Lyme disease: understanding and managing the risk of infection

Outline

• Background
  – Epidemiology of Lyme disease
  – The changing landscape of health and forests in Britain
• Ecology of Ixodid ticks and Lyme disease
  – Lifecycle of Ticks and Host Interactions
  – Habitat Issues and current research
• Public Education
  – Ticks and Lyme disease information
  – Case Studies
• Summary and Conclusions

Epidemiology of Lyme disease in the UK 1999-2010

- Confirmed reports are thought to significantly underestimate true incidence
- Up to 20 percent of cases in any year are acquired abroad

Lyme disease: Factors and Trends

- Several factors thought to be responsible for the rising trend in the number of infections, such as:
  – Improved diagnostics
  – Increased awareness and reporting of infection
  – Improved habitat for host species
  – Successive mild winters enabling ticks to survive
  – Growth in recreational travel to high-risk areas (UK and overseas)

Policy Drivers in Health: Physical activity and health

- Be Active, Be Healthy. Department of Health 2009.

Natural Environments and Health

- Primary evidence that natural places are beneficial for both physical and emotional well-being.
- Many sports and passive recreational activities are possible in forests and outdoors
- Evidence to suggest that the spiritual and "connectedness" aspects of nature have an added impact on healing, sense of well-being and psychological restoration (e.g., Ulrich 1984).
- This is something we are investigating in a range of urban green spaces in Sheffield, with a paper coming soon (Jorgensen et al).
- However, the health benefits need to be balanced with awareness of the health risks in natural places, especially Lyme disease.
Childhood experience in woods and nature is important in determining exercise preferences in later life.

Forest Policy and Ecosystem Change (1)

- Recent attempts by Government to sell public forests stirred an enormous outcry.
- 500,000 signed a petition and there were “mass protests” in many woodlands.
- People want the forest to remain public, and accessible for wide range of uses, often linked to health.
- We recognise that the forests are important for many purposes, not least as a “sink” for carbon in our efforts to reduce our impact on the climate.

Forest Policy and Ecosystem Change (2)

- Throughout the 20th century there has been a concerted effort to restore and enlarge the forest estate.
- Forests have become larger and more complex as they age.
- Now we are moving to a more ecological form of forest management to promote biodiversity and recreational values....
- This policy is proving successful, but this may bring more people into habitats where there are large numbers of ticks.

Forest stand dynamics

looking at the forest as developmental stages

Source: Oliver and Larson 1996
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**Area of High Forest by Age Class Groups 1947-2000**

- The area of woodland has increased dramatically from 1947-2000
- The amount and complexity of older woodland is increasing

**Environmental Benefits of Forests: Thirlmere Reservoir**

**Increase in deer populations in Britain, 2000-2007**

- Source: British Deer Society

**Ecology of Lyme Disease: The Epidemiological Triangle**

- Host
- Health
- Vector
- Environment
- Agent
Epidemiology of Lyme disease in the UK

- Who is at risk of acquiring Lyme disease?
  - Occupational: Forestry workers, deer managers, gamekeepers, farmers, soldiers, outdoor educators, conservationists
  - Recreational: ramblers, campers, ornithologists, nature photographers, returning travellers (from focal regions in US and EU)
- Where are “hotspots” in the UK?
  - New Forest, Thetford Forest, South Downs, Exmoor, woodland/heathland in southern England, North York Moors, Lake District, Scottish Highlands
  - Other local areas (habitat × host species × humans)
  - Therefore, important to note, infected ticks can be found in both rural and urban green space – forests, parks, gardens

Ixodid ticks can be active for most of the year in woodland habitats

- Major wildlife hosts at each blood feed
- Ixodes ricinus is most common vector, but also an urban risk from I. hexagonus and I. canisuga
- Ruminants support adult tick population, but do not transmit LD — evidence they kill Borrelia

Tick habitat

- Urban green space and gardens can be effective tick habitats
  - Parks and gardens provide excellent habitat for squirrels, hedgehogs, rodents, birds
  - Herbaceous vegetation especially interesting for children at play, pet dogs
Options for managing habitat

- **Vector** - Direct control of tick populations
- **Host** - Control/cull host populations
- **Environment** – Modify/spray/strim vegetation to reduce ground cover/questing potential
- **Micro-manage habitats** using knowledge of ecosystem dynamics
- **Education** to increase awareness and personal protection

Current research on ecology and habitats

- James Hutton Institute – Dr Lucy Gilbert
- Oxford University – Professor Sarah Randolph
- Forest Research – Dr Chris Quine

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Accessible public health information is key
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Online sources of information

UK Agencies
• Health Protection Agency (HPA) - [www.hpa.org.uk](http://www.hpa.org.uk)
• Health Protection Scotland (HPS) - [www.hps.scot.nhs.uk](http://www.hps.scot.nhs.uk)

International Agencies
• European Concerted Action on Lyme Borreliosis (EUCALB) - [http://meduni09.edis.at/eucalb](http://meduni09.edis.at/eucalb)
• US Centers for Disease Control and Prevention (CDC) - [www.cdc.gov/ncidod/dvbid/Lyme](http://www.cdc.gov/ncidod/dvbid/Lyme)

UK Charities
• Borreliosis and Associated Diseases Awareness UK (BADA-UK) - [www.bada-uk.org](http://www.bada-uk.org)
• Lyme Disease Action (LDA) - [www.lymediseaseaction.org.uk](http://www.lymediseaseaction.org.uk)

Ixodid tick morphology and development

Nymph
• 1 to 1.5 mm in size
• difficult to detect

Adult (female)
• 3 to 3.5 mm in size
• males are smaller
• can remain attached to host for several days

Start and completion of a blood feed

• Ticks are skilled at evading early detection - bites are painless
• They naturally focus on moist, warm areas of the body, often in skin folds
• Undisturbed, feeding will continue for several days
• A fully engorged tick will measure up to 10 mm in size, and appear like a small bean
• It usually takes several hours before a tick transfers the Borrelia bacteria to the host

Ixodid tick head and mouthparts

Head Chelicerae Hypostome Palps Chelicerae

Anatomical distribution of nymphal tick bites

% of total nymphal bites, recreational forest site, England


Adults mainly bitten below waist

Children mainly bitten above waist
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**Erythema migrans (EM) – the target rash**

• The rash expands from the site of the bite and gradually clears in the centre
• The rash appears over 3-30 days and may persist for several weeks
• The rash does not appear in over 40% of cases in Scotland
• The rash can be a wide variety of shapes depending on the location of the bite

**Symptoms and signs**

**Early:**
- red, expanding target rash
- feeling unwell or 'flu-like'
- headache, stiff neck
- swollen lymph nodes
- sound or light sensitivity

**Acute:**
- facial palsy
- heart problems
- breathing problems

**Weeks, months, years:**
- arthritis, typically of the knee
- sleep disorders
- extreme fatigue
- upset digestive system
- loss of weight
- muscle pain and/or weakness
- tendon pain
- tingling and numbness
- cognitive and psychological problems

**Removal of ticks – the dos and don’ts!**

**Best practice**
- Don’t panic
- Aim to remove the tick promptly
- Grip the tick by its mouthparts
- Use a dedicated tick tool, follow instructions
- Use fine tweezers – pull firmly, steadily, no twisting
- Disinfect site of bite after removing the tick

**Unsafe practice**
- Don’t squeeze the body of the tick
- Don’t twist (unless using a tick tool)
- Don’t use fingernails
- Don’t burn the tick
- Don’t use oils, alcohol, nail varnish

**Case Studies: Positive Action in Practice**

- **Case Study 1: Forestry Commission**
  - Staff induction and Health and Safety
  - Information (intranet) and training, tick tools
  - Risk assessments
- **Case Study 2: National Outdoor Centre, Glenmore Lodge, Cairngorms**
  - Staff induction
  - Awareness and training, tick tools
  - Annual testing (ELISA)
- **Case Study 3: Whinfell Forest, Center Parcs Holiday Village, Penrith, Cumbria**
  - Education and awareness - ground staff and visitors
  - Medical Centre – trained staff and information leaflets
  - Bracken spraying and habitat modification (especially around footpaths)

**Awareness raising at Whinfell Forest Village, Cumbria (Center Parcs)**

**Risk assessment and appropriate clothing required to access more natural woodland areas**
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Woodland paths with moderate risk: dense ground vegetation and overhanging saplings

Lower risk habitat with paths carefully prepared and vegetation cut back

Health Information for Outdoor Users: Key Points

1. Enjoy the outdoors - it’s great for physical and emotional well-being!
2. Before going outdoors - be aware of ticks and tick ecology
3. While outdoors - minimise risk of being bitten: dress appropriately; apply acaricide; avoid dense vegetation (questing)
4. After being outdoors - check for ticks on skin and clothes; check children; check the dog too!
5. If bitten by a tick - remove promptly using a safe technique
6. Medical treatment - seek early diagnosis and treatment if symptoms of infection develop after being bitten or after visiting tick habitat - early diagnosis is easier to treat with ABx
7. If in any doubt, speak with your GP

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Conclusions

1. The potential risk of Lyme disease is increasing for many social, environmental and ecological reasons.
2. The risk of being bitten by an infected tick is modifiable through application of ecological knowledge, often at the local scale, and also an understanding of how people interact with natural environments.
3. Public Health Information needs to be targeted, normalised and empowering so that more people can safely engage with the natural world for their physical and emotional well-being.