Primary Prevention and Surveillance of Lyme Borreliosis in Ireland

Report of the Lyme Borreliosis Subcommittee of the Scientific Advisory Committee of the Health Protection Surveillance Centre

October 2019

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Establishment of the Lyme Borreliosis Subcommittee of the Scientific Advisory Committee of HPSC

The Health Protection Surveillance Centre (HPSC) is Ireland's specialist agency for the surveillance of communicable diseases. HPSC is part of the Health Service Executive (HSE) and works in partnership with health service providers to provide the best possible information for the control and prevention of infectious diseases.

In 2015, a Subcommittee was convened to advise the HPSC Scientific Advisory Committee and tasked with the following terms of reference:

1. To raise awareness in Ireland of Lyme borreliosis amongst clinicians and the general public

2. To identify and highlight best international practice in awareness raising about Lyme borreliosis for the general public

3. To develop policies for the primary prevention of Lyme borreliosis in Ireland based on best international evidence

4. To explore ways to improve surveillance of neuroborreliosis in Ireland

5. To develop strategies to raise awareness among the general public particularly in relation to areas with higher tick populations

In considering the terms of reference, three overarching themes were identified namely;

- Raising awareness of Lyme borreliosis
- Primary prevention of Lyme borreliosis
- Surveillance of Lyme neuroborreliosis

Actions and recommendations in respect of each of these themes are outlined in this report.

Background

Lyme borreliosis was first identified in the north-eastern United States in 1975. A cluster of what was thought to be Juvenile Rheumatoid Arthritis turned out to be an infective arthritis caused by a bacterial spirochete *Borrelia burgdorferi*. The infection was subsequently discovered to be transmitted through the bites of infected *Ixodes* ticks, thus the prevention of tick attachment remains a key priority in reducing the risk of infection. Lyme borreliosis is now endemic across most temperate parts of the world.

To date in Ireland there has been limited published information on tick density however a number of small studies investigating tick borne disease agents have confirmed that Ixodes ticks in this country do carry pathogenic borreliae species. The reported infection rates of *Borrelia burgdorferis senso lato* in *Ixodes* ticks ranges from 2% to 27% with significant variations between locations and over time (1-3).

Infection with *Borrelia* can result in a range of clinical effects, from inapparent infection, to the development of a characteristic skin rash (referred to as erythema migrans), to serious disease involving organ systems, such as the nervous system, the heart and joints. Patients with early disease involving skin or those with non-specific symptoms generally present to their General Practitioner, whereas organ system disease usually requires referral to specialist services. The characteristic skin rash (Erythema migrans) is not always present in patients or indeed may not have been recognised at the time it occurred. Although severe disease is rare it most frequently arises due to previously unrecognised early Lyme disease or inadequate or incomplete initial treatment. As late Lyme disease can be a serious condition it is important to ensure that the possibility of being bitten by a tick and developing early disease is minimised.

Lyme borreliosis is notifiable in Ireland as its more severe disseminated form of neuroborreliosis. All medical practitioners, including clinical directors of diagnostic laboratories, are required to notify the Medical Officer of Health (MOH)/Director of Public Health (DPH) of cases of Lyme neuroborreliosis (S.I. No. 390/1981 - Infectious Diseases Regulations 1981, as amended). This information is used to investigate cases and to assist in the development of strategies to minimise the human harm caused by this disease.

Raising awareness of Lyme borreliosis in Ireland

Introduction

In recognising the risk associated with tick borne diseases it is essential to highlight that outdoor recreational and physical activities have many health benefits and in line with national policy, should be promoted and encouraged (Healthy Ireland, A Framework for Improved Health and Wellbeing 2013-2025 (DH, 2013)). Raising awareness of Lyme borreliosis should focus on empowering people with the knowledge required to prevent tick attachment or, to minimise the likelihood of infection by removing the tick in a timely, effective manner. Raising awareness of the signs and symptoms of Lyme borreliosis amongst clinicians and the general public is important in ensuring prompt recognition, diagnosis and treatment.

A study undertaken in the west of Ireland between 2010 and 2014 has shown that Lyme serology requests had almost doubled during this period, while the numbers testing positive remained relatively constant (~40 cases). These findings suggest increasing awareness of Lyme borreliosis, among both the general public and clinicians, with a stable number of new infections, possibly reflecting a lower threshold to seek medical advice and undertake serological testing (4)

HPSC is committed to raising awareness and highlighting strategies of primary prevention for Lyme borreliosis at a national level. In addition, awareness raising activities are actively undertaken by public health groups at local level including regional zoonoses committees.

Approaches to raising awareness internationally

Lyme borreliosis is an international health problem with cases occurring throughout temperate areas in Europe, North America and parts of Asia (5) International approaches to raising awareness of Lyme borreliosis have included;

- Providing online access to educational resources (6, 7)
- Providing print materials e.g. posters, leaflets (6, 7)
- Annual mass media campaigns (often at the start of “tick season”) (8)
- Public deliberation (8)
- Information boards/educational material at entrance points of forested/grassland areas
- eHealth Interventions e.g. smartphone applications, social media alerts/reminders, computer games, online video learning (9-11)
- School educational programmes (11)
- Art competitions for school children (7)
- Citizen Science programmes e.g. involvement of volunteers in science projects related to Lyme borreliosis (12)

- Academic publications
- Academic conferences/workshops

These initiatives are readily transferable and applicable. They highlight that educational content should come in a form and manner that are most likely to enable engagement with various target populations.

Approaches to raising awareness in Ireland

The following were identified as key elements of strategy for tick and Lyme awareness:

- The general public should have access to simple key health information on ticks, preventing tick attachment and Lyme disease
- This information should have a single source so that the likelihood of mixed messages or inaccurate information is minimised
- The media (including social media) should be used to ensure widespread transmission and penetration of these messages
- Simple messages should be reinforced at regular intervals through the use of social media.
- Media and other events should be intensified at the beginning of each tick biting season to bring the issue to public awareness. Although cases of Lyme borreliosis are reported throughout the year infection is more commonly diagnosed during the summer season, coinciding with tick activity and high levels of outdoor human activity that may result in tick exposure.

Resources provided by HPSC for raising awareness of Lyme borreliosis

Educational materials and content

Information provided by HPSC on www.hpsc.ie is reviewed and updated on a regular basis. The website covers topics for both healthcare professionals and the general public

Information for the general public

- Lyme Disease: Factsheet for the general public (Available here)
- Prevent tick bites and Lyme Disease: leaflets and posters (Available here)
- Laboratory testing for Lyme Disease: Factsheet for the general public (Available here)

Information for Clinicians and other healthcare professionals

- Lyme factsheet for health practitioners (Available here)
- Erythema migrans diagnostic support tool
- Prevention and control of tick-borne disease in Europe – Information for healthcare professionals (Slide set available here)
- Case definition for notification of Lyme neuroborreliosis (Available here)

- Clinical management of Lyme borreliosis consensus statement (Available here)
- Erythema migrans slide image set (Available here)
- Results of a laboratory survey on *Borrelia burgdorferi* diagnostic methods in Ireland

In addition the HPSC website hosts **links** to useful Lyme borreliosis resources from international public health bodies such as the Centers for Disease Control & Prevention (CDC), European Centre for Disease Prevention and Control (ECDC), Public Health England (PHE) and the Royal College of General Practitioners.

Campaign Material for Printing

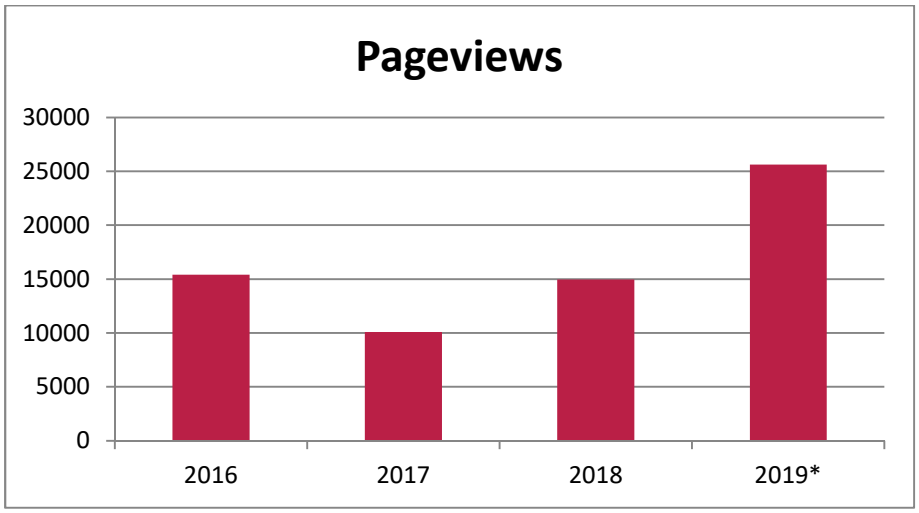
The HPSC website provides free materials for printing including posters and leaflets. Information is targeted for specific risk groups e.g. children (Figure 1).

Figure 1: Posters, Leaflets and Factsheets available for download and printing on the HPSC website

Public Engagement Campaigns for Lyme borreliosis

Activities undertaken by HPSC to raise awareness of Lyme include an annual Lyme awareness media campaign, issuing press releases, media appearances/ interviews, publishing news pieces on the homepage of HPSC and more recently tweets and posts on HPSC's social media platforms.

Figure 2: HPSC website Lyme borreliosis section page views 2016-2019 to date*



*2019 figures as of 23 December 2019

Tweet	Impressions	Engagement rate
Protect against #**Lyme** – top tips for tick removal #**LymeAwarenessDay** bit.ly/2q0fp4c @**cdcgov** pic.twitter.com/O3SC1iuE5x	490	3.5%
Preventing Lyme disease means preventing tick bites. Anyone who spends time outdoors should protect themselves against tick bites. This includes ramblers, campers, mountain bikers, people who work or walk in woodland. #**lymeawarenessday** bit.ly/LymeADi pic.twitter.com/ELFsIjHP8k	1075	2.3%
Today is #**lymeawarenessday** and HPSC has practical advice on how to protect yourself against the disease. bit.ly/2WbAKsw pic.twitter.com/TeHBFEQ0Wv	1846	16.1%

Table 1: HPSC tweets for Lyme Awareness Day, April 2019

HPSC Publications

Epidemiological Data

HPSC publishes annual epidemiological reports on vectorborne diseases including Lyme neuroborreliosis (Available here)

Epi-insight articles

A number of articles have been published in the HPSC "*Epi-insight*" bulletin to coincide with national Lyme awareness campaigns. Epi-Insight is a monthly bulletin on infectious diseases in Ireland which aims to improve the health of the Irish population by providing the best possible information on infectious diseases. Epi-Insight is circulated to approximately 2,000 online subscribers each month and is available as an open access publication via the HPSC website.

- Lyme Disease Raising Awareness - Epi Insight, Volume 20, Issue 6, June 2019
- Lyme Awareness Day - Epi Insight, Volume 19, Issue 5, May 2018
- Lyme Disease Awareness Week - Epi Insight, Volume 18, Issue 5, May 2017
- Lyme Disease - Epi-Insight, Volume 17, Issue 5, May 2016

Primary Prevention of Lyme borreliosis

Introduction

Primary prevention of Lyme borreliosis aims to reduce the risk of exposure to ticks and thereby decrease the incidence of new Lyme disease cases. As there is currently no effective vaccine against Lyme disease on the market and measures for vector elimination are not possible, the key focus of primary prevention should be the prevention of tick attachment (13, 14). Evidence suggests that knowledge, level of concern, and perceived efficacy are the main determinants of preventive behaviour regarding Lyme disease. Strengthening motivators and removing barriers should be incorporated in to prevention policies (15). Primary prevention interventions should therefore aim to increase people's confidence in their ability to carry out preventive behaviours, and aid in the realization that the necessary skills and resources are readily available for preventive measures to be taken (16).

A number of studies have shown the parts of the body where ticks are most likely to attach (17, 18) Evidence from studies indicates that more than two-thirds of all tick attachments occur on the limbs , with only about 1:10 attachments being found on the sheltered head, neck and groin areas. The pattern is slightly different for children; in one study ~80% of attached ticks in children under 10 were found on the head and neck (see Figure 3).

Companion animals (especially dogs) are particularly susceptible to tick attachments, and it is possible that animals may carry ticks into the home environment. The CDC has excellent resources on identifying and removal of attached ticks on companion animals and links to this information are hosted on the HPSC website.

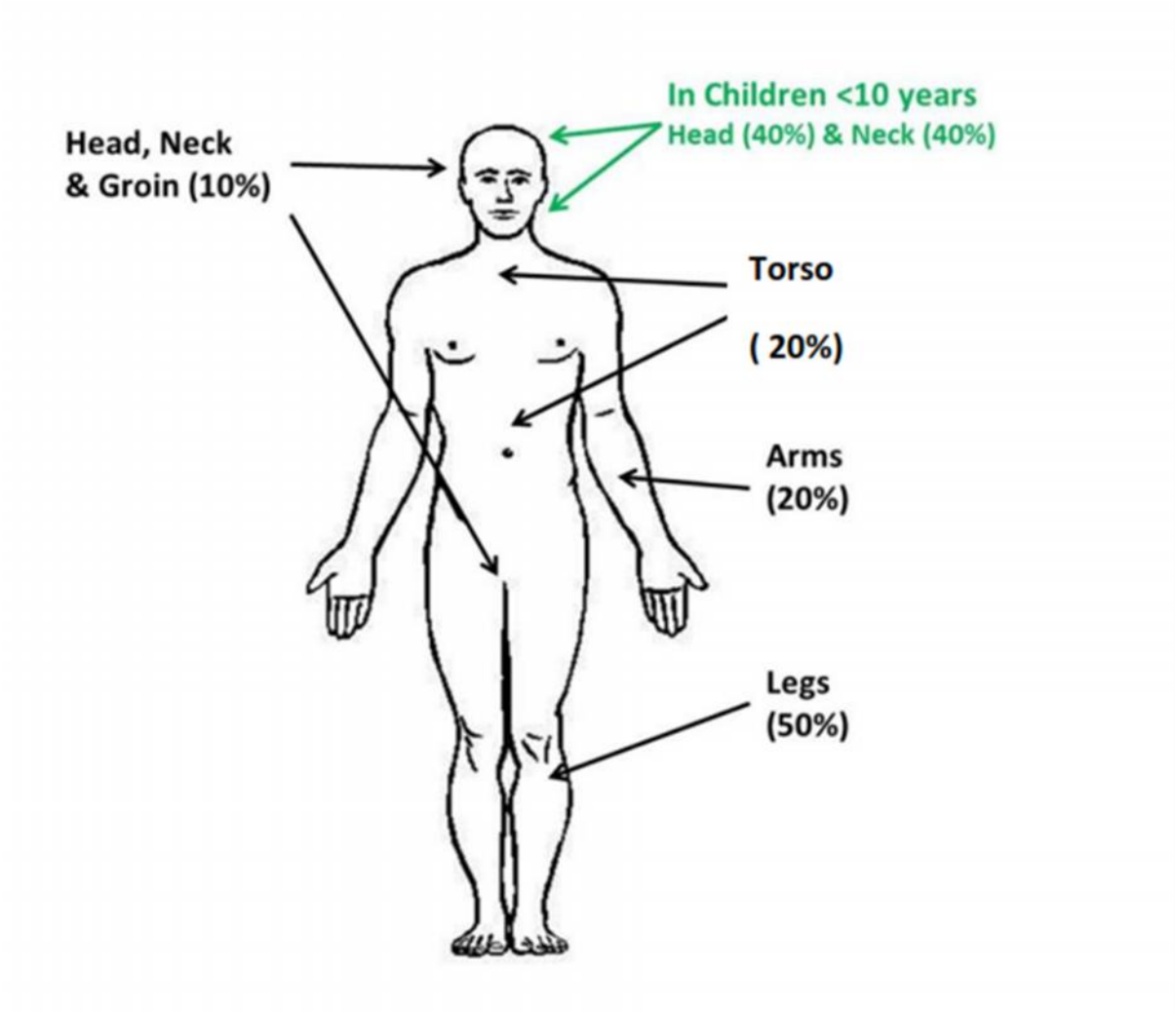


Figure 3: Areas of the body at risk for tick attachment

Modified from studies completed by Wilhelmsson P, *et al.* Ixodes ricinus ticks removed from humans in Northern Europe: seasonal pattern of infestation, attachment sites and duration of feeding. Parasit Vectors. 2013 Dec 20;6:362. and Hügli D, *et al.* Tick bites in a Lyme borreliosis highly endemic area in Switzerland. Int J Med Microbiol. 2009 Feb;299(2):155-60

Primary preventive behaviours

Information on primary preventive behaviours, based on best practice, is hosted on the HPSC website as previously outlined. Primary preventive behaviours for Lyme disease can be broadly classified into three key areas

Avoidance of tick attachment

- Cases of Lyme borreliosis are reported throughout the year however infection is more commonly diagnosed during the summer season, coinciding with tick activity and increased levels of human outdoor activity. The highest risk is from March to end of October
- Recognising typical tick habitats and where possible avoid brushing against vegetation where ticks may be present.
- Walk in the centre of trails
- Wear light coloured clothing so ticks crawling on clothes can be spotted and brushed off
- Wear appropriate clothing in tick-infested areas e.g. a long-sleeved top and trousers tucked into socks
- Use of tick repellents

Early recognition of tick attachment

- Knowing what ticks look like
- Knowing which part of the body attached ticks are most likely to be found (in the case of both adults and children – see Figure 3)
- When in tick habitats, performing regular tick checks throughout the day and inspecting the entire body at the end of the day (Table 2)

Effective removal of attached ticks

- Ensuring safe removal of ticks as soon as an attached tick is noticed
- Checking pets to ensure they are not carrying ticks in their fur (Table 4).

Adults and Children

✔ A full body tick check should be performed once you return indoors

✓ Showering may help wash off unattached ticks and it is a good opportunity to do a tick check.

✓ Undress and use a hand-held or full-length mirror to view all parts of your body.

✓ Check the body for ticks – pay particular attention to

- In and around the hair
- In and around the ears
- Under the arms
- Around the waist/inside belly button
- Back of the knees
- Between the legs

Pets

✓ Carefully examine animals by running your fingers through your pet's fur with gentle pressure to feel for any small bumps – Pay particular attention to

- Around the eyelids
- Under the collar
- Under the front legs
- Between the back legs
- Between the toes
- Around the tail
- In and around the ears

Table 2: Performing a Tick Check

Surveillance of Lyme Neuroborreliosis in Ireland

Introduction

Lyme neuroborreliosis (or LNB) refers to Lyme disease affecting the nervous system, which includes the nerves, spinal cord and brain. It is one of the most frequent early manifestations of disseminated Lyme borreliosis (LB) in Europe affecting up to 12% of those infected (19-21). LNB is classified as early or late, according to the duration of symptoms and whether the manifestations are predominantly in the peripheral nervous system (PNS) or central nervous system (CNS) Late cases of LNB are extremely rare (22).

The use of Lyme neuroborreliosis as a key indicator for surveillance is the EU standard. Through the use of a uniform surveillance definition based on laboratory findings cases of neuroborreliosis can be reliably monitored over time, providing important information as to whether the infection is becoming more or less frequent. It is important to state that the purpose of a surveillance case definition is not to set criteria for establishing a clinical diagnoses or for determining the standard of care necessary for a particular patient.

In the case of LNB, laboratory diagnosis involves the identification of abnormalities in the patient's cerebrospinal fluid (a clear, colourless fluid that bathes, support and cushions the brain and spinal cord). Such systematically gathered findings are more likely to be notified, than might be the case for a purely clinical diagnosis. Moreover, due to the severity of clinical symptoms of LNB, it is thought to be less susceptible to underreporting, therefore, trends in the incidence of LNB are more likely to reflect trends in true incidence of Lyme disease over time (19). In June 2018, the EU adopted Lyme neuroborreliosis as the notifiable entity for the surveillance of Borreliosis in Europe (see below). This ensures that data on LNB across Europe is gathered in a systematic and highly comparable way, allowing more accurate comparison of disease incidence in different countries

Surveillance of Lyme neuroborreliosis in Ireland

In 2014, Lyme neuroborreliosis became a notifiable disease in Ireland with mandatory reporting by laboratories and clinicians. The surveillance case definition for confirmed LNB requires that both clinical and laboratory criteria are met (Table 3). Since first becoming notifiable in Ireland, between 8 and 21 (on average about 14 cases) of Lyme neuroborreliosis are reported each year. .In June 2018 Lyme neuroborreliosis was included at EU level, for the first time, on the list of diseases under EU epidemiological surveillance (Table 3). To facilitate standardised collection of surveillance data, the use of previous national case definitions for Lyme neuroborreliosis was discontinued. Ireland adopted the EU case definition as the basis for LNB surveillance on 1/1/2019.

Clinical Criteria
Neurological symptoms according to European Federation of Neurological Societies (EFNS) suggested case definition without other obvious reasons

Laboratory Criteria - Confirmed case
— Pleocytosis in cerebrospinal fluid, AND
— Evidence of intrathecal production of Lyme borreliosis antibodies, OR
— Borrelia burdgorferi s.l. isolation, OR
— nucleic acid detection in cerebrospinal fluid
OR
— Detection of IgG Lyme borreliosis antibodies in blood specimen only for children (age under 18) with facial palsy or other cranial neuritis and a recent (< 2 months) history of erythema migrans

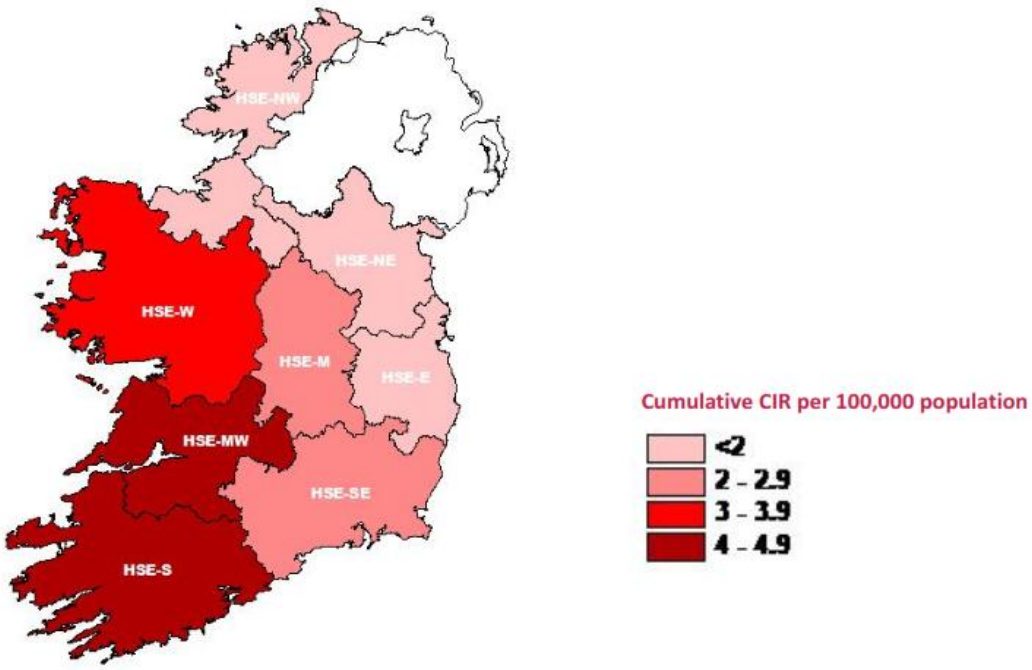
Laboratory Criteria - Probable case
— Pleocytosis in cerebrospinal fluid AND positive Lyme borreliosis serology in cerebrospinal fluid
OR
— Specific intrathecal Lyme borreliosis antibody production

Case Classification
Confirmed case
Any person meeting the clinical criteria and at least one of the laboratory criteria for confirmed cases
Probable case
Any person meeting the clinical criteria and at least one of the laboratory criteria for probable cases

Table 3: European Surveillance Case Definition for Lyme Neuroborreliosis

Figure 4 below shows the cumulative incident rate of Lyme neuroborreliosis in Ireland over the seven years between 2012 and 2018. Incidence of disease progressively increases towards the south and west of the country.

Figure 4: Crude incidence rate* of Lyme neuroborreliosis in Ireland, 2012-2018



* Data extracted from CIDR 02/01/2019, 2018 figures are provisional data only.

Improving surveillance of LNB

Key priorities for improving surveillance of LNB were identified as follows;

- Raising clinical awareness of the signs and symptoms of LNB to prompt appropriate laboratory testing (See Section 1.0)
- Confirming that there is laboratory capacity to provide diagnostic testing for Lyme borreliosis and ensuring that access to serological diagnostic tests are available in all regions.

In 2016 the first national survey of laboratory capacity for *Borrelia* diagnostics was carried out. A full report on the results is available here. The survey was conducted via a web-based questionnaire using Demographix software. Contact personnel working in the 39 microbiology laboratories in Ireland were e-mailed a link to participate and there was a 75% response rate. Of respondents the majority referred specimens externally to another

accredited laboratory for *B. burgdorferi* testing (n=25; 83%), four (13%) reported performing on-site testing for *B. burgdorferi*.

All laboratories performing testing are accredited to the ISO 15189 standard, which specifies requirements for quality and competence in medical laboratories. Commercial Enzyme Immunoassay (EIA) was the method used by all laboratories. All laboratories testing on-site reported referring reactive (that is, positive) specimens to the Rare & Imported Pathogens Laboratory (Public Health England, Porton, UK) for confirmation in line with international recommendations (22-24).

The survey demonstrated that all laboratories offering testing for *B. burgdorferi* in Ireland, are accredited, and are testing in accordance with international best practice, using two-tiered testing methodology. The antibody tests used in Ireland are developed and manufactured by commercial companies that are required to meet strict quality criteria. Irish laboratories must be accredited by the Irish National Accreditation Body (INAB) to perform the test. These laboratories must have their own quality assurance methods to ensure tests are operating correctly. The survey also shows that there is one laboratory providing onsite testing in each of the main geographical regions of Ireland (East, West, Midwest and South) providing nation-wide testing coverage for patients.

Conclusion

Raising awareness of Lyme borreliosis and the steps that can be taken to prevent this illness is an important public health intervention. It is therefore important that efforts continue to ensure that there is high awareness amongst the general public of Lyme borreliosis and information on primary prevention is promoted.

In June 2018 Lyme neuroborreliosis was included, for the first time, on the list of diseases under EU epidemiological surveillance. Data collection began at European level in 2019. In future, comparable European data on Lyme neuroborreliosis will provide more comprehensive information on the incidence of the disease at European level and a more reliable assessment of the trend of Lyme borreliosis among European Union (EU)/ European Economic Area (EEA) members.

The introduction of mandatory notification of LNB in Ireland has been a proactive step in both raising awareness and facilitating data collection. Access to laboratory testing is widely available in this country and does not present a barrier to surveillance. Ireland is well placed to contribute data to the European surveillance project launched in 2019.

Recommendations

General Recommendations

- HPSC will continue providing online access to educational resources, especially those that relate to preventing tick attachment and the appropriate methods to remove ticks
- HPSC will continue to provide up-to-date print materials e.g. posters, leaflets, for use by individuals, organisations and agencies
- HPSC will continue to promote the annual Lyme Awareness Day
- HPSC will continue to work in partnership with key stakeholders to raise awareness of Lyme borreliosis and highlight steps for primary prevention. To this end HPSC should develop a communication strategy to facilitate and improve communication among stakeholders
- HPSC should carry out a survey to establish the degree of awareness of Lyme borreliosis amongst GPs and other medical practitioners
- HPSC should seek resources to expand capacity for awareness raising activities in relation to Lyme and tick borne illness

Recommendations Primary Prevention of Lyme borreliosis

- For health professionals and the general public, HPSC should be identified as the main statutory health portal for advice on primary prevention of Lyme disease. Links to HPSC resources should be available from other relevant HSE, government and public body websites
- Information on prevention of tick bites utilising best international evidence and advice in relation to identification and avoidance of tick habitats, use of protective clothing, use of repellents and methods of examination (for adults, children and pets) should be readily available and easily accessible on the HPSC website. Moreover, this information should be available to be reproduced by other agencies with responsibility for allowing the public and employees access to high-risk tick habitats.
- This key message in relation to primary prevention of Lyme borreliosis should be focused on risk reduction with an emphasis on the importance of daily tick checks in endemic areas and following outdoor activities where exposure to ticks may have occurred.
- Instructions on effectively removing attached ticks from animals and humans should be made available on the HPSC website and this information should be used to inform all Lyme and tick education material. Consideration should be given by HPSC to develop its own tick removal graphics for use in such material. Such material should be made available in formats suitable for health professionals, other organisations with a preventive role, the general public and for children and schools.

- HPSC should consider development of an online or “app” based checklist identifying steps to take for reducing the risk of tick attachment.
- HPSC should continue to provide current information on Lyme epidemiology and the HPSC website should be used a method of highlighting information on tick distribution as it becomes available.
- HPSC should use its website to highlight new and important research findings that can inform policy in raising awareness and primary prevention of Lyme borreliosis
- There is a need for more information on infection rates of ticks in Ireland, to enable more effective mapping of ‘at risk’ areas. HPSC should advocate for additional research in this area.

General recommendations - Improving surveillance of Lyme borreliosis

- HPSC should implement a mandatory enhanced surveillance scheme for cases of Lyme neuroborreliosis.

Additional consideration

The terms of reference of this committee did not include the diagnosis or management of Lyme borreliosis. The clinical presentation of Lyme borreliosis is highly variable with many of the signs and symptoms e.g. joint pain, fatigue and neurological symptoms also found in other conditions. The experiences of committee members, and those we represent, are that establishing diagnoses and managing chronic ill health be very difficult for those with persistent symptoms. The committee strongly recommends the HSE establish clear clinical pathways so that individuals with persistent unexplained symptoms can have timely access to expert multidisciplinary services for clinical assessment, diagnosis and care.

Members of the Lyme Borreliosis subcommittee of the Health Protection Surveillance Committee Scientific Advisory Committee.

Mr Derek Bauer, Public Environmental Health Office, Environmental Health Association of Ireland

Dr Sarah Doyle, Public Health Specialist HSE South East

Mr Paddy Fenton, Kerry County Council

Dr Catherine Fleming, Infectious Disease Society of Ireland (IDSI) representative

Ms Sarah Jackson, Surveillance Scientist HSE – HPSC

Dr Sharon Lim, Occupational Health Physician, Faculty of Occupational Health representative

Ms Ann Maher, Patient Representative (from 2017)

Dr Paul McKeown, Public Health Specialist HSE – HPSC (Chair)

Mr Brian Nelson, Invertebrate Ecologist, National Parks & Wildlife Service

Dr Joanne O'Gorman, Clinical Microbiologist, Irish Society of Clinical Microbiology (ISCM) representative

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