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Editorial

# 'One Health' solutions for ticks and tick-borne diseases, and rickettsial pathogens of humans, domestic animals and wildlife

One of the causes increasing the threat of vector-borne diseases in humans and livestock are emerging infectious diseases of wildlife (Cunningham et al., 2017; Daszek et al., 2000; Titcomb et al., 2017). These emerging infectious diseases are mostly zoonotic or arising from animal reservoirs and adapting to human transmission (Plowright et al., 2017; Waltner-Toews, 2016). We recently convened the first Asia-Pacific Rickettsia Conference (APRC1) with the 9th Tick and Tick-borne Pathogens (TTP9) Conference in Cairns, Australia, from 27th August until 1st September 2017. The conference theme was 'One Health', which included a fusion of 240 medical, veterinary and wildlife delegates from 38 different countries. TTP9 Convenors Tabor and Rodriguez Valle (2018) prepared a conference overview (*Veterinary Sciences* journal), and this editorial provides a brief description of the articles presented in this Special Issue from the same conference. Prof. José de la Fuente was the TTP9 Senior Researcher awardee for his '*Outstanding Contribution to the Field of Ticks and Tick-Borne Pathogens*' and thus was also invited to present a plenary at the conference. His Special Issue article '*Controlling ticks and tick-borne diseases…looking forward*' fits well with the theme of the conference and discusses ideas this research community could consider 'moving forward'.

Some human vector-borne diseases (e.g. scrub typhus) are so neglected, they do not even appear on the World Health Organisation (WHO) 'neglected disease' lists (http://www.who.int/neglected_diseases/diseases/en/). This is due to a general lack of awareness of some of these infections. This has changed in the last several decades with the resurgence of Lyme borreliosis in the northern hemisphere (reviewed by Dantes-Torres et al., 2012), and now 'ectoparasites' are listed on the above WHO list. For several years, there has been conjecture in the medical literature that a similar disease exists in Australia, however, no definitive isolation of *Borrelia burgdorferi* sensu lato has occurred (Collignon et al., 2016). There is evidence for perhaps a similar tick-borne disease, however, the elusive pathogen has yet to be identified (Collignon et al., 2016). Fig. 1 shows the exponential increase in PubMed articles associated with the search term 'vector-borne diseases' with a predicted output of 1528 for 2018.

'Vector-borne diseases' are often transmitted by mosquitoes, but ticks are also significant vectors. The conference focussed on rickettsial pathogens that can also be transmitted by lice, fleas and mites (commonly known as chiggers). Prof. Daniel Paris, also an invited conference plenary speaker, provided an interesting article entitled '*Geometric morphometrics of the dorsal scutum for differentiation of trombiculid mites within the genus Walchia (Acari: Trombiculidae), a vector of scrub typhus*'. Usually *Leptotrombidium deliense* mites transmit the human rickettsial pathogen *Orientia tsutsugamushi* (scrub typhus), thus novel methods for differentiating mite species is of paramount importance.

There has also been a sharp increase in publications associated with terms 'ticks' and 'one health' (see Fig. 2) in the last decade. 'Rickettsia' and 'one health' publications are also on the increase from 2 articles in 2000 to 46 predicted for 2018 (data not shown). A decade ago, Piesman and Eisen (2007) concluded that vector-borne diseases including several viruses (*Flavivirus*, *Nairovirus* and *Coltivirus*) and rickettsial pathogens (*Rickettsia*, *Anaplasma*, *Coxiella* spp.) were 'on the rise'. There is also an escalating number of publications demonstrating the isolation of new pathogens from ticks on wildlife (Cunningham et al., 2017; Loh et al., 2016) yet at this stage it is unknown if these are tick and/or host pathogens or commensals.

Other conference topics highlighted the development of new genetic techniques for the manipulation of tick-borne pathogens which will revolutionise the control of these diseases in the future. For example: '*Mutational Analysis of Gene Function in the Anaplasmataceae: Challenges and Perspectives*' authored by Dr Oliva Chavez et al. (plenary presented by Prof. Ulrike Munderloh); and '*Transgenic* Babesia bovis *lacking 6-Cys sexual-stage genes as the foundation for non-transmissible live vaccines against bovine babesiosis*' authored by plenary speaker Prof. Carlos Suarez et al. Water buffaloes are known to harbour *Babesia* spp. potentially increasing cattle babesiosis which impedes the efforts of tick vector and pathogen eradication. Prof. Monica Florin-Christensen outlines in this Special Issue the '*Mitigated clinical disease in water buffaloes experimentally infected with* Babesia bovis'. The conference audience also received an update on the research tools available from the 'Tick Cell Biobank' by Dr Bell-Sakyi with an article entitled: '*The Tick Cell Biobank: a global resource for in vitro research on ticks, other arthropods and the pathogens they transmit*'.

Genomics and systematics were also common threads with several plenaries and articles addressing these knowledge gaps for both ticks and tick-borne diseases. Characterization and descriptions of rickettsial species are covered by these 2 Special Issue articles: '*Molecular characterization of* Haemaphysalis longicornis*-borne rickettsiae, Republic of Korea and China*' and '*Paradoxical evolution of rickettsial genomes*' with the latter from the group of plenary speaker Prof. Pierre-Edouard Fournier. Prof. Cate Hill and a group of conference delegates have prepared a meeting report summarised as '*Meeting the challenge of tick-borne disease control: A proposal for 1000* Ixodes *genomes*' which will lead the development of tick-specific genetic tools as well as options for tick-borne disease control. Prof. Ben Mans described an updated 'soft tick' species list in '*Argasid and ixodid systematics: Implications for soft tick biochemistry, evolution and systematics, with a new argasid species list*'. These studies underpin the development of control methods including the development of novel vaccines.

Last, but not least, one of the final plenaries presented at the

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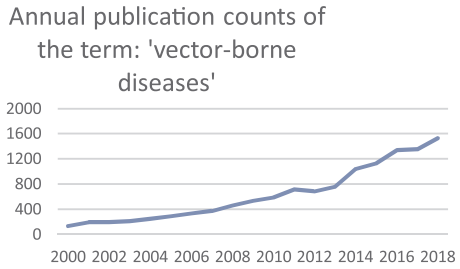


**Fig. 1.** Increasing trend of PubMed manuscripts under the search term of 'vector borne diseases' as at 13th June 2018 (https://www.ncbi.nlm.nih.gov/pubmed/?term = vector + borne + diseases).

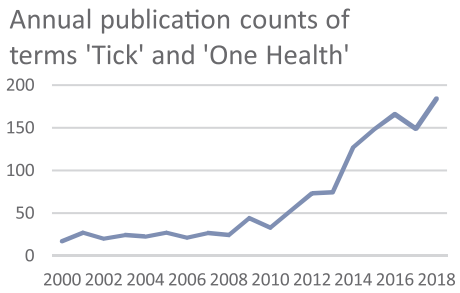


**Fig. 2.** A chart demonstrating the increase in publications associated the terms 'ticks' and 'one health' in PubMed including a prediction for 2018 based on 92 publications as at 13th June 2018. https://www.ncbi.nlm.nih.gov/pubmed/?term = ticks + one + health.

conference was Prof. Patricia Nuttall and her article entitled '*The wonders of tick saliva*'. This is a review prepared from the tick's perspective comprising the functional properties, multiplicity and adaptability conferred by its salivary content.

The broad-ranging topics and science described within the articles of this Special Issue are a reflection of the diversity and international standing of the conference delegates attending TTP9APRC1 in 2017. The Editors of this Special Issue thank all for their contributions and the vast assistance of the Elsevier Editorial team. This is the third TTP Special Issue by the Ticks and Tick-borne Diseases journal following the two previous conferences for TTP7 (Spain, 2011; de la Fuente and Estrada-Peña, 2012) and TTP8 (South Africa, 2014) which also published selected 'invited' articles.

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A.E. Tabor*
*The University of Queensland, Queensland Alliance for Agriculture & Food Innovation, Centre for Animal Science, St Lucia, Queensland, 4072, Australia*

S.R. Graves
*Australian Rickettsial Reference Laboratory, WHO Collaborating Centre for Reference & Research on Rickettsioses, University Hospital Geelong, Geelong, Victoria, 3220, Australia*

M. Rodriguez Valle
*The University of Queensland, Queensland Alliance for Agriculture & Food Innovation, Centre for Animal Science, St Lucia, Queensland, 4072, Australia*

J. Stenos
*Australian Rickettsial Reference Laboratory, WHO Collaborating Centre for Reference & Research on Rickettsioses, University Hospital Geelong, Geelong, Victoria, 3220, Australia*
*E-mail addresses:* a.lewtabor@uq.edu.au (A.E. Tabor), graves.rickettsia@gmail.com (S.R. Graves), m.rodriguezvalle@uq.edu.au (M. Rodriguez Valle), JOHNS@BarwonHealth.org.au (J. Stenos)

* Corresponding author.