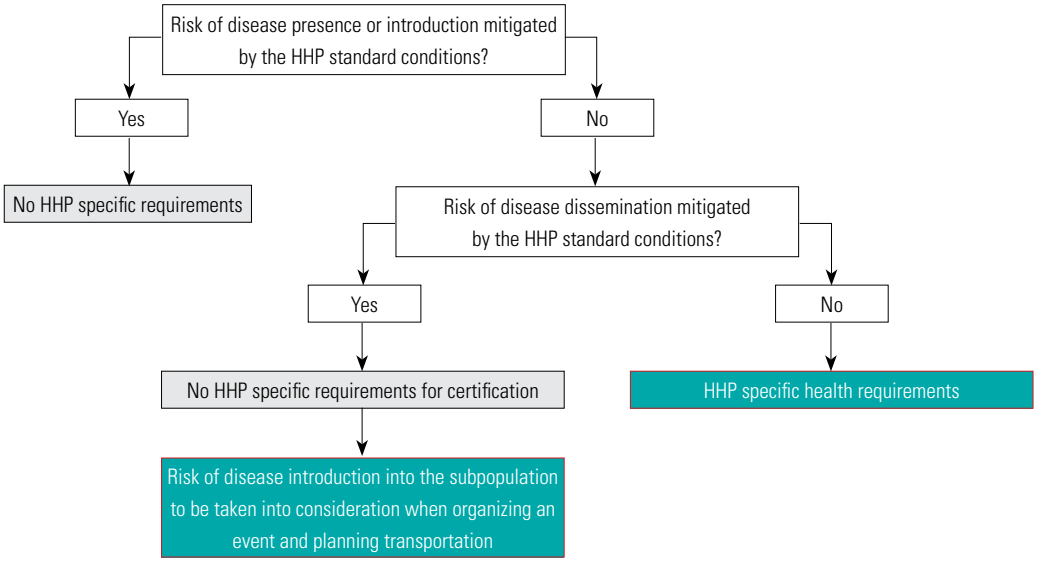

Figure 1
HHP risk mitigation strategies and identification of the diseases for which HHP specific health requirements are needed

HHP specific health requirements have been established for the diseases for which a risk of dissemination was identified, notwithstanding observance of the HHP standard conditions. The process of identification of these diseases is shown in Figure 1.

The risk of disease spread under the HHP standard conditions was qualitatively assessed for the OIE listed diseases of importance for horses, as well as for non-listed diseases of importance for the equine industry:

– The OIE considers 18 OIE listed diseases of importance for horses: African horse sickness (AHS), anthrax, contagious equine metritis (CEM), dourine, equine infectious anemia (EIA), equine influenza (EI), equine viral arteritis (EVA), glanders, Japanese encephalitis (JE), infection with equid herpesvirus-1 (EHV-1), Venezuelan equine encephalomyelitis (VEE), equine piroplasmosis, rabies, screwworm myiasis, surra, Eastern equine encephalomyelitis (EEE), Western equine encephalomyelitis (WEE), West Nile fever (WNF).

– OIE-FEI-IFHA regional conferences on the facilitation of international horses movements[1] identified seven non-listed diseases of greatest concern for the equine industry: strangles, epizootic lymphangitis, vesicular stomatitis, infection with Hendra virus, horse mange, horsepox, infection with Nipah virus.

1 A Regional Conference for Asia, the Far East and Oceania. Hong Kong SAR, 18-20 February 2014
Regional Conference for the Middle East and North Africa. Dubai. 29 September – 1 October 2014

Contingency planning

The HHP standard conditions, in conjunction with the HHP specific health requirements, aim at minimizing the risk of disease transmission. This is a **risk mitigation approach** (not a zero-risk approach).

Contingency planning is about preparing an effective and rapid response plan to contain any disease incident and is an integral part of the HHP concept. A contingency plan should be developed for all situations where HHP horses are held (home stable, temporary places of residence, event venue, transport) and arrangements worked out for dealing with any outbreak of communicable disease that are most appropriate to the situation in which it occurs.

Mitigation of the risk of disease presence or introduction through observance of the HHP standard conditions

The risk of disease presence or introduction assuming the HHP standard biosecurity measures and health management practices were adhered to, was considered minimal for one OIE listed disease and five non-listed diseases of concern for the equine industry (table 1).

Table 1
Diseases for which the risk of presence in or introduction into the subpopulation is mitigated through observance of the HHP standard conditions

Disease	Risk of undetected presence in the subpopulation	Risk of introduction into the subpopulation	Risk of transmission within and from subpopulation
Anthrax	**Extremely low** (Veterinary supervision)	**Extremely low** (Biosecure stabling)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
Epizootic Lymphangitis	**Extremely low** (Veterinary supervision and care for wounds)	**Extremely low** (Biosecurity practices and hygiene + veterinary supervision and care to prevent fungal contamination of open wounds)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
Infection with Hendra virus	**Extremely low** (Veterinary supervision)	**Extremely low** (Biosecurity measures to prevent direct or indirect contact with bats)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
Horse mange	**Extremely low** (Veterinary supervision)	**Extremely low** (Biosecurity measures to prevent fomite transmission and direct transmission from outside of the subpopulation)	**Extremely low** (Since the risks of the disease being present or introduced are negligible)
(Classical) horsepox	**Extremely low** (Veterinary supervision)	**Extremely low** (Biosecurity measures to prevent fomite transmission and direct transmission from outside of the subpopulation)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
Infection with Nipah virus	**Extremely low** (Veterinary supervision)	**Extremely low** (Biosecurity measures to prevent direct or indirect contact with swine)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)

The following presents a summary of the salient features of each disease and the basis for their risk classification.

Antrax is caused by a spore-forming bacterium (*Bacillus anthracis*). It is a serious zoonotic disease that can affect most mammals but is particularly important in herbivorous species (1) (2). Horses become exposed when they ingest spores in soil or on plants in pastures (2). In herbivores, infections become apparent after 3 to 7 days (2). Horses typically develop acute disease (2). In view of the short incubation period and the absence of asymptomatic carriers, the HHP continuous veterinary supervision should detect the disease in the subpopulation (if it had been introduced into the subpopulation prior to the start of the qualification period). Once the qualification period has started, the risk of introduction of anthrax in the subpopulation should remain low at all times, considering the HHP recommendations for biosecure stabling and feed and water quality. In endemic areas, modified live vaccines can prevent anthrax in livestock.

Epizootic lymphangitis is a systematic fungal disease (*Histoplasma farciminosum*). The fungus gains entry to animals through open wounds (3). Direct contact with infective materials through skin wounds or through cutaneous abrasions is the most common mode of transmission. Spread of the infection can also occur indirectly through contact with contaminated fomites. Flies that feed on open wounds might also be involved in transmission (4). During the qualification period, the HHP continuous veterinary supervision should detect the disease (if it had been introduced into the subpopulation prior to the start of the qualification period) since the maximal incubation period is 2 months (3). Once the qualification period has started, the HHP standard biosecurity practices, especially hygiene, associated with veterinary supervision and care (treatment of wounds) should prevent the introduction of epizootic lymphangitis in the subpopulation.

Hendra is a zoonotic viral disease (*Paramyxoviridae*). Fruit bats appear to be reservoir hosts for Hendra virus (5). Horses and humans seem to be spillover hosts for Hendra. Hendra virus infections may include influenza-like illness and progressive encephalitis. The virus is thought to be spread from bats to horses through environmental contamination of pasture with infective urine/birthing fluids. Route of exposure is ingestion or inhalation. The index case is usually a horse kept outside, near fruit bat roosts (5). Hendra virus does not appear to be highly contagious among horses. Horses are believed to be most contagious after they become symptomatic or during the

preceding febrile stage. The incubation period is short. Since infected horses most frequently present with clinical signs, HHP veterinary supervision during the qualification period should detect any infected horse (contaminated prior to the start of the qualification period). Once the qualification period has started, the biosecure stabling, especially controlled access of animals (bats), should prevent horses in the subpopulation from being exposed to Hendra virus.

Horse mange is a contagious chronic parasitic skin disease, caused by different species of mites burrowing into or living on the skin (6). It can be spread by direct and indirect contact (saddle pads, blankets, tacks and other items). Asymptomatic carrier state can exist in some animals during summer months. The HHP veterinary supervision should allow for the detection of the disease during the qualification period (if it had been introduced into the subpopulation prior to the start of the qualification period). Once the qualification period has started, the HHP standard biosecurity measures should mitigate the risk of introduction of horse mange in the subpopulation by preventing introduction by contaminated fomites or via direct contact with other animals that are not part of the subpopulation.

Classical horsepox is a rare infectious skin disease caused by a *Poxviriade*. Classically, horsepox can present in different clinical forms, ranging from benign and restricted to lesions on the muzzle, in the mouth or on the legs to a generalized, highly contagious papulonodular form. Lesions spontaneously resolve after 4-6 weeks. The infection is spread by direct contact with an infected host or with contaminated fomites such as combs, saddles, harness. It is believed the virus gains entry to the body by the respiratory route or the skin. Potentially, biting flies could also be involved in virus transmission. Recovery from horsepox results in a high level of immunity (7). The HHP continuous veterinary supervision should detect the disease in the subpopulation (if it had been introduced into the subpopulation prior to the start of the qualification period). Once the qualification period has started, the risk of introduction of horsepox in the subpopulation should remain low at all times, considering the HHP recommendations to prevent virus introduction by contaminated fomites or via direct contact with other animals that are not part of the subpopulation.

Nipah virus is a zoonotic viral disease (*Paramyxoviridae*). Fruit bats are the main reservoir hosts of the virus (8). Nipah virus is highly contagious in swine, which can serve as amplifying hosts (8). In humans, Nipah virus infections can be asymptomatic or mild, however most recognized clinical cases present with acute neurological signs. Horses can be infected by contact with pigs or with objects contaminated with the virus (9). The incubation period is short. Horses may be clinically or asymptomatically infected with the virus. There is no evidence of a long term carrier state in horses. The HHP veterinary supervision should detect the disease (if it had been introduced into the subpopulation prior to the start of the qualification period). Once the qualification period has started, HHP standard biosecurity measures should mitigate the risk of introduction of Nipah virus the subpopulation by preventing direct transmission by infected swine or indirectly, through contact with contaminated fomites.

Mitigation of the risk of disease dissemination through observance of the HHP standard conditions

The risk of disease dissemination assuming the HHP standard biosecurity measures and health management practices were upheld was considered minimal for eleven OIE listed diseases and two non-listed diseases of concern for the equine industry (Table 2).

The risk of introduction of certain of these diseases into the subpopulation should be taken into consideration when organizing an event and planning transportation (EEE, JE, WEE, WNF, surra, screwworm myiasis, vesicular stomatitis) (Table 2), (e.g. by requesting relevant vaccinations).

The following presents a summary of the salient features of each disease and the basis for their risk classification.

Diseases for which the risk of transmission should be mitigated because horses are considered dead-end hosts

Rabies is a viral (*Rhabdoviridae*) disease that affects the central nervous system of mammals and that is a zoonosis of major importance (10) (11). Rabies virus is usually shed in the saliva, and transmission results from the bite of an infected animal (11). All mammals are susceptible to rabies, but only a limited number of species act as reservoir hosts. Horses are susceptible to rabies. The incubation period of rabies can vary considerably. There may be a (very low) risk of non-detection of rabies in a horse incubating the infection during the qualification period. Under HHP conditions, controlled access of animals to the subpopulation should prevent horses in the subpopulation from being exposed to this infection. However, as horses are considered dead-end hosts, it is therefore extremely unlikely that transmission would occur (12). In animals in endemic areas, rabies prevention is based on vaccination.

Table 2
Diseases that are of minimal risk of transmission when HHP standard biosecurity measures and health management practices are observed

Disease	Risk of undetected presence in the subpopulation	Risk of introduction into the subpopulation	Risk of transmission within and from subpopulation
Rabies	**Yes** (Incubation period can be of extended duration)	**Extremely low** (Biosecurity measures to control access of rabid animals)	**Extremely low** (Horse dead-end host)
Strangles	**Yes** (There are asymptomatic long term carriers)	**Extremely low** (Biosecurity measures to prevent fomite transmission and direct transmission from outside of the subpopulation)	**Extremely low** (Biosecurity measures and veterinary supervision [shedding does not begin until first/second day after the onset of pyrexia])
EHV-1	**Yes** (Latent infections)	**Extremely low** (Biosecurity measures to prevent fomite transmission and direct transmission from outside of the subpopulation)	**Extremely low** (Biosecurity and management of the subpopulation mitigate the risk for reactivation; veterinary supervision should detect EHV-1 episodes and reduce the risk of transmission)
EVA	**Yes** (Acute infection can be subclinical. Asymptomatic long term carrier state in stallions)	**Extremely low** (Prohibition of breeding to prevent venereal transmission, biosecurity measures to prevent fomite transmission and to prevent direct transmission from outside of the subpopulation)	**Extremely low** (Respiratory transmission only during acute infection [i.e. not after the qualification period considering the short incubation period and the negligible risk of introduction]; Prohibition of breeding to prevent venereal transmission)
JE	**Yes** (Asymptomatic infections are frequent)	**Yes** (Vector-borne transmission [mosquitoes])	**Extremely low** (Horse dead-end host)
Surra	**Yes** (Chronic infection with recurrent episodes of parasitaemia)	**Yes** (Vector-borne transmission - mechanically transmitted by biting flies)	**Extremely low** (Continuous veterinary supervision and management [parasitaemia directly associated with pyrexia])
Vesicular stomatitis	**Extremely low** (Veterinary supervision [short incubation, clinical disease, no asymptomatic carriers])	**Yes** (Vector-borne transmission)	**Extremely low** (Veterinary supervision; horses that have signs of disease can act as of sources of the virus)
CEM	**Yes** (Asymptomatic long-term carrier state in stallions and mares)	**Extremely low** (Prohibition of breeding to prevent venereal transmission and biosecurity measures to prevent fomite transmission from outside of the subpopulation)	**Extremely low** (Prohibition of breeding to prevent venereal transmission and biosecurity measures)
Dourine	**Yes** (Incubation period can be of extended duration; subclinical infections may occur)	**Extremely low** (Breeding not permitted)	**Extremely low** (Breeding not permitted)
WNF	**Yes** (Asymptomatic infections are frequent)	**Yes** (Vector-borne transmission [mosquitoes])	**Extremely low** (Horse dead-end host)
EEE	**Yes** (Subacute Infections may occur)	**Yes** (Vector borne transmission [mosquitoes])	**Extremely low** (Horse dead-end host)
WEE	**Yes** (Subacute infections may occur)	**Yes** (Vector-borne transmission [mosquitoes])	**Extremely low** (Horse dead-end host)
Screwworm myiasis	**Extremely low** (Veterinary supervision and care)	**Yes** (Vector-borne [female fly laying eggs])	**Extremely low** (Veterinary supervision [larvae detection in the wound and interruption of the parasite lifecycle])

Japanese encephalitis (JE) is a zoonotic mosquito-borne viral disease (*Flaviviridae*) that can affect pigs, humans, horses and donkeys (13). JE virus is maintained in nature among mosquitoes, wild birds and pigs (14). In horses, most infections are subclinical. JE is a public health concern. In parts of Asia, JE is the most important viral encephalitis in humans. Vector protection is not included in the HHP standard biosecurity measures, JE would be at risk of being introduced into the subpopulation. In horses, the infection can cause encephalitis but is frequently unapparent (13) (14). JE may therefore not be detected via the veterinary supervision. However, horses are generally considered dead-end hosts, it is therefore extremely unlikely that transmission would occur (13) (14). JE vaccines can prevent disease in horses, pigs and humans.

Eastern equine encephalomyelitis (EEE) and Western equine encephalomyelitis (WEE) are zoonotic mosquito-borne viral diseases (*Togaviridae*) that can affect birds, humans and equids (15). Alternate infection between birds and mosquitoes maintain EEE and WEE viruses in nature (16). EEE and WEE virus may cause severe disease in humans. Vector protection is not included in the HHP standard biosecurity measures, therefore EEE and WEE could be at risk of being introduced into the subpopulation. Clinical disease due to EEE and WEE may be observed in horses, but some animals may be asymptomatically infected (15). EEE and WEE may therefore not be detected even under HHP continuous veterinary supervision. However, horses are considered dead-end hosts for these diseases, it is therefore extremely unlikely that transmission would occur (16). Vaccination is the main method of protecting equids from EEE and WEE.

West Nile Fever (WNF) is a zoonotic mosquito-borne viral disease (*Flaviviridae*) that can affect birds, humans and horses (17). WN virus belongs to the Japanese encephalitis complex. Wild birds are the main reservoir hosts for WN virus. Alternate infection between birds and mosquitoes maintains WNF virus in nature (17). WN viral encephalitis occurs in only a small percentage of infected horses; the majority of infected horses do not display clinical signs (17) (18).In humans, WN virus infection can cause WN fever (this flu-like illness is the most common form of the disease) or WN neuroinvasive disease. The disease may therefore not be detected via the HHP continuous veterinary supervision. Vector protection is not included in the HHP standard biosecurity measures, therefore WNF could be at risk of being introduced into the subpopulation. However, horses are considered dead-end hosts, it is therefore extremely unlikely that transmission would occur (17) (18). Commercial WN virus vaccines are available.

Diseases for which the risk of transmission should be mitigated by the prohibition of breeding activities in the subpopulation

Contagious equine metritis (CEM) is a contagious bacterial (*Taylorella equigenitalis*) venereal disease of horses (19). Horses appear to be the only natural hosts for *T. equigenitalis*. Direct venereal contact during natural mating presents the highest risk for transmission (20). Direct venereal transmission can also take place by artificial insemination using contaminated semen (20). Indirectly, infection may be transmitted through contact with contaminated fomites, inadequate observance of appropriate biosecurity measures at the time of breeding and at semen collection centers (20). Carrier stallions display no clinical signs (19). Mares can carry the bacteria asymptomatically after they recover from the acute phase of the infection (19). CEM may therefore be undetected in the subpopulation under HHP continuous veterinary supervision. However, the prohibition of breeding activities in the subpopulation and the HHP standard biosecurity practices should prevent the introduction and transmission of the disease.

Dourine is a protozoan (*Trypanosoma equiperdum*) venereal disease of breeding equids transmitted directly from animal to animal during breeding (21). The incubation period, severity and duration of the disease can vary considerably with the virulence of the strain, nutritional status of the host, and the existence of stressors that may precipitate a relapse (22). Considering that the incubation period can be up to several years and that subclinical infections can occur, dourine may be undetected in the subpopulation under uninterrupted HHP veterinary supervision (21). However, the prohibition of breeding activities in the subpopulation should prevent the introduction and transmission of the disease.

Diseases for which the risk of transmission should be mitigated by continuous observance of the HHP health management practices and biosecurity measures

Strangles is a contagious respiratory infection of horses caused by *Streptococcus equi*. It is transmitted by direct and indirect contact (tack and equipment, sharing drinking water buckets and feed, clothing, hands) (23). Shedding does not begin until a day or two after the onset of pyrexia (24). The majority of horses clear the bacteria and no longer pose a threat of infecting others after few weeks. However, some horses become asymptomatic carriers and can shed the bacteria and serve as a source of infection when undergoing stress (23). HHP standard biosecurity practices should prevent fomite introduction of strangles into the subpopulation or introduction by direct contact with horses that are not in the subpopulation. However,

since there are asymptomatic carriers, strangles could be present in the subpopulation and remain undetected during the qualification period. The HHP continuous veterinary supervision should enable the rapid detection of any episodes of pyrexia and result in the prompt isolation of any new cases before they transmit the infection (24). Vaccines are available against strangles.

Infection with equid herpesvirus-1 (EHV-1) is ubiquitous in horse populations worldwide. Transmission most frequently occurs by close direct contact with infected animals, aborted fetuses, placentas, or placental fluids. Horses invariably become infected by EHV-1 during their first year of life (25). Many adult horses are latently infected with EHV-1 and following reactivation, will subsequently shed the virus for a limited period of time (25). Stress or immunosuppression may result in virus reactivation, recrudescence of disease and shedding of infectious virus (25). Since there are asymptomatic carriers, EHV-1 could remain undetected in the subpopulation despite the HHP continuous veterinary supervision. The management of the HHP subpopulation should avoid stress as much as possible to reduce the risk of reactivation of the infection. There should be no risk of transmission via fetuses and placentas under HHP standard conditions(26) (27). Veterinary supervision may detect fever or clinical signs associated with an EHV-1 episode and this should minimize the chances of transmission through the prompt isolation of the infected animal (27). Vaccines are available for use in horses (but are not considered to be substitutes for strict adherence to the managements practices known to reduce the risk of infection with EHV-1).

Equine viral arteritis (EVA) is a viral disease (*Arteriviridae*) that affects Equidae. It can be transmitted by the respiratory and venereal routes or transmitted indirectly through contaminated fomites (28). Only acutely infected horses shed the virus via the respiratory route. Long-term carrier stallions can transmit the infection through breeding either by natural service or by artificial insemination. The majority of cases of acute infection with EAV are subclinical (29). The incubation period varies from 2 days to two weeks (30). Once the qualification period has started, the risk of exposure of the horses to the infection should be reduced by the prohibition of breeding, the HHP biosecurity measures to prevent fomite introduction and prevention of direct contact with horses that are not in the subpopulation. The HHP veterinary supervision may not detect acute infections because they are frequently subclinical during the qualification period. However, if there were infected horses in the subpopulation when the qualification period started, these horses would not be contagious by the respiratory route by the end of the qualification period. It is therefore unlikely that transmission would occur. Vaccines are commercially available against EVA.

Surra is a protozoal (*Trypanosoma evansi*) disease mechanically transmitted by flies that can affect a range of mammalian species, especially cattle and horses (31). One case of human infection with *T. evansi* has been documented. Surra can be a chronic disease in horses with recurrent episodes of parasitaemia. Importantly, pyrexia is directly associated with parasitaemia (32). Recent exposure to the causal agent or the existence of carriers could remain undetected despite the HHP veterinary supervision. However, effective HHP veterinary supervision should enable the rapid detection of any episodes of pyrexia and result in the prompt isolation of an infected horse in a vector- protected environment to mitigate the risk of transmission.

Vesicular stomatitis (VS) is a viral disease (*Rhabdoviridae*) that mainly affects horses, donkeys, mules, cattle and swine. Camelids, sheep and goats occasionally develop clinical signs. Humans are also susceptible (minor zoonosis). The reservoir or amplifying hosts for VSV are unknown (33). Insect vectors can introduce VS into populations of domesticated animals (flies, blackflies, *Culicoides*) (33). VS is characterized by vesicules, papules, erosions and ulcers. A transient fever usually develops when the lesions appear (33). Stabling animals appears to decrease the risk of disease; pastured livestock are more likely to become infected (33). Once it has been introduced into a herd, VS can be transmitted by infected animals that have signs of disease through direct contact (transcutaneous and transmucosal route) or indirect transmission (contact with buckets, equipment, housing, trailers, feed, bedding or other items used by an infected horse can provide a ready means of spread). The risk for virus transmission is considered minimal after lesions have healed (34). Vector protection is not included in the HHP standard biosecurity measures, VS could therefore be introduced in the subpopulation. However, the HHP continuous supervision should enable the rapid detection of any horse presenting fever or showing lesions and result in the prompt isolation of the infected horse to mitigate the risk of transmission.

Screwworm myiasis is caused by fly larvae that feed on living flesh, creating draining or enlarging wounds (35) (36). New World screwworm myasis is caused by the larvae of *Cochliomyia homnivorax*. Old World Screwworm myasis is caused by the larvae of *Chrysomya bezziana.* Human can be hosts for screwworm larvae (the disease can quickly become debilitating if it affects the eyes, mouth, nasal or frontal sinuses of the ears). HHP continuous veterinary supervision should permit detection of infested wounds and allow for the prompt treatment of any affected horse, thereby preventing possibility of further transmission.

Specific tools to be considered for the mitigation of the risk of disease introduction

The risk of introduction of certain diseases into the subpopulation should be assessed when organizing an event and planning transportation, especially with respect to JE, EEE, WEE, WNF, surra, vesicular stomatitis and screwworm myiasis (Table 2). Specific disease prevention measures might be considered to mitigate the risk of infection, such as commercially available inactivated vaccines against JE, EEE, WNF and WEE (16) (14) (17). No vaccines are commercially available for surra, vesicular stomatitis and screwworm myiasis (35) (32), but insect control is a key prevention tool (36) (31).

Mitigation of the risk of disease dissemination by meeting HHP specific health requirements

Risk of transmission

For 6 OIE listed diseases (glanders, AHS, EI, EIA, equine piroplasmosis, and VEE), a risk of disease transmission was identified, albeit at a variable level, even when HHP standard conditions were observed (Table 3). Specific health requirements were therefore established to mitigate the risk (Table 4).

The following presents a summary of the salient features of each disease and the basis for their risk classification.

Glanders is a highly important, zoonotic bacterial disease (*Burholderia mallei*), principally of equids. Glanders is also of significance as a human disease. Although its global distribution has been greatly reduced over the years as the result of national eradication programs, the disease still occurs in a significant number of countries and regions (37). Some infected horses may die within a few weeks. Many others may become chronically infected and spread the disease for years. Chronically infected as well as clinically ill animals can spread the disease (37). It can be spread between horses through direct physical contact with horses affected with nasal or pulmonary forms of the disease. Exposure to infection would appear to occur most frequently through ingestion of food or water contaminated with infective discharges from the respiratory tract or ulcerative skin lesions from carrier animals. Also, glanders can readily be spread by indirect means through horses sharing feed troughs, water bowls/buckets or items

Table 3
OIE listed diseases for which there is a risk of transmission under the HHP standard biosecurity measures and health management practices (i.e. without health specific requirements)

Disease	Risk of undetected presence in the subpopulation	Risk of introduction into the subpopulation	Risk of transmission within and from subpopulation
Glanders	**Yes*** (Asymptomatic long term carriers)	**Extremely low** (Biosecurity measures to prevent fomite transmission and direct transmission from outside of the subpopulation)	**Yes** (Horses infected subclinically can be a source of infection and direct transmission by the respiratory route not excluded within the subpopulation)
AHS	**Yes*** (Asymptomatic viraemia [partially immune animals or vaccination with a live attenuated vaccine])	**Yes** (Vector-borne [*Culicoides*])	**Yes** (Infected horses act as a source of infection ; *Culicoides* are widespread vectors ; vector protection is not included under the HHP standard conditions)
EI	**Yes*** (Subclinical infection in partially immune horses)	**Yes** (Effective airborne transmission, risk increased during air transportation)	**Yes** (Pre-symptomatic shedding ; asympatomatic shedding in partially immune horses ; air-borne transmission not excluded within the subpopulation)
EIA	**Yes*** (Asymptomatic long term carriers)	**Yes** (Vector-borne; transmitted mechanically by biting insects)	**Yes** (Infected horses act as a source of infection ; vectors are widespread)
Equine piroplamosis	**Yes*** (Asymptomatic long term carriers)	**Yes** (Vector-borne [ticks])	**Yes** (Infected horses act as a source of infection ; vectors are widespread, iatrogenic spread possible)
VEE	**Yes*** (Subacute infections)	**Yes** (Vector-borne: mosquitoes)	**Yes** (Epidemic VEE virus subtypes amplified in equids; vectors are widespread)

* In addition to the risk of recent introduction not yet detectable

of harness contaminated with infective material. The incubation period of glanders can be very variable ranging from a few days up to many months (37). It is influenced by route of exposure, infective challenge and intrinsic host factors. Horses frequently develop the chronic form of the disease. Subclinically infected carrier animals play an important role as reservoir and means of dissemination of glanders in equine populations (38). Since there are asymptomatic carriers, glanders can remain undetected in the subpopulation despite the HHP veterinary supervision. HHP standard conditions would not absolutely prevent glanders' transmission (especially the occurrence of direct transmission by the respiratory route). The importation of a horse that is not free from the disease would therefore pose a risk of subsequent transmission.

African horse sickness (AHS) is a non-contagious arthropod-borne viral disease (*Reoviridae*) of equids biologically transmitted by midges (*Culicoides* spp). Nine different viral serotypes have been described (39). Following an incubation period usually of 7 to 14 days, one of the four different clinical manifestations of AHS can develop in naïve horses. These are the acute pulmonary form, the mixed pulmonary and cardiac form, the subacute cardiac form and the subclinical form of AHS fever (40). In horses, the mortality rate can range from 70 to 95 percent (40). Viremia in the horse is usually from 4 to 8 days but may extend up to 21 days. Recovered animals do not remain carriers of the virus. Prevention of AHS in endemic or high risk countries or regions is based on vector control and annual vaccination (live attenuated vaccines) (40). Vector protection is not included in the HHP standard conditions. In countries that are not free from the disease, AHSV would therefore present a risk of being introduced into the subpopulation. In addition, concerns have been expressed over the risk of viremia induced by live attenuated vaccines routinely used to control AHS in endemic regions and the risk of incomplete vaccine protection leading to a subclinical viremia. There is therefore a risk of AHS being undetected in the subpopulation: horses could be incubating the infection (recent introduction) or unapparently viremic (as a consequence of vaccination). *Culicoides* are widespread and the importation of a horse that is not free from the disease would pose a significant risk of subsequent transmission, with the potential to cause extremely high fatality rates in naïve populations of horses and mules. The official recognition by the OIE of the AHS free status of Member Countries is of great importance for the safe international trade of equids.

Equine influenza (EI) is a highly contagious respiratory disease (Type A orthomyxovirus) of horses and other equid species, that is wide spread throughout the world (41). Two major subtypes are known to cause disease in equines: H7N7 and H3N8; however there have been very few reports of H7N7 subtype virus infections in the last 30 years (42). Sub-lineages of H3N8 virus continuously emerge due to antigenic drift (point mutations) or to antigenic shift (reassortment of the genome). Antigenic drift contributes to the continuing susceptibility of horses to infection and to the reduced efficacy of some vaccines (41). Transmission of EI occurs primarily by the respiratory route. Aerosol spread can occur over distances of up to 35 meters (41). EIV can also be transmitted by direct contact or indirectly, through the use of contaminated fomites. EI is highly contagious and can spread rapidly among horses, especially those kept in close confinement (e.g. at shows, training yards, etc.). In countries that are not free from the disease, and in light of the high transmissibility of EIV, the HHP standard conditions would not absolutely prevent the risk of introduction of EIV into the subpopulation (by the air-borne route). The incubation period is usually 1 to 3 days, but may be less than 24 hours. Infected horses shed virus in their respiratory secretions during the incubation period and continue to shed the virus for 4 to 5 days after the onset of clinical signs (41). There is no evidence of the existence of the carrier state in EI. After infection, protective immunity to homologous strains of the virus persists for a year. Immunity after vaccination is subtype specific and depends on the strain(s) of virus included in the vaccine (41). Partially immune animals (e.g. previously vaccinated older horses) may be infected subclinically and also act as sources of the virus to their cohorts (42). HHP veterinary supervision would not be able to detect situations in which presymptomatic or subclinical virus shedding is taking place, and to prevent subsequent transmission within and from the subpopulation. In addition, air transport can increase the susceptibility of the respiratory tract to the infection (43). Over the past, 50 years EI has been responsible for a significant number of epidemics/widespread occurrences of respiratory disease in naïve equine populations following the importation of horses from countries in which the disease is endemic. Experience has repeatedly shown that the economic impact of major EI events can be enormous.

Equine infectious anemia (EIA) is a non-contagious viral disease (*Retroviridae*) of horses and other equid species. EIA is worldwide in its distribution. Few countries have self-declared freedom from the disease to the OIE. Under natural conditions, the most important mode of transmission of EIA is by the transfer of virus-infective blood by hematophagous insects between horses kept in proximity to one another (44). Transmission of EIA on the mouthparts of hematophagous biting insects is purely mechanical. Vector protection is not included in the HHP standard conditions. In countries that are not free from the disease, EIAV would therefore present a risk of being introduced into the subpopulation. The incubation period for EIA in naturally acquired cases of infection is usually but not invariably within the range of 15 to 45 days (44). There have been instances however, where the incubation period in individual animals can be much longer, extending up to

90 days, or even longer, after exposure to a known source of infection. The virus persists in blood leukocytes for the life of the infected animal. It also occurs in plasma during febrile episodes. The existence of a life-long carrier state in infected horses is of singular importance in the epidemiology of the disease (45). EIA could be undetected in the subpopulation despite the HHP continuous veterinary supervision. Even though symptomatic horses are more likely to transmit the disease than animals with inapparent infections, the risk of transmission by an asymptomatic horse cannot be ruled out. Insects that can mechanically transmit EIAV are widespread and the importation of a horse that is not free from the disease would pose a risk of subsequent transmission. EIA can be responsible for outbreaks of acute disease in naïve horses associated with high morbidity and mortality rates that can be economically very costly.

Equine piroplasmosis is a tick-borne protozoal disease of horses that is widespread in its global distribution (46). The two hemoprotozoan parasites that can cause equine piroplasmosis (*B. caballi* and *T. equi)* are transmitted by ticks, which become infected when they ingest parasites in the blood of infected equids. A range of species of ticks belonging to the genera *Dermacentor, Hyalomma* and *Rhipicephalus* can be vectors for these organisms. *B. caballi* and *T. equi* can set up a long-term carrier state in infected horses (47). Carriers can act as sources of infection for ticks. The incubation period in equine piroplasmosis is usually from 10 to 30 days in the case of *B.* caballi and 12 to 19 days for *T. equi* (46). Protection against ticks is not included in the HHP standard conditions. In countries that are not free from the disease, equine piroplasmosis would therefore present a risk of being introduced into the subpopulation. Illness associated with infection *B. caballi* or *T. equi* or both, can vary from mild to severe depending on which parasite is involved and the immune status of the host. Many cases are subclinical. Since horses can be asymptomatic carriers of the parasites, they can remain undetected in the subpopulation despite HHP veterinary supervision. Competent tick vectors may be widespread in certain regions and inapparent carriers can act as sources of infection; the importation of a horse that is not free from the disease would therefore pose a risk of subsequent transmission.

Venezuelan equine encephalomyelitis (VEE) is a highly important zoonotic mosquito-borne viral disease (*Togaviridae*) that can affect both equids and humans. Transmission of VEEV is through the bite of infected hematophagous vectors, primarily mammalophilic mosquitoes (48). In humans, VEE is usually an acute, often mild, systemic illness. In equids, VEE may be asymptomatic, mild or resemble clinical EEE or WEE (15). Infection with certain subtypes of the virus can give rise to extensive epidemics of the disease with significant morbidity and mortality rates in naïve horses and other equid species that can vary from 50 to 90 percent. These occurrences are invariably associated with spread of disease to humans in affected countries/regions. Six antigenic subtypes have so far been recognized that comprise the VEE virus complex (subtypes I to VI, with subtype I further subdivided into five antigenic variants or serovars, AB to F). VEE complex viruses are divided into epidemic and enzootic groups, based on their epidemiological characteristics. All viruses except VEEV variants I-AB, I-C, I-E are considered enzootic. Enzootic VEE viruses occur in limited geographic areas, where they are maintained in cycles involving wild animals (rodents). They are not amplified in equids, and do not usually cause disease in these animals. In contrast, epidemic VEE viruses are detected only sporadically, are amplified in equids, and can cause extensive epidemics affecting both equids and humans (15). Vector protection is not included in the HHP standard conditions. In countries that are not free from the disease, VEEV would therefore be at risk of being introduced into the subpopulation. VEE could be undetected in the subpopulation, since some horses could be incubating the infection (recent introduction) or infected asymptomatically. Since epidemic VEE viruses can be amplified in equids, and considering the large distribution of competent vectors, if a horse that is not free from the disease was to be imported, there would be a risk of subsequent transmission. VEE has historically given rise to disease events of major proportions associated with very significant mortality rates in affected equine populations. An added dimension of importance in the case of VEE is that it is a zoonotic disease. Vaccination is the main method or protecting equids from VEE.

Specific health requirements

For the six diseases for which a risk of dissemination was identified (notwithstanding observance of the HHP standard biosecurity conditions and health management practices) specific requirements were defined to maintain the high health status of the subpopulation. Their impact on the risk of disease dissemination is shown in Table 4.

The specific health requirements aimed at mitigating the risk of undetected presence in the subpopulation are detailed in the Model HHP veterinary certificate.

The specific requirements aimed at mitigating the risk of introduction in the subpopulation are detailed in the Biosecurity Guidelines.

They are briefly summarized below.

Glanders. In countries that are not free from glanders, no case of glanders should have occurred within the 6 months of the start of the qualification period of the subpopulation, and horses in the subpopulation shall test negative for glanders (two serological tests). In countries that are free

Table 4
Mitigation of the risk of transmission for 6 selected diseases via the inclusion of specific health requirements in the HHP concept

Disease	Risk of undetected presence in the subpopulation	Risk of introduction into the subpopulation	Risk of transmission within and from subpopulation
Glanders	**Extremely low** (Serological tests)	**Extremely low** (Biosecurity measures to prevent fomite transmission and direct transmission from outside of the subpopulation)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
AHS	**Extremely low** (In countries that are not free from AHS, horses should test negative)	**Extremely low** (The country [or zone] hosting the event (as well as transport routes) should be free from AHS)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
EI	**Extremely low** (Effective EI vaccination)	**Extremely low** (Effective EI vaccination)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
EIA	**Extremely low** (In countries that are not free from EIA, horses should test negative for EIA)	**Extremely low** (If the country [or zone] hosting the event (as well as transport routes) cannot be certified as being free of EIA, measures should be taken to minimize exposure of horses to vectors).	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)
Equine piroplamosis	**Extremely low** (Serological tests)	**Extremely low** (Measures should be taken to minimize exposure of horses to vectors - event facility and immediate surroundings should be treated against ticks)	**Extremely low** (Specific measures to mitigate the risk of transmission if infected horses are identified in the subpopulation)
VEE	**Extremely low** (In countries that are not free from VEE, horses should be vaccinated against VEE or test negative for VEE)	**Extremely low** (If the country [or zone] hosting the event (as well as transport routes) cannot be certified as being free of VEE, measures should be taken to minimize exposure of horses to vectors)	**Extremely low** (Since the risks of the disease being present or introduced are extremely low)

from glanders, HHP horses shall test negative for glanders before travel (one serological test).

AHS. In countries that are not free from AHS, horses should test negative for AHS (confirmed under specific vector protection conditions). The country (or zone) hosting the event should be free from AHS.

EI. Prevention and control of EI depend upon the appropriate use of vaccines containing strains of the virus most closely representative of those in current circulation in a country or region. While the level of protective immunity engendered by vaccination may not be absolute, if carried out as recommended, with vaccines updated with epidemiologically relevant strains, regular vaccination should mitigate the severity of clinical illness and reduce the magnitude and duration of nasal shedding in horses following natural exposure to the virus. Vaccine breakdowns are reported to be due to inadequate vaccine potency, inappropriate vaccination schedules or outdated vaccine virus strains that fail to induce protection as a result of antigenic drift. An OIE expert surveillance panel provides annual recommendations on EI vaccine composition. Recommendations for effective EI vaccination protocols that will be applied to the high health status subpopulation are also under consideration.

EIA. In the absence of a safe and reliable vaccine, prevention and control of EIA is based upon a programme of serologic testing. In countries that are not free from EIA, horses should test negative for EIA. If the country (or zone) hosting the event cannot be certified as being free of EIA, measures should be taken to minimize exposure of horses to vectors.

Equine piroplasmosis. In the absence of any commercial vaccine against the disease, prevention and control of equine piroplasmosis is based on sanitary prophylactic measures. HHP specific requirements for equine piroplasmosis differ from the other five diseases in one major aspect: HHP horses shall be tested for piroplasmosis to establish their serological status before they travel as a HHP horse, but they can qualify for HHP status even though infected by

B. caballi or *T. equi* (provided that they do not exhibit any clinical signs of disease at time of veterinary examination and certification). However, if a horse is seropositive for piroplasmosis in the subpopulation, various measures shall be taken to mitigate the risk of transmission (e.g. horses that are seropositive for piroplasmosis should be held in vector protected accommodation to minimize the risk of transmission of piroplasmosis to horses that are seronegative).

VEE. In countries that are not free from VEE, horses should be vaccinated against VEE or test negative for VEE. If the country (or zone) hosting the event cannot be certified as being free of VEE, measures should be taken to minimize exposure of horses to vectors.

Conclusion

The HHP risk mitigation strategies rely on standard health management practices and biosecurity measures being applied at all times (home stable, travel, competition), as well as on meeting specific health requirements for selected diseases.

The HHP standard conditions aim to mitigate the risk of dissemination of a great number of equine diseases and limit the number of diseases that HHP horses have to be certified for. Six diseases have been identified as priority diseases to be addressed in the definition of the HHP subpopulation and in export health certification relating to these horses. These diseases are of critical importance for HHP horses in terms of vaccination, laboratory testing, quarantine and health certification.

The HHP risk mitigation strategies should provide assurance to the countries of destination of the low health risk associated with the temporary importation of a particular animal. National animal health authorities are therefore encouraged to harmonize their entry requirements with respect to the temporary importation of this class of horses.

The importance of the role that national veterinary services and equine industries need to play in the operationalization of the HHP concept cannot be overemphasized. Their support and oversight are critical to ensuring the success of this initiative and their close collaboration should be fostered at national levels through the development of public-private partnerships.

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