

## **Mosquito-borne diseases: Transmission dynamics and host-pathogen interactions**

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The majority of the pathogenic zoonotic mosquito-borne viruses circulating in Australia belong to the genus Alphavirus and Orthoflavivirus. As the landscape and climate, hence ecological biotopes, vary greatly across different regions of Australia this affects the transmission dynamics of mosquito-borne diseases. Horses and humans are dead-end hosts for several mosquito-borne viruses presenting with similar clinical disease manifestations when infected, making horses a potentially valuable animal model for the study of zoonotic mosquito-borne diseases.<sup>1</sup>

To date, most studies investigating the risk factors of mosquito-borne virus transmissions and infections in Australia are retrospective using notification data. A recent prospective multi-year longitudinal study using horses in south-east Queensland revealed that the transmission of Ross River virus (the most prevalent arbovirus (alphavirus) in Australia) in horses in peri-urban area peaks three months (December) prior to the reporting of human cases (March).<sup>2</sup> The same study population also served as sentinels for the transmission of orthoflaviviruses.<sup>3</sup> Seroconversion to Japanese encephalitis virus (orthoflavivirus) in this horse population first occurred approximately a month after its first detection in a piggery in Queensland in 2022. Furthermore, the transmission pattern of orthoflaviviruses observed in this sentinel horse population was consistent with the reporting in humans throughout the study period. This confirms that horses as sentinels is likely a useful tool for active surveillance of mosquito-borne viruses in Australia.

Despite decades of research efforts, there remains little progress in our understanding of host-pathogen interactions of mosquito-borne viruses in the natural dead-end hosts (i.e., horses and humans). This is likely due to the use of inappropriate animal models affecting the translatability of results. Recent studies using a model system derived from horses have revealed many previously undescribed pathways into the pathogenesis of Ross River virus infection.<sup>4</sup> The involvement of mitochondria in the pathogenesis of Ross River virus infection is of particular interest and warrants further investigation. The study also found that existing immunity to Ross River virus is likely to provide protection against clinical disease upon re-infection, rather than antibody-dependent enhancement. This study demonstrates the

importance of the use of appropriate animal models for host-pathogen interactions/pathogenesis studies.

Both alphaviruses and orthoflaviviruses have been detected in various bat species, both directly (detection of virus) and indirectly (serological response), across the globe. However, our understanding of the role of bats in the transmission of arboviruses in general and in Australia in particular remains limited. To date, there remains no published findings on the detection of Japanese encephalitis virus in bats since its incursion in Australia in late 2021/early 2022. While bats may be productively infected with many different viruses, it is important to remember that bats play a critical role in maintaining a balanced ecosystem as well.

## References

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