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Do neglected Australian arboviruses pose a global epidemic threat?

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Arboviruses (Arbo: ARthropod BOrne) remain a concern for public health in Australia. They are transmitted between their vertebrate hosts by arthropods (mosquitoes, ticks, sandflies and midges). Although more than 75 arboviruses have been identified in Australia, for most there is no information as to whether they infect or cause disease in people.[1] Clinically, the most important Australian arboviruses are Ross River, Barmah Forest, Murray Valley encephalitis and West Nile (Kunjin strain).[2] However, several other arboviruses that are indigenous to Australia also infect humans, including notably Kokobera, Stratford, Alfuy and Edge Hill virus.[2]

Symptoms of infection are similar to those produced by Zika virus, a mosquito-borne flavivirus discovered in East Africa in the 1950s but which recently was proposed as the probable causative agent involved in thousands of cases of microcephaly in Brazil and associated with an ongoing epidemic in Latin American and Caribbean countries.[3] This virus was hitherto seen as being of little clinical or public health importance, causing very few, often asymptomatic, cases with limited fever, muscle pain, conjunctivitis, eye pain and sometimes maculopapular rash.[3]

The emergence of Zika in new regions of the world may have been enabled by climate conditions suitable to support the population growth of its transmitting vectors[4] – *Aedes* species mosquitoes – over an extended distribution, combined with an escalating and rapid movement of people globally. The question that might obviously be raised is do Kokobera, Stratford, Alfuy, Edge Hill or any of the other Australian arboviruses pose a potential threat similar to that of Zika virus for global transmission and epidemic outbreak? Can we foresee a scenario in which one of these understudied Australian arboviruses could cause a public health event of international concern at either regional or transcontinental level?

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Some Australian mosquito species have a range limited to within the immediate Australasian ecozone. Similarly, commonly attributed animal reservoir hosts for Australian arboviruses – kangaroos, wallabies and other macropods – are confined to Australia. Therefore, based on available knowledge of these arboviruses, their vectors and reservoirs, a superficial opinion may suggest that there is less potential for any of the neglected viruses to pose a global threat. However, expansion of the geographical range of mosquitoes is always possible through a combination of urbanisation, climate change and inadvertent human-assisted dispersal. Furthermore, there has been negligible research on vector competence most of these viruses and the true range of potential mosquito vector species may be wider than presumed. The involvement of migratory birds in the transmission cycle of some Australian arboviruses (Alfuy, Kunjin and Murray Valley encephalitis) allows the potential for spread beyond the region.[5] Transmission by infected travellers may cause Australian arbovirus outbreaks outside the nation, as was experienced in the Ross River epidemic in the Pacific islands during the late 1970s.[6,7] This outbreak demonstrated that even in the absence of their established reservoir hosts, Australian arboviruses may be spread by non-endemic mosquitoes.

The competence of a widely distributed vector – *Ae. aegypti* – has been assessed for some lesser known Australian arboviruses (Edge Hill, Kunjin, Kokobera, Alfuy) and shown to be moderately capable of transmission of most of these viruses.[8] The implication is disturbing since, should this capacity for transmission be sufficiently robust, the geographical range of these viruses could expand to match those of Zika and other globally established viruses (dengue, yellow fever, chikungunya). It is in this context that if a series of unforeseen climatic, anthropogenic or animal-related events were to lead to an outbreak of any of these overlooked native arboviruses within Australia or its near neighbours, there is no information as to the potential for side effects such as those now associated with Zika virus infection.

From a medical perspective, biomarkers for early diagnosis and identification of any possible associations with organ failure, organ tropism (e.g. central nervous system, cardiovascular, renal) or with congenital malformations are undetermined for most Australian arboviruses. Many remain uncharacterised and are classified only on the basis of serology. For most, genome sequence information and clinical data are sparse. Not much is known of their transmission cycles and geographical distribution.

In order to evaluate the potential for emergence of these native Australian arboviruses, to address the public health impact of any disease outbreak and to prepare with confidence to limit rapidly its spread, the highlighted knowledge gaps should be addressed. Indeed, even the annual incidence of infection in this country is not known, let alone if there is any associated pathology such as that now highly suspected for Zika virus infection. We call for heightened interest in investigating these endemic arboviruses, underpinned by increased research funding. Australia should not be caught under-prepared to respond to a sudden increase in cases of infection caused by the emergence of one of its indigenous arboviruses.

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References

1. Russell RC, Dwyer DE. Arboviruses associated with human disease in Australia. *Microbes Infect.* 2000;2(14):1693-704.
2. Smith DW, Speers DJ, Mackenzie JS. The viruses of Australia and the risk to tourists. *Travel Med Infect Dis.* 2011;9:113-25.
3. Fauci AS, Morens DM. Zika virus in the Americas – yet another arbovirus threat. *N Engl J Med.* 2016;374:601-4.
4. Diagne CT, Diallo D, Faye O, Ba Y, Faye O, Gaye A, et al. Potential of selected Senegalese *Aedes spp.* mosquitoes (*Diptera: Culicidae*) to transmit Zika virus. *BMC Infect Dis.* 2015;15:492.
5. Doherty RL. Arthropod-borne viruses in Australia, 1973-1976. *Aust J Exp Biol Med Sci.* 1977;55:103-30.
6. Aaskov JG, Mataika JU, Lawrence GW, Rabukawaqa V, Tucker MM, Miles JA, et al. An epidemic of Ross River virus infection in Fiji, 1979. *Am J Trop Med Hyg.* 1981;30:1053-9.
7. Tesh RB, McLean RG, Shroyer DA, Calisher CH, Rosen L. Ross River virus (Togaviridae: Alphavirus) infection (epidemic polyarthritis) in American Samoa. *Trans R Soc Trop Med Hyg.* 1981;75:426-31.
8. Kay BH, Carley JG, Fanning ID, Filippich C. Quantitative studies of the vector competence of *Aedes aegypti*, *Culex annulirostris* and other mosquitoes (Diptera: Culicidae) with Murray Valley encephalitis and other Queensland arboviruses. *J Med Entomol.* 1979;16:59-66.

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