

WA Lyme Association
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7 February 2014

Attention: Dr Gary Lum

Professor Chris Baggoley
Chief Medical Officer of Australia
Department of Health
Canberra

Dear Professor Baggoley,

Re: Submission of Additional Comment and Letter of Support for Lyme Disease Association of Australia's Response to *Scoping Study to Develop and Research Project(s) to Investigate the Presence or Absence of Lyme Disease in Australia*

I write on behalf of the WA Lyme Association (WALA) primarily to provide full endorsement for the Lyme Disease Association of Australia (LDAA)'s main patient submission in response to the Scoping Study commissioned by the Chief Medical Officer (CMO) as part of the review into Lyme disease in Australia.

Members of the WA Lyme Association were active participants in the consultation process conducted by the LDAA and contributors to the research and writing that culminated in the document submitted on behalf of Australians suffering from Lyme-like illness.

In Western Australia, there are more than 400 people who have been diagnosed with Lyme disease since 2011. There are only a very small number of doctors courageous enough to challenge the controversy and stigma attached to Lyme disease and committed to providing appropriate diagnosis and treatment for Lyme-like illness in WA. Some of these doctors have closed their books because they cannot cope with any more patients; others have waiting lists out to eight or nine months for new patients. So the number of patients diagnosed with Lyme disease in WA is limited by the capacity of a few Lyme-aware doctors to meet the demand.

In addition, there are hundreds more Western Australians who have lived for years, and sometimes decades, with the symptoms of Lyme-like illness and who should be diagnosed and treated, but they simply cannot afford either the expense of pathology testing or the associated treatments, many of which are not covered by PBS.

The obvious and repetitive official counter to this has been received when our members have raised their concerns with their MPs and the WA Health Minister, who suggest patients should be referred to an infectious diseases specialist and have their testing via an Australian laboratory accredited to test for Lyme disease.

WALA members welcomed with gratitude the issuing of the CMO's Advice to Clinicians (on Lyme disease) in August 2013; however, it is clear this message has not filtered through to the clinicians themselves and many patients continue to complain of encounters with

general practitioners and specialists who simply 'rule out' the possibility of Lyme disease in Australia. Patients have provided numerous accounts regarding the derision and misdiagnoses they have encountered when referred to infectious disease specialists, not to mention the fruitless expense.

It is also now well known in circles of chronic illness sufferers that it is not worth drawing blood for a Lyme disease test on the public health system in Australia, for the reasons elaborated on pages 25-29 of the LDAA's Response to the Scoping Study.

WALA therefore supports the urgent implementation of strategies 1.1 – 1.6 (page 45) and the detailed Diagnosis and Testing Action Plan (page 50) outlined in Appendix A – Patient-focused Strategic Approach to the Lyme Problem in the LDAA's submission.

WALA also strongly supports the LDAA's recommendation that Study 6. - Epidemiological Research should be included in the research component of the CMO's review of Lyme disease in Australia.

It seems only prudent that, before reaching a hypothesis about the *causes* of an illness, diligent scientists would:

- study the patients suffering from the syndrome;
- gather data from the patients and their doctors regarding disease presentation and medical history;
- undertake initial clinical studies with patients suffering from the illness to identify potential pathogens involved; and,
- observe the patterns of the dispersal to ensure any further research decisions and directions are based upon a well-informed foundation of scientific and anecdotal evidence.

The omission of uniquely Australian clinical evidence or reference to the Australian patient experience within the Scoping Study is of considerable concern. The narrowly confined scope of the CMO's review process occurred prior to Professor McKenzie's appointment, as reflected in the Terms of Reference for his consultancy brief.

WALA provided input to the public comment on the Terms of Reference for the Clinical Advisory Committee on Lyme Disease (CACLD) and this was incorporated within the LDAA's response presented by the patient representative, Rev. Nikki Coleman, at the second meeting of the CACLD in April 2013.

At this meeting, the CACLD agreed to adopt the first recommendation of the patients' submission, that is:

Draft Terms of Reference

“whether there is evidence of *Borrelia* spp causing illness in humans in Australia”

Recommendation 1:

It is, therefore, suggested that the wording of the first ToR be amended to read:

1. “the extent to which there is evidence of *Borrelia* spp causing illness in humans in Australia;”

Reframing the wording of this first ToR would indicate to Lyme patients that the committee is approaching Lyme disease with the intention to open-mindedly explore and fully review the issue and not simply 'rubber stamp' the current policy status quo.

What was envisaged was not a mere *rephrasing* of the Terms of Reference document, but an actual *reframing* of the Terms of Reference for the CACLD. This would ensure the review process takes into consideration the factors introduced in supporting the LDAA's recommendations; namely the recognition that Lyme disease and/or Lyme-like illness *is* here in Australia, whether it is acquired overseas, through indigenous ticks or by some other means of transmission.

The CACLD adopted the changes in wording to the Terms of Reference and then agreed that the Committee's primary focus would be on identifying the causative agents for Lyme disease in Australia¹ and that ticks would be studied as the most likely vector. Given the composition of CACLD and the members' areas of professional expertise, it is understandable that they are inclined to promote approaches which support their own areas of research. However this presumptive approach has not been satisfactory to patients living with Lyme-like illness, whose presentations or suspected causes often fall outside these narrow parameters.

Forgotten within the CACLD's priorities appears to be the fact that we have yet to obtain unequivocal proof that *Borrelia* is the primary pathogen causing Lyme-like illness in Australia, nor has it been established that ticks are the only possible vectors or form of transmission.

The rationale presented by one member of the CACLD that "if we find *Borrelia* in Australian ticks, then our problems will be solved and research into other potential transmission modes will naturally follow" is unconvincing. To use a term very familiar to patients, *there is no evidence to suggest* this would be the case; in fact, the evidence elsewhere suggests that once *Borrelia* is located in indigenous ticks, other modes of transmission are discounted. Countries with far greater research budgets have yet to fully investigate the potential for transplacental, sexual or blood exchange transmission, or via other vectors.

The CACLD's focus is evident in both the Scoping Study Terms of Reference instructing their colleague, Prof. McKenzie, and in the title chosen for his report. It is, therefore, not surprising his research supports the CACLD's focus on Lyme Borreliosis as it presents in other countries as the basis for evaluating *whether or not* Lyme disease exists in Australia, instead of making any attempt to describe or establish the *extent* of the Lyme-like disease as it presents in Australia.

The Study's lack of in-depth consultation with patient groups and the doctors treating Lyme disease in Australia makes a very clear statement. It is apparent that the author and those directing him consider the direct experience of Lyme disease and/or Lyme-like illness in Australia to be irrelevant, or lacking in credibility, while drawing upon information about Lyme disease as described by scientists, not sufferers, elsewhere. This is, quite frankly, insulting and demoralising to the primary stakeholders who live and work at the cutting edge of Lyme-like illness in *this* country.

In any study of Lyme disease in Australia there is a need for epidemiological (and clinical) data to be collected and analysed from Western Australia. The state's isolation and unique ecosystems could give rise to entirely different strains of

pathogens which may reveal different hosts capable of maintaining the pathogens as well as different vectors transmitting them.

Cases of Lyme disease have been diagnosed from all areas of Western Australia, in coastal and inland areas of the north and south west, as well as within the metropolitan area of Perth. In some cases, there was an obvious correlation with tick bite, whereas in other cases haematophagous (blood-sucking) insects such as stick fast fleas, sand flies and March flies were suspected.

Given Western Australia's proximity to SE Asia, there may be a correlation between coastal infections and the presence of migratory birds, as examined by Karen Smith in the web page *Role of Birds as Vector & Reservoir Hosts*ⁱⁱ.

The historical prevalence of rodents escaping from ships in the port city of Fremantle, as well as squirrels and birds able to traverse the boundaries of the Perth Zoological Gardens, may be worthy of further investigation in terms of identifying potential reservoir hosts in the metropolitan area.

However a number of 'clusters' of Lyme disease cases following tick bites have also been observed in inland areas. In one of these, involving a small community 400 kilometres south east of Perth and containing only 250 families, eight people have been clinically diagnosed (and confirmed with overseas serology) while another three, who have yet to be diagnosed, are suspected of having Lyme-like illness. Four of those diagnosed, including three children, have never left the country.

Clusters such as this warrant further investigation. The example of Hong Kong's diligent approach to Lyme disease outbreaksⁱⁱⁱ was mentioned in the LDAA's response to the Scoping Study and could serve as a model to emulate.

Small town communities are often close-knit and likely to exchange information about their health conditions, so awareness about appropriate diagnosis and treatment pathways can be quickly disseminated. Hence, this cluster might be attributed to higher levels of Lyme disease and tick risk awareness. If this is the case, the high levels of diagnosis in this tiny remote community could also provide an alarming indicator of the potential *extent* of the Lyme 'epidemic' once Lyme disease awareness penetrates the mainstream population.

Contrast this to a larger inland south west town with a population of around 4,000 where the community is not generally aware of Lyme disease but casual conversations reveal concerning anecdotes of a series of farmers retiring with a 'mystery illness' or having been diagnosed with Motor Neurone Disease via a local medical practice where Lyme disease is categorically ruled out as a possible or differential diagnosis.

The personal attitudes and beliefs of general practitioners play a major role in the discovery (or lack of discovery) of patterns of Lyme disease dissemination. These beliefs are currently informed by official "there is no Lyme in Australia" statements propagated through the Communicable Diseases Network Australia, and frequently result in Lyme disease sufferers enduring painful, costly and unnecessary misdiagnosis.

WALA recommends that epidemiological studies also include collection and analysis of data in relation to any high incidence of diagnoses for diseases that *mimic* Lyme disease, such as Motor Neurone Disease, Multiple Sclerosis, Parkinsons' Disease, ME/CFS, Fibromyalgia and Alzheimer's disease.

Another factor worthy of investigation, particularly where clusters are occurring in rural areas, is the potential for cross contamination from livestock, particularly livestock imported from overseas and from other tick-endemic regions of Australia.

In the past, cattle, horses, deer, alpacas, llamas, goats and sheep have been imported to Australia from all parts of the world. Deer imports were suspended in 1993 and cattle imports were suspended between 1997 and 2003. Imports from New Caledonia were suspended in 2011, although cattle had not been imported from there for a decade. Live animal imports currently include horses (multiple countries), alpacas (multiple countries), cattle (Norfolk Island only) and goats and sheep (NZ only)^{iv}.

Although Australia maintains some of the most stringent customs and quarantine processes in the world, these are not foolproof. Biosecurity issues remain a concern in all areas of agriculture and outbreaks involving diseases, parasites and insects have occurred. The policy of 'adequate level of protection' is not a guarantee of protection against animals serving as hosts for human diseases, or for zoonosis.

Australia's current import requirements for live horses, for example, rely on the self-disclosure of overseas exporters during pre-export veterinary certification checks as the primary screening mechanism for ascertaining whether the horse has been kept in an area where Lyme disease has been found in the previous 90 days.^v Under circumstances where a breeder is in the process of exporting a very expensive horse, it would be easy to simply 'overlook' an asymptomatic animal or the fact that a farm employee or neighbour may have been suffering from a Lyme-like illness.

From the information available on the Department of Agriculture, Fisheries and Fauna (DAFF) import database^{vi} and preliminary email communications with their veterinary staff, it would appear that no serological testing is required with respect to *Borrelia* (even though *Borrelia burgdoferi* is known to occur in horses^{vii}), and testing for *Babesia* and *Theileria* is constrained to equine strains^{viii}. Similarly, there appears to be no requirement for serological testing specific to *Borrelia* for camelids (alpacas, llamas etc) and goats^{ix}, which are also potential hosts^x.

Livestock imported from overseas are required to be closely examined for tick infestation and to be treated with a parasiticide effective against ticks and a broad-spectrum anthelmintic. However acaricide resistance is an ongoing and well documented^{xi xii} issue, of which people living in agricultural areas are well aware.

Frozen semen and ova from livestock (including species for which live imports have been suspended) can still be imported to Australia and *Borrelia* is not listed as one of the diseases requiring risk management. It is possible that pathogens causing Lyme disease and Lyme-like illness can remain viable after freezing.^{xiii}

In summary, based on a preliminary investigation, it appears that most screening processes on imported livestock are primarily directed toward protection from *diseases affecting livestock rather than humans*. Other than the previously mentioned self-disclosure requirement on overseas exporters of live horses, Lyme disease (Borreliosis) does not appear to be specifically mentioned in any of the requirements or pre-export veterinary screening processes. Nor is there reference to any of the other tick-borne pathogens associated with Lyme disease as co-infections, other than Brucellosis. On the basis of these concerning discoveries, it becomes questionable how Lyme disease (and other pathogens

with potential to harm humans) could *not* have already entered Australia via the importation of infected livestock from endemic areas.

WALA recommends that the CMO arranges for discussions to be held with the Department of Agriculture, Fisheries and Fauna (DAFF) to ensure more stringent quarantine controls are adopted to reduce the possibility of Lyme disease (and co-infections) being conveyed into Australia via imported livestock and biological products.

Interstate and intrastate transporting of livestock involves (for WA) individual inspection of livestock at quarantine points in Kalgoorlie and Kununurra. Livestock being transported from known cattle tick zones in the north of Australia are required to undertake full immersion dipping before being transported. However animals arriving from other states known to have endemic tick populations of other genera will only be intercepted and drenched (twice with Bayticol) if ticks are observed during inspections at quarantine entry points. Although quarantine officers provide assurances that their inspections for ticks are very thorough^{xiv}, the system is not entirely foolproof in ensuring the non-transference of tick-borne illness from endemic regions.

One such non-endemic outbreak has recently occurred in the southern coastal area of WA where cattle have been infected with bovine anaemia through the tick-borne parasite, *Theileria orientalis* variant buffeli (previously known as *Theileria buffeli*). The WA Department of Agriculture fact sheet for veterinarians^{xv} indicates that *Haemaphysalis longicornis*, the bush tick, is considered the principal vector, however notes that "native ticks such as *H. bancrofti* and *H. humerosa* may also be important. *H. longicornis* is primarily a parasite of cattle, but readily infests many other warm-blooded animals including other livestock, wildlife, birds, dogs and cats" (and presumably humans). It also notes that other unidentified means of transmission may be occurring, such as biting insects and livestock management techniques that potentially transmit infected blood between animals.

While the outbreak above relates to a tick-borne parasitic infection *in cattle*, it is indicative that the current inspection processes on movements of livestock cannot be *guaranteed* to exclude the transportation of other tick-borne pathogens, including those that cause Lyme-like illness.

Migratory birds may be a risk factor here as well because they are not required to undergo any customs inspections and it is unreasonable to expect that they would all pass through Christmas Island or an inland quarantine inspection point to shake off their ticks before traversing Australia.

It is worth noting that the recent *Theileria* outbreak has occurred in a region of WA where *H. longicornis* has previously been discovered. The potential for *H. longicornis* to act as a vector for *Borrelia* and other co-infections is further examined by Australian Lyme patient, Karen Smith, on her webpage entitled *Mammals as Vector and Reservoir Hosts*^{xvi}.

In this same region, there are also populations of feral deer^{xvii} and pigs^{xviii}, both potential hosts for Lyme and co-infections, not to mention the as-yet-unknown and unquantified potential native hosts.

WALA is aware there are at least four diagnosed Lyme disease cases in this region, at least two of whom spent their working lives in agricultural industries.

Livestock breeders are often reassured by industry veterinarians that there is little risk to humans of cross contamination due to host specificity, both of ticks and pathogens, particularly with parasitic pathogens such as *Babesia* and *Theleiria*. This reassurance again relies on "there is no evidence to suggest" when, closer to the truth would be to say, "It is not known" - because thorough investigations of all the possibilities have not been conducted.

Far too little is known about zoonoses^{xix} and vector-borne diseases in relation to human hosts in Australia. Little is known because no one is looking and no-one is likely to look for pathogens related to Lyme disease, which they are told *is not here*. Other than A/Prof Peter Irwin's research projects focusing on Lyme disease (and co-infections) in human companion animals at Murdoch University, there appears to be little similar research being undertaken by veterinarians or scientists exploring human disease relationships with larger animals, or with indigenous species, that could serve as potential hosts in tick breeding cycles.

WALA recommends adopting a multidisciplinary approach to an epidemiological study of Lyme disease and co-infections, which would include veterinarians, entomologists and optometrists (who are able to supply information which may be of assistance in diagnosing and monitoring Lyme disease).

Members of the Lyme community frequently joke about wishing they could consult vets instead of doctors for their own Lyme-like illness. Underlying this humour is a far more concerning situation wherein patients have observed that their pets' illnesses are taken far more seriously than their own and they can have intelligent and open-minded conversations with veterinarians about Lyme disease, but not with their medical practitioners. This situation arises because, in general, *veterinarians approach Lyme disease as an infection* and not as a political controversy to be avoided.

WALA has received numerous accounts regarding doctors who either refused outright to see Lyme patients or who were hasty in referring to other clinicians those patients who requested diagnosis and treatment for Lyme disease, including patients whose infections had obviously been contracted outside Australia. Some doctors can't get Lyme patients out the door quickly enough! The stigma associated with treating patients for Lyme disease generates a kind of embarrassment in many GPs, almost as if they are being asked to admit they believe in astrology or elves.

This stigma regarding Lyme disease is so well established and deeply embedded into the consciousness of the Australian medical profession that it has become like a systemic mythology: founded on the legendary Russell and Doggett 1994 tick study; modelled on commercially and politically influenced American policy guidelines; and cemented by public laboratory testing procedures that preclude positive diagnoses.

The Lyme community would like to see the Australian medical profession begin to approach Lyme disease and Lyme-like illness as a systemic infection or illness syndrome that is affecting Australian patients, divested of the stigma, mythology and political controversy with which it is currently approached.

As noted in the LDAA's response to the Scoping Study, the American "Council of State and Territorial Epidemiologists (CSTE) considers a county to be endemic for Lyme disease if there are at least two confirmed human cases that were acquired in (not just reported from) that county".^{xx}

In the case of the outbreak of a tick-borne *Theiliera* infection in cattle mentioned above only two farms were affected. Appropriate notices were duly disseminated to alert veterinarians, inform them about the disease and advise how to deal with the livestock. This is a professional and responsible approach to a disease outbreak.

There are over four hundred cases of diagnosed Lyme disease in Western Australia and more than a thousand nationally, so where is the equivalent response to the outbreak of human Borreliosis in Australia?

WALA would like to encourage the CMO to carefully consider the Patient-focused Strategic Action Plan submitted as Appendix A in the LDAA's response to the Scoping Study and to implement as many strategies as are feasible within the jurisdiction of his office.

Of the 400-plus patients in WA, some patients who have completed a full Lyme treatment protocol under the guidance of Lyme-aware clinicians have already been 'clinically cured'. Many of those who have been following treatment protocols in which the initial focus has been treatment of Lyme co-infections have already experienced noticeable improvements in their health conditions and quality of life. This information could be relevant to both the Australian Lyme disease epidemiology and to developing treatment pathways, but was not sought in the Scoping Study.

The WA Lyme Association was founded in August 2012 with the intention of providing peer support, information sharing and advocacy toward policy change. Although other Perth-based Lyme groups have been involved in publicising Lyme disease, WALA deliberately elected not to focus on public promotion of Lyme awareness for fear of generating a public demand that exceeds the capabilities of existing Lyme-aware doctors. Our decision not to actively publicise Lyme disease or seek media attention was based on a belief that only top-down policy change will create the paradigm shift needed to remove the stigma from treating Lyme disease and Lyme-like illness in this country.

In July 2013, Western Australia lost a beautiful and intelligent young woman to Lyme disease^{xxi}. Theda Myiint was not a member of our Association but her passing has deeply impacted the Lyme community Australia-wide^{xxii}. Theda was 37 years of age and should have been out in the world enjoying her life, being a wife and mother and/or at the peak of her career as a television journalist. Instead she had already lost 14 years to Lyme disease and was a prisoner to her bed, wracked with intolerable physical pain and emotional suffering. When she was well enough, Theda was a devoted crusader for Lyme awareness.

Theda's death will not be counted as an 'official' Lyme statistic, but she was nonetheless a casualty of Lyme disease in an even more shameful way. Theda gave up the fight and ended her own life because she could no longer tolerate the suffering of Lyme disease when compounded by repeated demoralising encounters with physicians who asserted that her condition was a mental illness.

Theda eventually gave up the fight *because she couldn't wait any longer for a policy change* that might re-educate these ignorant attitudes, recognise her illness and provide her with access to appropriate treatment to take away her pain.

There is a strong feeling in the Lyme community that *time's up!* In fact, the time is well overdue for the Lyme denial to end in this country and for the medical community to start

doing its job in understanding, diagnosing and providing treatment to alleviate the relentless suffering that can often accompany Lyme-like illness.

Yours sincerely

Kate Daniels

Chairperson
WA Lyme Association

Post script

Re: Additional information and minor amendment to original WALA submission on CACLD Scoping Study

The academic originally cited as the reference for the statement in WALA's original submission regarding the possibility of *Borrelia burgdoferi* pathogens remaining viable in frozen semen has now provided a copy of a previously inaccessible research paper on this topic.

The research paper (Kumi-Diaka, J. and Harris, O, (1995) *British Veterinary Journal*, Mar/Apr 1995. v. 151 (2)) appears to confirm WALA's assertion: "It is possible that pathogens causing Lyme disease and Lyme-like illness can remain viable after freezing" is correct.

WALA's original submission has therefore been amended to include a change in referencing to verify this statement.

A copy of the paper (Kumi-Diaka) is available from WALA.

However the following excerpts from the Kumi-Diaka study are of relevance to WALA's submission in relation to concerns expressed about imported livestock semen.

Continues next page....

Table I
Percentage of motile spermatozoa and *Borrelia burgdorferi* in semen after storage*

Animals	Initial sperm % motility	Post-storage at 5° C for 48 h		Post-freezing at -196° C for 12 weeks	
		% Sperm	% Spirochetes	% Sperm	% Spirochetes
Dog 1	90	65	100	45	83
Dog 2	90	75	100	50	87
Dog 3	90	75	100	50	91
Dog 4	85	60	100	45	85
Dog 5	90	75	85	65	79
Mean ± SD	89.0 ± 2.2	70.0 ± 7.1	97.0 ± 6.7	51.0 ± 8.2	85.0 ± 4.5
Ram 1	90	85	100	55	87
Ram 2	80	75	100	50	91
Ram 3	90	75	93	45	88
Mean ± SD	8.67 ± 5.8	7.83 ± 5.8	97.7 ± 4.0	50.0 ± 5.0	88.7 ± 2.1
Bull 1	80	70	97	45	88
Bull 2	85	80	100	50	89
Bull 3	70	60	100	35	95
Mean ± SD	78.3 ± 7.6	70.0 ± 10.0	99.0 ± 1.7	43.3 ± 7.6	90.7 ± 3.8

*Figures for individual animals are averages of two readings (duplicates) to the nearest digit.

This study indicates that storage had no significant adverse effect on the viability of *B. burgdorferi*. The effect(s) of storage on the spirochetes and spermatozoa were significantly parallel for the semen in all the three species of animals. The post-storage viability of the *B. burgdorferi* was significantly higher than that of spermatozoa. Other investigators have reported the survivability of *B. burgdorferi* in blood samples processed for transfusion (Johnson *et al.*, 1990) but not in semen.

Gustafson (1993) reported DNA sequences in tissues from foetuses from seronegative bitches that had been bred with semen from *B. burgdorferi*-infected dogs. This demonstrates the potential of *in utero* infection of the foetuses. Consequently, the survival of the spirochetes in frozen-thawed semen raises awareness of potential semen-borne transmission of Lyme borreliosis. However, the significance of venereal mode of transmission needs to be investigated by epidemiological studies.

A mean figure of 90%+ viability for *Borrelia burgdorferi* spirochetes in semen frozen for 12 weeks should be of sufficient concern to warrant further investigation by both medical authorities responsible for public health protection and the livestock industry.

Documents supplied by DAFF indicate that frozen semen and ova are required to undergo cleaning and washing processes to eradicate pathogens; however it is not known if these processes are effective in removing *Borrelia* pathogens or other affiliated pathogens capable of infecting humans because these are not listed for risk management on DAFF's site. These 'cleansing' processes, too, bear further investigation from those at a level where responses may be more forthcoming than in WALA's initial inquiries.

Additional information re testing of Australian livestock for *Borrelia burgdorferi*

In addition, WALA has made inquiries on behalf of a person who believes her horse may be infected with Lyme disease. WALA's preliminary inquiries regarding the availability of testing within Australia for *Borrelia burgdorferi* in livestock revealed that this could be extremely difficult, if not impossible. These inquiries included calls to Murdoch University Vet School, the Australian Veterinary Association and the CSIRO's Australian Animal Health Laboratory in Geelong, all of which are unable to readily refer to a testing process available in Australia.

So even if owners of livestock suspect Lyme-like illness in their animals, they would have to be willing to go to considerable lengths (possibly involving overseas pathology testing) to have this scientifically confirmed or denied.

Large animals and the tick breeding cycle

In overseas research it is generally accepted that larger animal species are considered to be 'end hosts', meaning that they serve as a blood meal for adult ticks, which then cannot pass on the infection. It is believed only tick larva and (mostly) nymphs are the stages that feed from reservoir hosts (rodents, birds and possibly, marsupials) and can pass on the infection to the next life cycle stage.

While this is the accepted theory in countries where Lyme disease is known to occur, the ability of ticks in Australia to carry and transmit infection (and their breeding cycles relative to this) remains uncertain at this time.

Also unknown are the potentials of non-tick vectors and uniquely Australian reservoir animals in hosting pathogens for Lyme-like illness or the potentials of blood, urine or venereal transmission between livestock, or indeed livestock and humans. In short, there are many more questions that can be listed as 'gaps in our knowledge' than those outlined in the Scoping Study.

The additional information supplied here and minor amendment to WALA's original submission serve only to reaffirm recommendations regarding the need for a full and thorough epidemiological study to be conducted and for further investigation into Australia's quarantine and animal importation procedures to be undertaken.

ⁱ <http://www.lymedisease.org.au/wp-content/uploads/2010/11/20130528CACLDMtg2NikkiNotes.pdf>

ⁱⁱ <http://www.lymeaustralia.com/birds-as-vector--reservoir-hosts-including-examination-of-iuriae-seabird--iaurituluss-bird-ticks.html>

ⁱⁱⁱ http://www.chp.gov.hk/files/pdf/prevention_of_lyme_disease_in_hong_kong_r.pdf

^{iv} Email communication with DAFF quarantine veterinary officer.

^v

http://apps.daff.gov.au/icon32/asp/ex_QueryResults.asp?Commodity=horses&Area=All+Countries&EndUse=All+End+Uses&QueryType=Search

^{vi} http://apps.daff.gov.au/icon32/asp/ex_querycontent.asp

^{vii} <http://www.thehorse.com/articles/10200/lyme-disease-in-horses>

[http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.05.08 EQUINE PIROPLASMOSIS.pdf](http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.05.08_EQUINE_PIROPLASMOSIS.pdf)

^{ix} http://apps.daff.gov.au/icon32/asp/ex_querycontent.asp

^x <http://www.aaem.pl/pdf/aaem0223.pdf>

^{xi} Wharton, RH (1967) Acaricide resistance and cattle tick control, *Australian Veterinary Journal*, Volume 43, Issue 9, pages 394–398

<http://onlinelibrary.wiley.com/doi/10.1111/j.1751-0813.1967.tb04892.x/abstract>

^{xii} University of Glasgow (2013) Secret of cattle ticks' resistance to pesticide, ScienceDaily, 7 October 2013. www.sciencedaily.com/releases/2013/10/131007122556.htm

^{xiii} Kumi-Diaka, J. and Harris, O, (1995) *British Veterinary Journal*, Mar/Apr 1995. v. 151 (2)

^{xiv} Personal communication, livestock inspectors, Kalgoorlie Quarantine Inspection Station of AgWA.

^{xv}

http://archive.agric.wa.gov.au/objtwr/imported_assets/content/pw/ah/dis/cat/batog_veterinarian_fact_sheet.pdf

^{xvi} <http://www.lymeaustralia.com/mammals-as-vector--reservoir-hosts-including-examination-of-hlongicornis-scrubbush--hbispinosa-ticks.html>

^{xvii} <http://www.feral.org.au/wild-deer-density-2007-western-australia/>

^{xviii} <http://www.feral.org.au/feral-pig-density-2007-western-australia/>

^{xix} http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0011/334001/Zoonoses-animal-diseases-transmissible-to-humans.pdf

^{xx} <http://www.cdc.gov/lyme/faq/#endemic>

^{xxi} <http://www.youtube.com/watch?v=U29UAqR2RfE>

^{xxii} <http://www.lymeaustralia.com/theda-myint---july-2013.html>