

Clinical Commentary

Equine influenza and air transport

A. Cullinane

Virology Unit, Irish Equine Centre, Naas, Ireland.

Corresponding author email: acullinane@equine-centre.ie

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Air travel, which is now an integral part of the lives of high performance horses for competition and breeding, plays a critical role in the international spread of equine influenza viruses. A multifaceted approach is necessary to minimise the risk of global dissemination of equine influenza virus. Virus incursions are frequently due to the importation of infected vaccinated horses. This risk is mitigated by the updating of vaccines with epidemiologically relevant strains in line with World Organisation for Animal Health recommendations. More detailed investigations of vaccination breakdown, enhanced surveillance and a regulatory process that facilitates the timely update of vaccines are necessary to combat equine influenza especially in horses that have travelled long distances. A better understanding of the factors that influence the response to influenza vaccination is required to develop effective regimes that avoid over vaccination of horses at peak fitness. This in turn will facilitate international harmonisation of vaccination regulations. Pathogen interaction in horses transported long distances merits investigation as infection with particular combinations of pathogens may result in increased risk of equine influenza virus shedding. The potential effectiveness of targeted interventions needs to be assessed, as does the minimisation of stress and environmental challenges encountered during air travel.

In this issue of *Equine Veterinary Education*, Pusterla *et al.* (2014) report the detection of a clade 2 equine influenza virus (EIV) in a 4-year-old vaccinated mare recently imported from Germany to the USA. Clade 2 viruses predominate in Europe and have caused major outbreaks of influenza in Asia (reviewed by Cullinane and Newton 2013). However, this first report of the identification of a clade 2 virus in the USA illustrates yet again the critical role played by global travel in the international spread of EIV. Air travel is now an integral part of the lives of high performance horses for competition and breeding. In fact, horses travel by air more frequently than any other species except man, and the increase in long-haul travel in the past 10 years has considerably reduced the time of potential virus spread between continents. This was evident from the introduction of clade 1 viruses into South Africa in 2003 and into Japan and Australia in 2007. The virus responsible for the 2007 outbreak in Australia appeared to have originated in the USA and entered Australia via a stallion imported from Japan. Over 75,000 horses were affected prior to the eradication of the virus at an estimated cost of approximately one billion Australian dollars. Like the incident described by Pusterla *et al.* (2014), these incursions into South Africa, Japan and Australia were due to the importation of infected vaccinated horses. Vaccines may provide clinical protection but frequently fail to prevent virus shedding.

The World Organisation for Animal Health (OIE), Terrestrial Animal Health Code recommends that horses are vaccinated

against equine influenza between 21 and 90 days before shipment either with a primary course or a booster but there is currently an absence of international standardisation amongst importing countries. The mare discussed by Pusterla *et al.* (2014) had not been vaccinated for over a year and the United States Department of Agriculture's Protocol for the Importation of Equines makes no reference to vaccination against equine influenza. The mare had exhibited signs of respiratory disease while in a quarantine holding facility in the USA. The detection of horses infected with EIV is not unusual in such facilities. In the recent past, influenza incursions in Japan and Dubai have been prevented by timely identification of virus shedding in imported horses. However, the current trend is to reduce quarantine in order to facilitate the international movement of horses for breeding, competition and racing. It has been proposed that, as sport horses are under close veterinary supervision governed by FEI and IFHA rules, they present a very low health risk and can be defined as a subpopulation of the global horse population, the High Health Population (HHP) (<http://www.oie.int/>). Importing countries that are hosting international equestrian events or horse races are advised to develop temporary importation requirements and recognise the biosecurity level at the venue or racecourse to be equivalent to post arrival quarantine if biosecurity measures are applied in line with OIE provisions. In such circumstances there will be increased reliance on effective vaccination against equine influenza and an obvious benefit from international harmonisation of vaccination requirements.

Equine influenza is endemic in the USA and Europe where it is controlled by vaccination. However, the majority of the vaccines have not been updated in line with the OIE Expert Surveillance Panel recommendations (2010–2014) to include representatives of both clade 1 and 2 of the Florida sublineage. The risk of virus shedding by infected vaccinated horses is mitigated by the updating of vaccines with epidemiologically relevant strains. More detailed investigations of vaccination breakdown, enhanced surveillance and a regulatory process that facilitates the timely update of equine influenza vaccines are necessary to combat influenza especially in horses that have travelled long distances. A better understanding of the factors that influence the response to influenza vaccination is required to develop effective regimes that avoid over vaccination of horses at peak fitness.

The environmental challenges linked to air transport and their impact on susceptibility to influenza are poorly understood. Twenty percent of horses transported long distances by air become febrile and it is not unusual for mean bodyweight to fall by 4% (reviewed by Leadon *et al.* 2008). The incidence of equine shipping fever is reported to be higher since open stalls have been superseded by jet stalls, which are designed for increased safety and to facilitate rapid loading

and unloading. Some horses are stressed by confinement and dry air can increase the vulnerability of the respiratory tract to infection. Surveys of people have indicated that the transmission of upper respiratory tract infections in commercial aircraft is far higher than normal daily ground level transmission. Influenza and parainfluenza viruses were identified as the most common cause of clinical respiratory signs in people after air travel (Luna *et al.* 2007). Adenoviruses, human metapneumovirus, coronaviruses and rhinoviruses were far less prevalent. Different viruses apply different strategies for entry of host cells and it is possible that damage to the respiratory tract by the environmental conditions encountered during long distance travel may render the respiratory epithelial cells particularly susceptible to influenza viruses.

Equine influenza outbreaks are frequently associated with the arrival of horses after air, sea or road transport. However, many of the epidemiological and virological investigations in relation to such outbreaks lack scientific rigour and the index case may be confused with the source of infection. A horse that has completed an arduous journey and arrived in an unfamiliar environment is likely to be immunocompromised and highly susceptible to viruses circulating amongst resident equids. However, although subclinically infected horses may serve as a source of virus it is usually horses with little or no immunity that amplify virus, contaminate the environment and drive outbreaks. Horse owners should ensure that all new arrivals have been vaccinated and are isolated from the resident population for a minimum of 2 weeks. The mingling of recently transported horses of unknown vaccination history with resident horses is hazardous and does not reflect well on the management of biosecurity.

The mare described by Pusterla *et al.* (2014) had been treated at the quarantine station for a suspected bacterial bronchopneumonia and subsequent microbiological testing yielded large numbers of *Streptococcus equi* ssp. *zooepidemicus*. She was diagnosed with bacterial bronchopneumonia secondary to equine influenza. A synergism between influenza and certain bacteria particularly

Streptococcus pneumoniae and *Staphylococcus aureus*, has been identified in people but the underlying mechanisms are poorly understood. Studies in mice suggest that influenza infection induces epithelial and mucosal degradation and reduced ability of alveolar macrophages to clear bacteria (Smith *et al.* 2014). Subsequent *S. pneumoniae* infection enhances viral release from infected cells, thus increasing the virus titre. Pathogen interaction in horses transported long distances merits investigation as infection with particular combinations of pathogens may result in increased risk of EIV shedding.

In summary, a multifaceted approach is necessary to minimise the risk of global dissemination of EIV. Compliance with evidence-based vaccination regimes, early diagnosis of infected horses and appropriate infection control measures will limit the spread of virus. The potential effectiveness of targeted interventions such as booster vaccination and the prophylactic use of pharmaceutical products need to be assessed, as does the minimisation of stress and environmental challenges during transportation.

Author's declaration of interests

No conflicts of interest have been declared.

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