



# Is there a Lyme-like disease in Australia? Summary of the findings to date



Melissa Judith Chalada <sup>a</sup>, John Stenos <sup>b</sup>, Richard Stewart Bradbury <sup>a,\*</sup>

<sup>a</sup> School of Medical & Applied Sciences, Central Queensland University, Rockhampton, Queensland, Australia

<sup>b</sup> Australian Rickettsial Reference Laboratory, Barwon Health, Geelong, Victoria, Australia

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## ABSTRACT

Lyme Borreliosis is a common tick-borne disease of the northern hemisphere caused by the spirochaetes of the *Borrelia burgdorferi* sensu lato (*B. burgdorferi* s. l.) complex. It results in multi-organ disease with arthritic, cardiac, neurological and dermatological manifestations. In the last twenty-five years there have been over 500 reports of an Australian Lyme-like syndrome in the scientific literature. However, the diagnoses of Lyme Borreliosis made in these cases have been primarily by clinical presentation and laboratory results of tentative reliability and the true cause of these illnesses remains unknown. A number of animals have been introduced to Australia that may act as *B. burgdorferi* s. l. reservoirs in Lyme-endemic countries, and there are some Australian *Ixodes* spp. and *Haemaphysalis* spp. ticks whose geographical distribution matches that of the Australian Lyme-like cases. Four published studies have searched for *Borrelia* in Australian ticks, with contradicting results. The cause of the potential Lyme-like disease in Australia remains to be defined. The evidence to date as to whether these illnesses are caused by a *Borrelia* species, another tick borne pathogen or are due to a novel or unrelated aetiology is summarised in this review.

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\* Corresponding author.

E-mail address: [r.bradbury@cqu.edu.au](mailto:r.bradbury@cqu.edu.au) (R.S. Bradbury).

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## 1. Introduction

Lyme Borreliosis is a common tick-borne disease of the northern hemisphere. It is caused by spirochaetes of the *Borrelia burgdorferi* sensu lato (*B. burgdorferi* s. l.) complex. Typically, the disease first presents with an erythema migrans rash at the site of the tick bite, followed by flu-like symptoms and later by debilitating arthritic, dermatological and neurological manifestations. The bacteria are transmitted by *Ixodes* species ticks, although other Ixodidae ticks [1–4] and haematophagous arthropods [2,4–14] have been implicated in carrying the bacteria. Bacterial reservoirs of the disease are usually small mammals, birds and occasionally reptiles [15,16]. The presence or absence of Lyme disease (or a Lyme-like disease) in Australia remains a contentious issue with varying opinions being held by medical practitioners, scientists and lay stake holders while the aetiological agent remains undetermined.

In response to the continued controversy and media attention regarding the possibility of there being Lyme Borreliosis in Australia, the Australian Government Chief Medical Officer, Professor Chris Baggoley, established the Clinical Advisory Committee on Lyme Disease (CACLD) in 2013 [17]. The purpose of this committee was to advise the Chief Medical Officer on the following points:

1. The extent to which there is evidence of *Borrelia* species causing illness in humans in Australia
2. The most appropriate laboratory diagnostic testing algorithms (best world practice) for persons who have suspected Borreliosis in Australia
3. The most appropriate treatments for Borreliosis in Australia
4. The most appropriate ways to disseminate information to health professionals and the general public on Borreliosis/Lyme disease
5. The requirements for further research into Borreliosis in Australia, and the generation of appropriate new questions relevant to the terms of reference.

Furthermore, the Australian Government Department of Health commissioned a scoping study [18] to identify the gaps in scientific evidence surrounding the causative agent of the Australian Lyme-like disease. Subsequently, upon advice from the CACLD, the Australian public was called upon to review and contribute to the scoping study, and 36 submissions were obtained in total. All points raised were considered individually and then collated, culminating in the following twelve considerations [18]:

1. Does *B. burgdorferi* s. l. occur in Australian ticks, and especially in *Ixodes holocyclus*?
2. Do other Australian tick species transmit Lyme Borreliosis?
3. Can Australian ticks be infected with, maintain, and transmit *B. burgdorferi* s. l.?
4. Can we find better diagnostic tools to search for Lyme Borreliosis?
5. Is there an indigenous species of *Borrelia* in Australia able to infect humans and able to cause a Lyme disease-like syndrome?
6. Do other possible pathogens occurring in Australian ticks cause a Lyme disease-like syndrome?
7. Are there any relapsing fever group *Borrelia* species in Australia?
8. Can *B. burgdorferi* s. l. be detected with any certainty in erythema migrans rashes following a tick bite, as demonstrated by PCR and/or culture of biopsy specimens?
9. Is there an immune response to *B. burgdorferi* s. l. or to any other possible agent in the sera of patients presenting with a Lyme disease-like syndrome?

10. Are there any *B. burgdorferi*-specific IgG antibodies in the sera of patients with Lyme disease-like syndrome?
11. If there is evidence found to indicate the presence of Lyme Borreliosis or a Lyme disease-like syndrome in Australia, what is the geographic spread of cases?
12. Are there other potential vectors that could transmit *Borrelia* in Australia?

Further to the above identified knowledge gaps, during the course of this literature review, the authors will consider two further points of investigation:

1. Could native Australian animals act as reservoirs of *B. burgdorferi* s. l.?
2. Could introduced animals such as foxes, hares, placental mice and rats act as reservoirs of *B. burgdorferi* s. l. in Australia?

The purpose of this review is to assess the current situation of the controversial Lyme or Lyme-like illness reported by some to be present in Australia. The existing evidence is explored and areas require further investigation are identified. Alternative infectious and non-infectious diagnoses are also considered.

## 2. Potential reservoirs of Lyme Borreliosis-causing *Borrelia* species in Australia

If a *Borrelia* causing a Lyme-like disease is present in Australia, importation or native evolution are both possible origins of the causative agent. Such an agent might be a known *Borrelia* species or a novel, as yet undescribed microbial pathogen.

### 2.1. *Borrelia* in introduced animals

In the 1900s, two species of *Borrelia* were introduced to Australia via the agricultural industry. These were *Borrelia theileri*, the worldwide cause of bovine Borreliosis [19], and *Borrelia anserina*, the worldwide agent of avian spirochaetosis [20]. *B. theileri* has been reported in cattle of Queensland and New South Wales [21–23] and *B. anserina* has infected poultry of Victoria and the Northern Territory [23–25]. *B. theileri* is transmitted in Australia by the cattle tick *Rhipicephalus (Boophilus) australis* [21,26] while the vector of *B. anserina* is *Argas persicus* s. l. [27]. *Argas persicus* ticks have been observed in all states of Australia except for Tasmania, and *R. australis* is distributed along the northern and eastern coasts of Australia [26]. *R. australis* may occasionally bite humans [26]. Neither *B. anserina* nor *B. theileri* belong to the *B. burgdorferi* s. l. complex, nor have they ever been described as causing a Lyme-like illness in humans.

If Lyme Borreliosis was present in Australia, it is reasonable to expect that its presence would be prominent in livestock, domestic animals and particularly feral deer, as is the case with Lyme Borreliosis in the northern hemisphere. However, very few cases of a Lyme-like illness in Australian animals are present in the veterinary literature. Lyme Borreliosis was reported in two cows at Camden, New South Wales in 1989 [28]. These cows were previously infested with *Haemaphysalis longicornis* (see Section 2.5) and presented with fever, anaemia, poor condition and polyarthritis. The diagnosis of Lyme Borreliosis was made in the first cow on the presence of spirochaetes in the synovial stroma and the second by positive IFA Lyme serology. However, from the images of spirochaetes from the first case described in the paper it is unclear if these represent true spirochaetes or artefact. Ephemeral fever, chlamydiosis, *Mycoplasma bovis* and “other septicemic bacteria” were ruled out in the cows, but it is unspecified if *B. theileri* was one of

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