

Editorial

Lyme disease and occupation

Lyme disease is a bacterial zoonosis that is spread by ticks from infected animals to humans [1]. The UK tick and disease vector, *Ixodes ricinus*, is widely distributed in woodland, parks, gardens, agricultural and shrub land. Ticks require 3 blood meals from available mammals/birds over their 2- to 3-year life cycle. If the animal is infected with the *Borrelia burgdorferi* spirochete, or any other tick-borne pathogen, it can be transferred to a human during the ticks' next blood meal. Ticks seek warm vasodilated skin, locking on for >24 h, and injecting an anticoagulant.

The occupations at risk of tick-borne disease include forestry workers, shooting estates, park rangers, ecologists, fencers, farmers [2], crofters, wildlife photographers, rail-track workers, road maintenance, gardeners, golf course greenkeepers, fire people dealing with forest fires, electricity line maintenance, windfarm construction, veterinarians, army personnel on exercise and police on surveillance [3].

The individual employee risk of acquiring ticks depends on tasks and time exposed. Ticks lay their eggs on the forest floor under leaf mould. Thus, lying or sitting in the forest is higher risk. Brushing through bracken and undergrowth is medium risk and walking on paths is low risk.

Ecological studies show a variable distribution of tick-borne pathogens between locations and within seasons. Some woodlands have 10% of infected ticks while others have none [4, 5].

The differing species of *B. burgdorferi* in Northern America and Northern Europe are important for disease expression, testing and vaccination [6, 7].

Other rarer tick-borne diseases in Europe include Tick-borne Encephalitis [8] and zoonotic Louping ill from sheep to workers in Scotland [9]. Anaplasma [10] and Babesiosis [11] are also potential tick-borne diseases in the UK.

Thus, correct tick removal remains the cornerstone of the public health and occupational health response for current and future pathogens in the UK.

The ecosystem for Lyme disease is changing. The wild animal reservoir for *B. burgdorferi* is complex. Roe deer enter parks and gardens. Human behaviours include more recreational use of forests and parks. Sheep used to act as 'tick mops' and clean bracken, before being treated for ticks with toxic organophosphate sheep dips, and risk to farmers. Ticks become active above 7°C and are being helped by the warmer, wetter weather of climate change. Re-wilding may also encourage ticks.

The incidence of Lyme disease varies with geography in the UK, with hotspots in the Scottish Highlands, New Forest and Thetford Forest areas of England. Highland has the highest UK annual incidence with 362/100 000 General Practice case treatments for Lyme disease and 69/100 000 laboratory-confirmed cases. Empirically treated Erythema Migrans is thus 5.2 times more common in hotspots than laboratory data suggest. England and Wales record 1.94/100 000 laboratory-confirmed cases.

Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) reports for Lyme disease in Scotland's public forestry organization over 5 years are 8.94 per 1000 employees. Non-Lyme RIDDOR reports are 4.3 per 1000 employees with no Hand-arm Vibration Syndrome reports in same time frame.

Thus, Lyme disease is the most significant health risk in the forestry company most likely to record accurate figures. An estimated 19 000 people work in UK Forestry suggesting 169 cases per year in UK Forestry.

The public are advised to wear long trousers and apply DEET to skin to avoid tick bites.

However, lifetime, daily DEET occupational exposure has unknown risks and non-toxic pyrethroid-impregnated clothing for forestry workers has reduced tick acquisition. They are washed at home over 60 washes and are classed as control measures rather than personal protective equipment (PPE).

Control of Substances Hazardous to Health (COSHH) risk assessments also require training and tick removal devices to be widely available for employees.

The evidence base on tick removal is weak [12]. First principles suggest prompt tick removal within 12 h, without squeezing the tick, gives the best chance of reducing disease transmission. The outcome for tick removal should be a live tick, which has not regurgitated its stomach content into the human.

Current Public Health England information advocates 'fine-tipped tweezers' for removal, but the public use home tweezers which squeeze the tick and facilitate disease transmission in clinical experience! Twisters and cards are better.

Small plastic Tick Twister removal devices looking like a claw hammer with a bevel to slide under and twist off the tick. They have three sizes to match the larval, questing nymph and adult size of ticks. Also recommended in the occupational setting are Tick Cards which are plastic credit card size to carry in wallets.

Tick Twisters and Cards require wide availability for employees to have in their pockets, glove compartments of vans and at home in first aid kits. Employees are most likely to find a tick at home after a shower and should be encouraged to take work tick removal devices home. Ticks will crawl to behind the knees, genitals, groin, skin folds, armpits and into the hairline and behind ears.

The health and safety culture of tick risk industries needs to encourage mutual tick checks between employees on their backs, behind knees and behind ears after their days of work. Lone workers can use mobile phones like a mirror to inspect behind knees. Annual seasonal 'Toolbox' talks on tick risks are advised and the provision of sunscreen will allow outdoor workers to return to work while on treatment with doxycycline for Erythema Migrans.

Tick removal devices can be reused after washing in detergent or with an alcohol wipe.

Occupational first aid courses need to be commissioned which include tick removal and diseases.

The first local skin reaction to a tick bite may be a red itchy lump that does not spread and resolves in a week. The allowable local reaction is allergic and does not signify infection.

A red rash spreading beyond 5 cm after tick bite or exposure confirms the clinical diagnosis of Erythema Migrans without the need for a blood test. The rash is variable and depends upon the age and colour of the skin. In North America, the rash may be a ring or target in appearance. However, in the UK, a clear ring around a central bite is unusual and a spreading redness is usual. The body location is important: behind knees, in the groin and skin folds. This can lead to misdiagnosis as 'fungal'. The rash may be faint and disappear, but still requires treatment. National Institute for Health and Care Excellence 2018 sets out treatments, starting with effective high-dose doxycycline for 21 days [1, 13]. Compliance advice on gastrointestinal side-effects and using sunscreen is crucial. Employees should be encouraged to record pictures of any rash after tick exposure on mobile phones. Early localized disease of Erythema Migrans is completely cured with antibiotics and employees can usually return to work with sunscreen.

Early disseminated Lyme disease presents with Lyme neuroborreliosis or Lyme arthritis 6–8 weeks after exposure. Importantly, the patient may not recall a rash or tick bite, and the diagnosis is made with serology from an approved lab detecting IgM and IgG antibodies. Focal symptoms of a Bell's palsy [14], leg motor neuropathy or single warm knee or wrist should prompt serology. Bell's palsy in adults and children requires urgent steroids and antibiotics before blood test results are available. The clinical history can be confused by non-specific flu-like symptoms, fatigue and 'brain fog'.

The persisting symptoms of Post-Treatment Lyme Disease Syndrome occur in 10% of treated patients after 6 months but most patients have recovered and returned to employment after 2 years [1]. UK Industrial Injuries benefits include Lyme disease under biological hazards.

In addition to Lyme disease, new tick-borne pathogens including Tick-borne Encephalitis [8], Louping ill [9], Babesiosis [11] and Anaplasma [10] will continue to challenge clinicians.

Alpha-gal syndrome is a new to UK red meat food allergy caused by repeated tick bites.

All above require the same preventive approach from occupational health to prevent tick bites, remove them promptly and employee awareness of early symptoms of tick-borne disease.

In conclusion, a range of workers are at risk from Lyme disease from big companies to self-employed people. Established occupational safety practice from Forestry needs to be applied from the HSE downwards. COSHH requires tick risk assessments, reliable employee information, providing tick removal twisters and cards. Pyrethroid clothing and information on when to seek medical help need to be clear and included in first aid training. However, neither biological monitoring with annual serology nor prophylactic antibiotics after tick bites can be recommended on current evidence. Congenital syphilis raises the potential of vertical transmission, but there are no case reports in Lyme disease. Pregnant workers require individual risk assessment and documented understanding.

A Lyme disease vaccine is projected for launch in 2027 [7]. An effective vaccine for tick-borne encephalitis is available but not currently required in the UK. Employers will need to consider offering a Lyme vaccine to employees as part of COSHH assessments.

Forestry industries and their employees have an important role in their local rural communities regarding public education on how to confidently live with ticks [15].

There remains much more benefit to health and well-being from life, work and recreation in green spaces than the small but important risks of tick-borne disease.

James D. M. Douglas 

Tweeddale Medical Practice, Fort William, UK
e-mail: jamesdmdouglas@gmail.com

Ruth Scott

Health and Safety Manager, Forestry and Land Scotland, Inverness, UK

REFERENCES

1. Kullberg BJ, Vrijmoeth HD, van de Schoor F, Hovius JW. Lyme borreliosis: diagnosis and management. *Br Med J* 2020;**369**:m1041.
2. Baird AG, Gillies JC, Bone FJ, Dale BA, Miscampbell NT. Prevalence of antibody indicating Lyme disease in farmers in Wigtownshire. *Br Med J* 1989;**299**:836–837.
3. Magnavita N, Capitanelli I, Ilesanmi O, Chirico F. Occupational Lyme disease: a systematic review and meta-analysis. *Diagnostics (Basel)* 2022;**12**:296.
4. Hansford KM, Gillingham EL, Vaux AGC *et al.* Impact of green space connectivity on urban tick presence, density and *Borrelia* infected ticks in different habitats and seasons in three cities in southern England. *Ticks Tick Borne Dis* 2023;**14**:102103.
5. Hawkes N. Ticks transmitting Lyme disease are found in a third of Britain, mainly the south. *Br Med J* 2018;**360**:k692.
6. Marques AR, Strle F, Wormser GP. Comparison of Lyme disease in the United States and Europe. *Emerg Infect Dis* 2021;**27**:2017–2024.
7. Hajdusek O, Perner J. VLA15, a new global Lyme disease vaccine undergoes clinical trials. *Lancet Infect Dis* 2023;**23**:1105–1106.
8. Holding M, Dowall S, Hewson R. Detection of tick-borne encephalitis virus in the UK. *Lancet* 2020;**395**:411.
9. Davidson MM, Williams H, Macleod JA. Louping ill in man: a forgotten disease. *J Infect* 1991;**23**:241–249.

10. Matei IA, Estrada-Peña A, Cutler SJ *et al.* A review on the eco-epidemiology and clinical management of human granulocytic anaplasmosis and its agent in Europe. *Parasit Vectors* 2019;**12**:S99.
11. Hildebrandt A, Gray JS, Hunfeld KP. Human babesiosis in Europe: what clinicians need to know. *Infection* 2013;**41**:1057–1072.
12. Due C, Fox W, Medlock JM, Pietzsch M, Logan JG. Tick bite prevention and tick removal. *Br Med J* 2013;**347**:f7123.
13. Cruickshank M, O'Flynn N, Faust SN; Guideline Committee. Lyme disease: summary of NICE guidance. *Br Med J* 2018;**361**:k1261.
14. Markby DP. Lyme disease facial palsy: differentiation from Bell's palsy. *Br Med J* 1989;**299**:605–606.
15. St Pierre SE, Gould ON, Lloyd V. Knowledge and knowledge needs about Lyme disease among occupational and recreational users of the outdoors. *Int J Environ Res Public Health* 2020;**17**:355.