Committee Secretary  
Senate Standing Committees on Community Affairs  
PO Box 6100  
Parliament House  
Canberra ACT 2600

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To the Committee Secretariat:

I am a research scientist at The University of Queensland in the Institute for Molecular Bioscience. I have a PhD in Chemistry and a MSc in Entomology (the study of insects), and my research program is focused on the discovery and characterization of novel, environmentally-friendly insecticides. I am now a proud Queenslander, but am also an American citizen and grew up in New England, in the epicentre of Lyme Disease in the United States.

Please find below my submission to the Senate Community Affairs References Committee, based on the terms of reference.

The growing evidence of an emerging tick-borne disease that causes a Lyme-like illness for many Australian patients.

a. the prevalence and geographic distribution of Lyme-like illness in Australia;

Lyme Disease is caused by infection with bacteria of the *Borrelia* type. Lyme disease is a type of borreliosis, and Lyme borreliosis exhibits a range of acute and sometimes chronic multisystemic symptoms [1]. Of the 30 or so known species of *Borrelia* across the United States and Europe, the majority of human cases are caused by only three species [2,3].

In the United States, Lyme disease is transmitted by ticks in the genus *Ixodes*, primarily *I. scapularis* (the deer tick) and *I. pacificus* (the western blacklegged tick). In Australia, this genus of tick is also present, and is widely distributed along the southern and eastern coastlines (Figure 1). The Australian paralysis tick (*I. holocyclus*) is a member of this genus, and the tick is so named because the saliva contains a neurotoxic component that causes paralysis [4].

![Occurrence records map](image-url)

**Figure 1.** The distribution of *Ixodes* ticks in Australia. Data from the Atlas of Living Australia (http://bie.ala.org.au/species/Ixodes).
Australian ticks in the genus *Ixodes* have been implicated in the transmission of tick typhus [5]. There are several types of tick typhus found in Australia, although none are commonly reported. The causative agent is *Rickettsia*, a genus of Gram-negative bacteria.

Persons infected with Queensland Tick Typhus (caused by *Rickettsia australis*) and Flinders Island Spotted Fever (caused by *R. honei*) exhibit similar symptoms to Lyme Disease, including rashes, eschars, headaches, fever, flu-like symptoms, and lymph node tenderness; unusual clinical features of tick typhus have been noted in the literature [6]. Clinical diagnosis is confirmed through blood tests and treated with antibiotics, and is rarely fatal.

Ricksettial infection is uncommon and is not a national notifiable disease in Australia; Tasmania is the only state to track the number of cases diagnosed each year. In 2013, there were two cases of ricksettial infection notified in Tasmania; from 2008–2012, the annual number of cases ranged from zero to six [7].

In the United States, 96% of all reported cases of Lyme Disease were reported from 14 states, and were concentrated in the northeast and upper midwest (Figure 2).

Lyme Disease is the fifth most common nationally notifiable disease in the United States.

![Reported Cases of Lyme Disease — United States, 2014](http://www.cdc.gov/lyme/stats/maps.html)

As is the case with other vector-borne diseases that have the potential to thrive in Australia (for example, dengue fever), having a vector does not necessarily translate to the disease becoming endemic and widespread.

One might conjecture that if tick-borne diseases were on the rise in Australia, either due to increased tick populations or increased human exposure to ticks (e.g., through more use of tick habitat through outdoors activities like hiking), it might begin with an uptick in reported cases of endemic tick-borne diseases, like the tick typhus caused by *Rickettsia* bacteria (Queensland Tick Typhus and Flinders Island Spotted Fever), or incidences of paralysis in animals or humans caused by the Australian paralysis tick. From the evidence available in the literature and clinically, this does not appear to be the case.

b. methods to reduce the stigma associated with Lyme-like illness for patients, doctors and researchers;

As with many conditions specific to Australia, there is much to be learned. If patients are reporting similar symptoms that don't correspond to a diagnostic test, it suggests further research is needed to establish both a clinical and laboratory diagnostic framework.
c. the process for diagnosis of patients with a Lyme-like illness, with a specific focus on the laboratory testing procedures and associated quality assurance processes, including recognition of accredited international laboratory testing;

The CDC laboratory criteria for Lyme Disease diagnosis are:

- a positive culture for *Borrelia burgdorferi*,
- two-tier testing (e.g., via a Western Blot, which looks for specific protein signatures in a sample) interpreted using established criteria, or
- a single-tier immunoglobulin G (IgG) immunoblot seropositivity interpreted using established criteria.

In the United States, the number of reported and probable cases of Lyme Disease are recorded annually (Figure 3). In 2008, the CDC updated its case definition of Lyme Disease to include suspected cases, which is defined as:

- a case of erythema migrans rash (that occurs in 60–80% of American Lyme disease patients) with no known exposure to potential tick habitats where Lyme disease is present, or
- a case with laboratory evidence of infection but no clinical information available.

Figure 3. The number of Lyme Disease cases from 1995–2014 in the United States. Data from the CDC (http://www.cdc.gov/lyme/stats/graphs.html).

Although there has been a slight increase over time in the number of recorded cases of Lyme Disease in the United States, this may be due to increased awareness by clinicians; increased awareness by patients of what symptoms to look for; and, an increased sensitivity of the laboratory testing assays to serologically confirm a diagnosis.

d. evidence of investments in contemporary research into Australian pathogens specifically acquired through the bite of a tick and including other potential vectors;

There are many gaps in the literature with respect to Australian tick typhus and other tick-borne pathogens, which have similar presentation symptoms to Lyme disease. The list of unknowns includes, but is no means limited to:

- which of species of Australian tick are able to transmit one or more types of pathogen, and which pathogens those are;
- whether Australian ticks are able to transmit *Borrelia* (perhaps done in conjunction with an American or European laboratory, where *Borrelia* cultures have been established); and,
- whether any *Borrelia* species are present in Australian ticks (by culturing tissue from a geographically diverse range of tick specimens).
e. potential investment into research to discover unique local causative agents causing a growing number of Australians debilitating illness;

In Australia, there is already an established relationship between tick bite and mammalian meat allergy [8], which has also been reported elsewhere in the world [9].

Additionally, the Australian paralysis tick is unique in the potent nature of the neurotoxic salivary component responsible for paralysis [4], although paralysis has been reported from heavy infestations of other tick species [10]. Although recovery is often quick once the tick is removed, there is no comprehensive review of the long-term effects of paralysis tick bite.

Some areas of potential investment include:

• an examination of current and novel repellents, to prevent tick bite in the first place;
• whether any pathogen (Borrelia or otherwise, but especially Ricksettia) can be cultured from the cerebrospinal fluid or serum of Australian patients suffering from a Lyme-like illness;
• determining the nonhuman hosts or reservoirs of tick-borne pathogens;
• investigating the long-term effects of infection with tick-borne pathogens, for both treated and untreated infections;
• determining the efficacy of laboratory diagnostic tests for different populations, strains, or species of Australian pathogens; and
• determining the efficacy of antibiotic treatment for acute and chronic infections, which has been questioned for Lyme disease [11] and for some antibiotics, tick typhus [12].

f. the signs and symptoms Australians with Lyme-like illness are enduring, and the treatment they receive from medical professionals;

The signs and symptoms of Lyme disease in American patients have been recorded in detail over a number of years (Figure 4). The primary pathogen responsible for Lyme Disease in the United States is Borrelia burgdorferi, although a number of other Borrelia species are also pathogenic, and the symptoms are not the same across Borrelia species.

Clinical Manifestations of Confirmed Lyme Disease Cases--United States, 2001-2010

![Clinical Manifestations of Confirmed Lyme Disease Cases--United States, 2001-2010](http://www.cdc.gov/lyme/stats/graphs.html)

This figure represents the breakdown of reported Lyme disease cases from 2001 to 2010 by disease manifestation. The majority of cases are the erythema migrans (EM) rash. Other manifestations are less common, some patients have more than one presentation.

*Figure 4. The clinical signs of Lyme Disease infection in the United States (2001–2010). Data from the CDC ([http://www.cdc.gov/lyme/stats/graphs.html](http://www.cdc.gov/lyme/stats/graphs.html)).*
In Scotland, clinicians have revised their laboratory diagnostic procedure and produced an 80% increase in the number of equivocal Lyme Disease cases compared to the American and European standards in use previously [13].

Further, there has been a very recent description of a new pathogenic Borrelia species in the United States [3]. The species produces an atypical laboratory diagnostic result using the traditional Lyme Disease assay for Borrelia burgdorferi, as well as distinct clinical features and high levels of B. burgdorferi in the blood.

g. any other related matters.

References

Thank you for the opportunity to contribute to the inquiry. I would be delighted to answer any questions that arise.

Sincerely,

Margaret C. Hardy, MSc PhD GCHEd FRES
Postdoctoral Research Fellow