UK Health Security Agency

Human Animal Infections and Risk Surveillance (HAIRS) group

Qualitative assessment of the risk that canine leishmaniosis presents to the UK population

Updated January 2022

Contents

About the Human Animal Infections and Risk Surveillance group

This document was prepared by the UK Health Security Agency (UKHSA) on behalf of the joint Human Animal Infections and Risk Surveillance (HAIRS) group.

HAIRS is a multi-agency cross-government horizon scanning and risk assessment group, which acts as a forum to identify and discuss infections with potential for interspecies transfer (particularly zoonotic infections).

Members include representatives from the UKHSA, Department for the Environment, Food and Rural Affairs (Defra), Department of Health and Social Care (DHSC), Animal and Plant Health Agency, Food Standards Agency, Public Health Wales, Welsh Government, Public Health Scotland, Scottish Government, Public Health Agency of Northern Ireland and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland.

Information on the risk assessment processes used by the HAIRS group can be found at HAIRS risk assessment process.

Version control

Date of this assessment: January 2022

Version: 2.0

Reason for the assessment: Positive cases of Leishmania were reported in dogs exported from Afghanistan to the UK whilst they were under quarantine in 2021. This has warranted a review of the existing HAIRS risk assessment.

Completed by: UKHSA, APHA

Non-HAIRS group experts consulted: Michelle Macrelli (APHA), Gauri Godbole (UKHSA)

Date of initial risk assessment: 28 November 2019

Information on the risk assessment processes used by the HAIRS group can be found online.

Summary of risk assessment for canine leishmaniosis in the UK population

In 2021, positive cases of Leishmaniosis were reported in dogs exported from Afghanistan to the UK, whilst the dogs were under quarantine following their arrival. This warranted a review of the existing HAIRS risk assessment. However, it can be concluded that despite the import of these infected dogs from Afghanistan to the UK, the risk to the UK population in terms of probability and impact remains unchanged from the previous risk assessment. This is because populations of the competent vector(s) of *Leishmania*, most notably phlebotomine sandflies, are not currently present in the UK.

Assessment of the risk of infection in the UK

Probability: Very low.

Impact: Very low to moderate.

Level of confidence in assessment of risk

Good.

Actions and recommendations

Raise awareness with vets and pet owners.

Maintain overview of changing epidemiology and/or evidence.

Consider the need to institute systematic surveillance for sandflies.

Step 1. Assessment of the probability of infection in the UK human population

This section of the assessment examines the likelihood of an infectious threat causing infection in the UK human population. Where a new agent is identified there may be insufficient information to carry out a risk assessment and this should be clearly documented. Please read in conjunction with the Probability Algorithm found at Annex A.

Is this a recognised human disease?

Outcome: Yes

Quality of evidence: Good

Yes. The earliest recognisable description of leishmaniasis in the Old World dates from circa 1885 BC, in ancient Egypt (1). Leishmaniasis is the term used to cover a diverse group of diseases of humans and other mammals (in which it is usually called leishmaniosis), caused by obligate intracellular protozoan parasites of the genus *Leishmania*. It is prevalent in tropical and some temperate regions of Africa, Asia, South America and parts of Europe. The parasites are phagocytosed into mononuclear phagocytes of the spleen, liver and bone marrow where they replicate causing cell rupture and release of new parasites. These can then infect new cells, including macrophages in the blood stream. The parasite-infected blood cells are then picked up in the blood meal of sandflies, of the genus *Phlebotomus* in the Old World and *Lutzomyia* in the New World.

Globally, there are more than 20 human-infective *Leishmania* species, and more than 90 sandfly species implicated in their transmission (2). There is some debate about the involvement of other arthropod vectors, including fleas, ticks and biting midges, but scientific evidence is limited (3 to 6). For development in the insect host, the parasite requires specific triggers (pH and temperature dependent) to develop from the amastigote form (in the mammal host) to the promastigote form. This form then binds to insect midgut cells, replicates and moves to the anterior midgut and mouthparts to be delivered to the mammal host in the next blood meal (7).The ability of the parasite to downregulate certain digestive enzymes in the midgut is most likely to explain their vector species specificity.

In most settings, the life cycle of *Leishmania* parasites is indirect, requiring both a vector and a mammalian host (either domestic or sylvatic) and humans become infected when they come into contact with the domestic or sylvatic transmission cycle. Transmission is primarily zoonotic, with reservoir hosts varying by parasite species and by location. Only transmission of *L. donovani* (causative agent of visceral leishmaniasis (VL)) and *L. tropica* (causative agent of cutaneous leishmaniasis (CL)) is mainly anthroponotic (ie has a human reservoir).

In humans, non-vectorial transmission is considered extremely rare and is limited to autochthonous transmission via blood transfusion and/or organ transplantation. For certain species of *Leishmania*, particularly *L .infantum* causing VL in Europe and North Africa, the domestic reservoir is the dog and *L infantum* is therefore considered the causative agent of canine leishmanisis (CanL).

Disease in humans (all *Leishmania* spp)

Most human infections with *Leishmania* remain asymptomatic. Clinical manifestations of leishmaniasis are varied but can broadly be classified into 3 main forms: cutaneous, mucosal (ML) and visceral. Which form of leishmaniasis develops, and the severity of signs and symptoms, depends on a complex interplay of infecting parasite species, vector biology and host factors (8). Among host factors, immunosuppression is an important risk factor for the development of ML and VL. Leishmaniasis is treatable and curable; however, this depends on a functioning immune system: people with HIV/VL co-infection are at increased risk of treatment failure, relapse and death.

Cutaneous leishmaniasis (CL)

CL is the most common and least severe form and causes skin lesions, mainly ulcers, on exposed parts of the body, leaving life-long scars and serious disability or stigma. Globally, there are an estimated 600,000 to 1 million new cases of CL per year, occurring mainly in South and Central America, the Mediterranean, the Middle East and Central Asia (2).

Mucosal leishmaniasis (ML)

In ML, the naso-oropharyngeal mucosa is affected. ML can also arise simultaneously with initial skin sores (mucocutaneous leishmaniasis), or more commonly as sequelae after their apparent resolution. If untreated, ulceration can result in the partial or total destruction of the mucosa, and severe disfigurement. Most cases occur in Bolivia, Peru, Brazil and Ethiopia (2).

Visceral leishmaniasis (VL)

Visceral leishmaniasis (VL; also known as kala-azar) is the most serious form of leishmaniasis. VL is a systemic disease, particularly affecting the spleen, liver and bone marrow; it is often fatal if untreated in over 95% of cases. It is characterized by irregular bouts of fever, weight loss, enlargement of the spleen and liver, and anaemia (9). During or after treatment, some patients develop post kala-azar dermal leishmaniasis – a macular, papular or nodular rash, usually most prominent on the face. WHO estimates that there are 50,000 to 90,000 new cases of VL annually worldwide, with a majority occurring in the Indian subcontinent, East Africa, and Brazil, where VL is highly endemic. In 2020, more than 90% of new cases reported to WHO occurred in 10 countries: Brazil, China, Ethiopia, Eritrea, India, Kenya, Somalia, South Sudan, Sudan and Yemen (2).

Epidemiology of human leishmaniasis in Europe

In Europe, leishmaniasis (visceral and rarely cutaneous) is mostly due to *L. infantum*, with sporadic CL caused by *L. tropica* in Greece. *L. donovani* has been implicated in both VL and CL, and recently been detected in sporadic cases in Cyprus and Turkey (10, 11). In the WHO European region in 2016 (12) , 4,046 CL cases were reported, 2862 (71%) of which were autochthonous and the rest imported. 391 VL cases were reported, of which 90% were autochthonous. Turkey has consistently borne over half the burden of CL since 1998, with a peak of 4,187 cases in 2004. With Uzbekistan, Israel and Kazakhstan, these 4 countries accounted for over 90% of the CL burden in the region in 2016. For VL, Azerbaijan, Georgia, Greece, Italy and Uzbekistan accounted for over 70% of cases reported in 2016. (Additional data source: WHO Global Health Observatory data to 2017).

The main domestic reservoir of *L. infantum* is the domestic dog, although other mammals can also act as reservoir hosts, for example a recent peri-urban outbreak in Spain was linked to hares (13). The delay in reporting and diagnosis in human cases can mean it is very difficult to ascertain whether a sylvatic, domestic or anthroponotic transmission cycle is involved, in the absence of information about the vector and mammalian reservoir.

Leishmaniasis is currently re-emerging in Europe and the wider Mediterranean region. In the 1990s, endemic areas in Europe saw a rise in VL cases in adults, linked to co-infections with HIV (8). Conflict areas in the Middle East have seen an important recrudescence of CL, and it is thought that migration and forced displacement from these areas may be contributing to the emergence in the region (8, 11).

Leishmaniosis in dogs (14, 15, 16)

Canine leishmaniosis (CanL) is primarily caused by *L. infantum*. CanL is endemic in southern Europe (17, 18, 19) and prevalences of infection (estimated by serologic and molecular diagnosis) can be as high as 60% in exposed populations (20), including at least 2.5 million seropositive dogs (21, 22). Other *Leishmania* spp. have also been found to infect dogs in other European countries including *L. donovani* in Cyprus (23), and *L. tropica* in parts of Greece (24). When clinically apparent, CanL can manifest as a chronic self-limiting disease, or a severe non-self-limiting illness. Skin lesions are the most obvious clinical manifestation and include alopecia, different forms of dermatitis and onychogryphosis (excessive development and curving of the claws). The incubation period varies from 3 months to several years. Symptomatic treatment for dogs in endemic areas is required to manage the disease. In non-endemic areas, treatment may be lifelong (drug of choice is allopurinol). Dogs with clinical or subclinical infection may be infectious to sandflies for life, as the parasite can remain in immunologically privileged sites. Susceptibility to development of clinical disease may vary according to breed of dog. Cats are also susceptible to infection but are not known to show clinical signs.

Is the disease endemic in the UK?

Outcome: No

Quality of evidence: Good

No. The UK is not endemic for leishmaniasis (2), and the phlebotomine sandfly species that are known or suspected vectors are not currently present in the UK (25). While there have been no known locally acquired cases of human leishmaniasis in the UK, increasing numbers of CanL in travelled dogs and imported rescued dogs from endemic areas have been documented, creating a potential reservoir of infected animals. However, the accepted definition of a reservoir host (as opposed to a maintainence host) is one which maintains and acts as a source of the parasite in nature, leading to onward transmission and given the lack of effective vector-borne transmission from dogs to humans in the UK, there is still uncertainty about the risk these infected dogs present to the human population. This is particularly relevant for *L. infantum* infections in domestic dogs. The recent reports of leishmaniosis in dogs in 2 unconnected households alongside historical reports suggests that imported infected dogs do occasionally arrive in the UK after travel. However, the most recent case described in the Veterinary Record (26) was not officially tested and the report suggested the animal concerned had never travelled abroad before, but there was no detail on whether the dog could have acquired infection through transplacental transmission.

Data on leishmaniasis and leishmaniosis occurrence in the UK is incomplete, because of difficulties associated with diagnosis and under-reporting. Studies in endemic settings indicate that a large proportion of both human and canine infections remain asymptomatic or subclinical, suggesting that many imported infections may never be diagnosed. Additionally, leishmaniasis is not a notifiable disease (in either humans or animals), and is not included in national surveillance schemes. Data is thus compiled on a voluntary basis. For human cases, reporting of laboratory diagnoses is now required in England and Wales (Public Health regulations).

Imported human clinical cases are often referred to the Hospital for Tropical Diseases (HTD), London, which houses the UKHSA's National Parasitology Reference Laboratory (PRL). Between 1996 and 2018, the PRL reported 666 cases to UKHSA (then Public Health England), an average of 29 (range 3 to 59) new cases per year [personal communication]. These were predominantly CL (223 laboratory-confirmed cases between 1998 to 2009 (27)), with small numbers of VL and ML cases.

In 2005, a single probably autochthonous case of CL was reported in scientific literature: a patient who had no recent travel history but who distinctly recollected having developed the skin lesion after an insect bite in Surrey. The source of infection was thought to be an imported infected sandfly (28). Additionally, venereal transmission was implied in a case from the 1950s, in which a CL lesion in a woman with no travel history was traced back to an asymptomatic

recurrence of VL, originally acquired in Africa, in her husband (29). To our knowledge, these are the only autochthonous cases of human leishmaniasis in the UK.

There is no specific surveillance for non-notifiable animal diseases. Cases in companion animals were collected by Defra's Dog and Cat Travel And Risk Information (DACTARI) voluntary reporting scheme during 2003 to 2008, but have not been routinely recorded since. DACTARI recorded 40 laboratory-confirmed CanL cases, in addition to 2 notifications from 2001 to 2002 (30). The origin of these reports was mainly through the Pet Travel Scheme, 9 through quarantine, and 3 were cases with unknown travel origin. Studies by the University of Bristol suggest that the true number of cases is much larger (31, 32). Aiming to quantify the CanL reservoir in the UK, the 2005 to 2007 study recorded 257 laboratory-confirmed cases, but this only included dogs diagnosed at, or advised on by, the University of Bristol (32). It was estimated that 96% of cases for which a travel history was known had spent at least 6 months in endemic countries. A more recent study estimated prevalences of clinical CanL to be ranging from 0.007 to 0.04%, with the highest values in southern England (33).

In 2019, 2 autochthonous cases of CanL were identified in dogs that had no history of travel outside the UK (26, 34). The first dog was presumed to be infected through direct contact with another dog in the same household, which had originally been imported from Spain and was euthanised after a diagnosis of CanL 6 months earlier (34). The second dog had no history of contact with known CanL-infected dogs, but its owners had recently holidayed in Spain. Although the authors speculated that the owners could have brought back an infected sandfly in their transport, luggage, or clothes, this was considered unlikely. However, infection through incidental socialising with an infected dog could not be excluded (26).

The possibility of sporadic autochthonous cases of CanL in the UK had previously been suggested (but not proven) (32, 35). The reports are consistent with similar cases of non-vectorial transmission of CanL from other non-endemic settings (including the USA, Germany and Finland). These include demonstrated transplacental/vertical transmission (36, 37); suspected venereal transmission (36, 38); and suspected transmission through wounds or bites, acquired during fights or play with other dogs in the same household or kennel (38 to 42). CanL can also be transmitted via blood transfusions (43, 44, 45).

Are there routes of introduction into the UK?

Outcome: Yes/no

Quality of evidence: Good

Yes/No. While individual phlebotomine sandflies could accidentally be imported from endemic areas, for example, in luggage of returning travellers, they are fragile and have specific geospatial, temperature and humidity requirements, and are thus not expected to survive journeys by aircraft, or to establish widely in the UK, even if in the intermediate or longer term, climate change may expand the natural range of phlebotomine sandflies.

Leishmania spp. could also be imported into the UK by humans or domestic animals (particularly dogs) infected abroad or by imports of contaminated blood, blood products or germinal products. Plasma, cellular fraction and whole blood are also a risk, due to parasite presence in macrophages and other phagocyctic cells, and as free-living amastigote stages in plasma.

Per year, the Hospital for Tropical Diseases in London sees approximately 2 human cases of VL (46, 47) and 20 cases of CL (27), all imported. About 75% of the VL cases reported between 1985 and 2013 (n < 100) were acquired in the Mediterranean, with fewer cases acquired in Africa and Asia, and one in South America. The CL cases reported between 1998 and 2009 (n = 223) were mostly imported from Central and South America (57%), and Asia (19%). These are probably underestimates of case numbers, given the large proportion of asymptomatic and subclinical infections and the lack of surveillance. Nonetheless, imported infections are few, considering the large numbers of travellers to and migrants from endemic areas. (The WHO Global Health Observatory database shows 21 imported CL cases in 2017 and 17 in 2016. For VL cases, there was no data.)

Humans infected in endemic areas may be the source of onwards transmission via blood transfusions, shared needles (for example, outbreaks in IDU in Spain), sexual contact or congenital transmission. These non-vectorial modes of transmission are considered extremely rare, and would not lead to endemicity of leishmaniasis.

Infected dogs with travel history to endemic areas could be responsible for direct transmission via bites, venereal or vertical transmission, or (theoretically) via donated blood used for transfusions (48). Canine blood transfusions are on the rise, and over 10,000 dogs in the UK are now registered as blood donors. To qualify as donors, dogs need to meet certain criteria such as being in general good health and having a normal temperature, heart rate and respiration. Among other requirements, owners must also confirm that the dog has not been abroad. However, because of prohibitive costs, formal testing is not conducted for bloodborne diseases that are not prevalent in the UK (49). The adoption of harmonised rules for travelling with pets to the UK in 2012 has meant there has been an increase in the number of dogs of travelling to the UK. The majority (80%) are UK origin which are returning from a visit to Europe.

Dogs from rehoming centres in endemic areas could be considered a high risk group for leishmania, as indeed would any dog which had spent time in an endemic country. Although insecticide treatment could be used to prevent sandfly bites, it is not known how frequently or how effectively it is used generally in Europe.

Are effective control measures in place to mitigate against these routes of introduction?

Outcome: No

Quality of evidence: Good

No. There are no effective control measures against introduction of phlebotomine sandflies into the UK. Additionally, surveillance for phlebotomine sandflies is currently limited in the UK. However, in Europe, the European Centre for Disease Prevention and Control (ECDC) and the European Food Safety Authority (EFSA) have established VectorNet, an initiative to collect data on vectors of human and animal diseases, including phlebotomine sandflies (50). This network regularly produces maps showing the distribution of phlebotomine sandfly detections in Europe (25).

There are no requirements for travelling pets or companion animals to be tested for Lesihmaniosis prior to or after travel. This is not a notifiable disease in the European legislation nor a reportable or listed disease in animals in the UK. While there is guidance available to pet owners who take their animals abroad to endemic areas, it is not known if these preventive measures are widely used. Methods to limit exposure to sandflies in endemic areas include staying inside and keeping dogs inside during night time when sandflies are active (sunset to sunrise), and the use of insecticide sprays, insecticide-treated bednets, and protective clothing. For dogs, additional preventive measures include deltamethrin-impregnated collars; this reduced the proportion of phlebotomine sandflies that took blood meals and survived by over 90% for at least 8 months after the collars were applied (51).

There are also 2 vaccines (CaniLeish® and Letifend® (52) licensed in the UK and EU that provides partial protection against active infection and clinical disease (14, 53). Prophylactic medication with domperidone (a serotonin agonist) is being investigated in dogs in endemic area, but data on efficacy and safety is currently limited (14). Allopurinol, a parasite protein inhibitor used as treatment for leishmaniosis could also have some prophylactic effect but again, nothing has been licensed.

There are no cost effective steps to prevent *L infantum* from becoming established in the UK, given there are no sandfly vectors so this would only concern preventing the establishment of small household transmission foci. These measures could include voluntary screening of dogs that are imported from *Leishmania*-endemic regions, implementing similar screening among the contact population of any dogs presenting with CVL, regular follow-up to ensure conversion does not occur (an important consideration given the chronic nature of the infection and often delayed disease presentation), exclusion of subclinically infected dogs from blood donation, vaccination and use of topical insecticides for dogs travelling to endemic areas (49).

Do environmental conditions in the UK support the natural reservoirs or vectors of disease?

Outcome: No

Quality of evidence: Good

No. For the majority of cases a vector-reservoir transmission cycle is required therefore if one part of the cycle does not exist, transmission cannot be completed.

The *L. infantum* main reservoir is the domestic dog, although wild canids, cats, and hares have also been known to act as reservoirs. There are around 8 million domestic dogs in the UK, but only a small proportion travel to endemic areas for substantial periods of time there each year and could potentially return with infection. The non-vectorial transmission cycle can occur in the UK environment. In Europe, transmission cycles for *L. donovani* and *L. tropica* are anthroponotic – humans are the principal reservoir host and could present a non-vectorial transmission cycle. Reservoir hosts for these species are therefore abundant in the UK.

The vectors of Old World *Leishmania* species, *Phlebotomus* sandflies, are not currently present in the UK. Phlebotomines require a warm and humid environment, and in Europe their range is largely limited to the Mediterranean basin. However, entomological studies in Europe have documented a northwards expansion of the range of several sandfly species implicated in *Leishmania* transmission (54). Particularly, as of January 2019, the established vector *Phlebotomus perniciosus* and the suspected vector *Phlebotomus mascittii* have been detected as far north as northern France, Belgium (*P. mascittii* only), and western Germany (25, 55, 56).

Will there be human exposure?

Outcome: No

Quality of evidence: Good

No. Between humans, non-vectorial transmission is considered extremely rare. Direct dog-to-human transmission has never been reported. *L. infantum* in dogs produces some skin lesions and the parasites themselves can be occassionaly found in skin biopsies around the lesions or chancres. Parasites can be found in the cell rich blood fractions, organs and plasma of infected animals, therefore there is only a very small theoretical possibility that a dog with an open wound would bite a human and transfer blood. The parasites are not present in saliva or respiratory fluids.

Hence, other theoretical transmission cycles (blood transfusion, organ transplantation, sexual transmission) can be ruled out for dog to human transmission, and, in the absence of sandflies, the limited numbers of *Leishmania*-infected dogs or other reservoir species pose few risks to humans.

Are humans highly susceptible?

Outcome: No

Quality of evidence: Good

No. The majority of human infections with *Leishmania sp*., particularly *L. infantum and L. donovani*, are thought to be asymptomatic (57, 58, 59). In symptomatic infections, the spectrum of severity is broad, and can range from subclinical to severe disease. Immunocompromised people and those at risk of malnutrition are more likely to develop clinical VL. In the EU each year there are a few hundred cases of locally acquired *Leishmania* reported. Nevertheless, there is likely to be underreporting and delayed diagnosis for the less severe cases. The prognosis of severe VL is poor without treatment.

Is this disease highly infectious in humans?

Outcome: No

Quality of evidence: Good

No. There is no human to human transmission without the presence of a sandfly stage unless through blood donation and organ transplantation. Humans who are infected carry the parasite in the cells of the reticuloendothelial system or phagocytic cells such as macrophages.

Outcome of probability assessment

The **probability** of human infection with canine *Leishmania* species in the UK population is **very low.**

Step 2: Assessment of the impact on human health

The scale of harm caused by the infectious threat in terms of morbidity and mortality: this depends on spread, severity, availability of interventions and context. Please read in conjunction with the Impact Algorithm found at Annex B.

Is there human-to-human spread of this pathogen?

Outcome: No

Quality of evidence: Good

No. For *Leishmania sp.,* non-vectorial human to human transmission is exceptionally rare. Indirect human-to-human spread, via sandflies, is the most common transmission route for the 2 anthroponotic species, *L. donovani* and *L. major*. For *L. infantum*, a domestic zoonotic vector borne transmission cycle is most common.

Is there zoonotic or vector borne spread?

Outcome: Yes

Quality of evidence: Good

Yes. *Leishmania* parasites are transmitted between mammals by sandfly species in the genera *Phlebotomus* (in the Old World) or *Lutzomyia* (in the Americas). Different parasite species have different reservoir hosts and main vectors. Most species are zoonotic, with the exception of *L. donovani* and *L. tropica* that are primarily anthroponotic.

- *L. infantum* (zoonotic VL): domestic dogs, foxes, jackals, rabbits, hares, rodents, cats, other mammals. Various *Phlebotomus spp*.
- *L. major* (zoonotic CL): rodents, dogs. Vector = *Ph. papatasi* [primary form in WHO EURO region]

Direct transmission of visceral leishmaniasis in the absence of sandfly vectors from dogs to humans has never been documented.

For zoonoses or vector-borne disease is the animal host or vector present in the UK?

Outcome: Yes/no

Quality of evidence: Good

Yes/No. Phlebotomine sandflies are the only proven vector for *Leishmania* species in Europe, and are not currently known to be present in the UK. The primary reservoir host for *L. infantum*, the agent of zoonotic VL in Europe and occasionally CL, is the domestic dog, with secondary reservoir hosts including wild canids, wild rabbits, hares, rats and humans. Hence, suitable reservoir hosts are present in the UK.

Is the population susceptible?

Outcome: Yes

Quality of evidence: Good

Yes. There is currently no registered vaccine for human leishmaniasis. Recovery from natural leishmanial infection is in many cases immunising against further infection (8), however treatment for severe cases of VL is necessary and often complex and lengthy.

Does it cause severe disease in humans?

Outcome: Yes/no

Quality of evidence: Good

Yes/No. The majority of human *Leishmania* infections are asymptomatic. The most common clinical form, CL, is the least severe, and is often self-healing. VL does cause severe disease and is often fatal if left untreated. Immunosuppression, and particularly coinfection with HIV, is an important risk factor for severe disease, relapses after treatment, and death. Antiretroviral treatment reduces the development of the disease, delays relapses and increases the survival of the coinfected patients. As of 2021, *Leishmania*-HIV coinfection has been reported from 45 countries. High *Leishmania*-HIV coinfection rates are reported from Brazil, Ethiopia and the state of Bihar in India (2).

Would a significant number of people be affected?

Outcome: No

Quality of evidence: Good

No. In the absence of sandflies, only travellers to endemic areas. On very rare occasions, humans could be infected after accidental importation of sandflies or by non-vectorial transmission, but these would not contribute significantly to case numbers. Direct transmission from dogs to humans has never been documented.

Is it highly infectious to humans?

Outcome: No

Quality of evidence: Good

No. Infection of humans normally requires a bite by an infected female sandfly. Even in areas of the Mediterranean where L. infantum is highly endemic and sandflies are present, incidence in humans is low (for example, in Spain, 100 to 200 human cases are reported each year). In non-endemic areas where sandflies are absent, infections in humans with no history of travel, presumably acquired by means of an imported sandfly or through non-vectorial transmission, are extremely rare.

Are effective interventions available?

Outcome: Yes/no

Quality of evidence: Good

Yes/No. The prevention and control of leishmaniasis in highly endemic areas or in epidemic situations require a combination of intervention strategies, including vector control, disease surveillance and early diagnosis, effective case management, and control of the animal reservoir.

Preventative measures or vector control

When visiting endemic areas, preventive measures should be taken to limit exposure to sandflies. These include staying inside and keeping dogs inside during night time when sandflies are active (sunset to sunrise), and the use of insecticide sprays, insecticide-treated nets and protective clothing. For dogs, additional preventive measures include deltamethrin-impregnated collars, and 2 vaccines (CaniLeish® and Letifend®(56)) that provide partial

protection against active infection and clinical disease (14, 53). The main controversy regarding CanL vaccines is that they do not block the establishment of infection. This could potentially keep an infected dog (without clinical disease) healthy, but possibly able to spread infection to people and dogs. Moreover, all vaccines are recommended solely for clinically healthy and seronegative dogs (52). Prophylactic medication with domperidone is being investigated in dogs in endemic area, but data on efficacy and safety is currently limited (14). Allopurinol has also been investigated as a preventive treatment but again, not proven.

Surveillance and early diagnosis

In dogs, early diagnosis improves the chances of recovery, and treatment reduces infectiousness, but will not prevent a relapse, hence awareness of the disease among owners and veterinarians is important.

Case management

Leishmaniasis is treatable in humans, with safe and effective treatments available particularly for VL. Pentavalent antimonials have long been the first-line treatment, but, particularly where resistance has developed, this is being replaced by miltefosine, paramycin and/or liposomal amphotericin B (60). Treatment reduces the risks of developing disabling complications and of death, however its success is dependent on the patient's immune function. Treatment options are more limited for CL, but oral treatments are being developed (61).

For canine leishmaniosis treatment is available, but this is a long-term (often life-long) regimen. It slows down the progression of infection and improves disease manifestation, as well as reducing infectiousness, but its efficacy in eliminating of parasites is limited (14).

Control of the animal reservoir

Early recognition, diagnosis and treatment of clinical infection is vital to improve prognosis, prevent spread and allow early long-term management planning for individual patients. Raising awareness and vigilance for leishmaniosis as well as other common parasites in imported pets is important. The implications for canine blood banking facilities and the potential for transmission in the absence of competent sandfly vectors, need further work, as the practice is not well understood.

Outcome of impact assessment

The **impact** of canine leishmaniosis on human health in the UK is **very low** to **moderate.**

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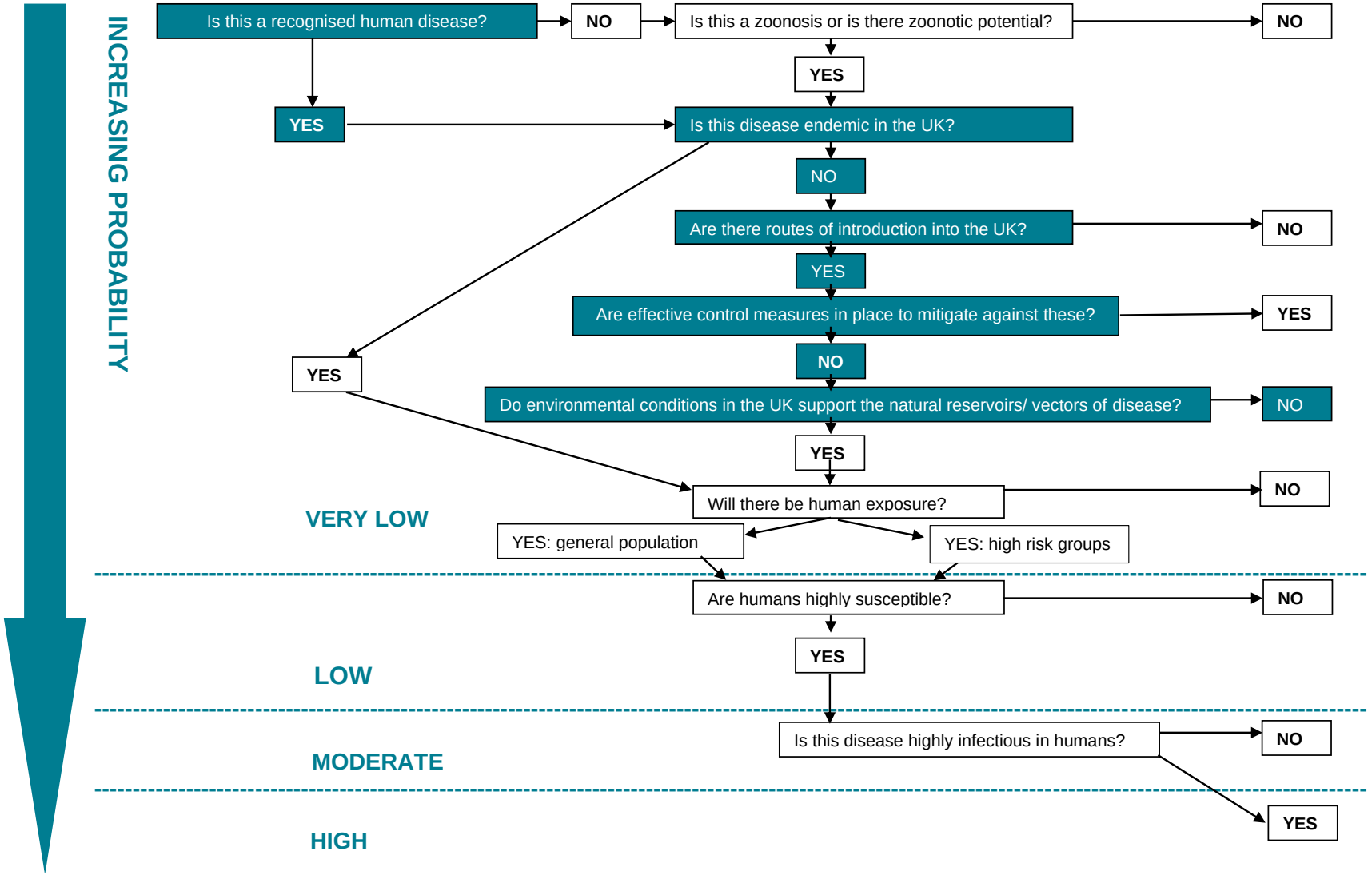
Annex A. Assessment of the probability of infection in the UK population algorithm



Annex B. Accessible text version of assessment of the probability of infection in the UK population algorithm

Outcomes are specified by a ✓ (tick) beside the appropriate answer. Where the evidence may be insufficient to give a definitive answer to a question, the alternative is also considered with the most likely outcome shown with ✓✓ (2 ticks) and/or the alternative outcome(s) with a ✓ (tick).

Question 1: Is this a recognised human disease?

Yes: go to question 3 ✓ (tick)
No: go to question 4

Question 2: Is this a zoonosis or is there zoonotic potential

Yes: go to question 3
No: probability of infection in UK population is very low

Question 3: Is this disease endemic in the UK?

Yes: go to question 7
No: go to question 4 ✓ (tick)

Question 4: Are there routes of introduction into the UK?

Yes: go to question 5 ✓ (tick)
No: probability of infection in UK population is very low

Question 5: Are effective control measures in place to mitigate against these?

Yes: probability of infection in UK population is very low
No: go to question 6 ✓ (tick)

Question 6: Do environmental conditions in the UK support the natural reservoirs/vectors of disease?

Yes: go to question 7 ✓ (tick)
No: probability of infection in UK population is very low

Question 7: Will there be human exposure

Yes: high-risk groups: Go to question 8
No: probability of infection in UK population is very low ✓ (tick)

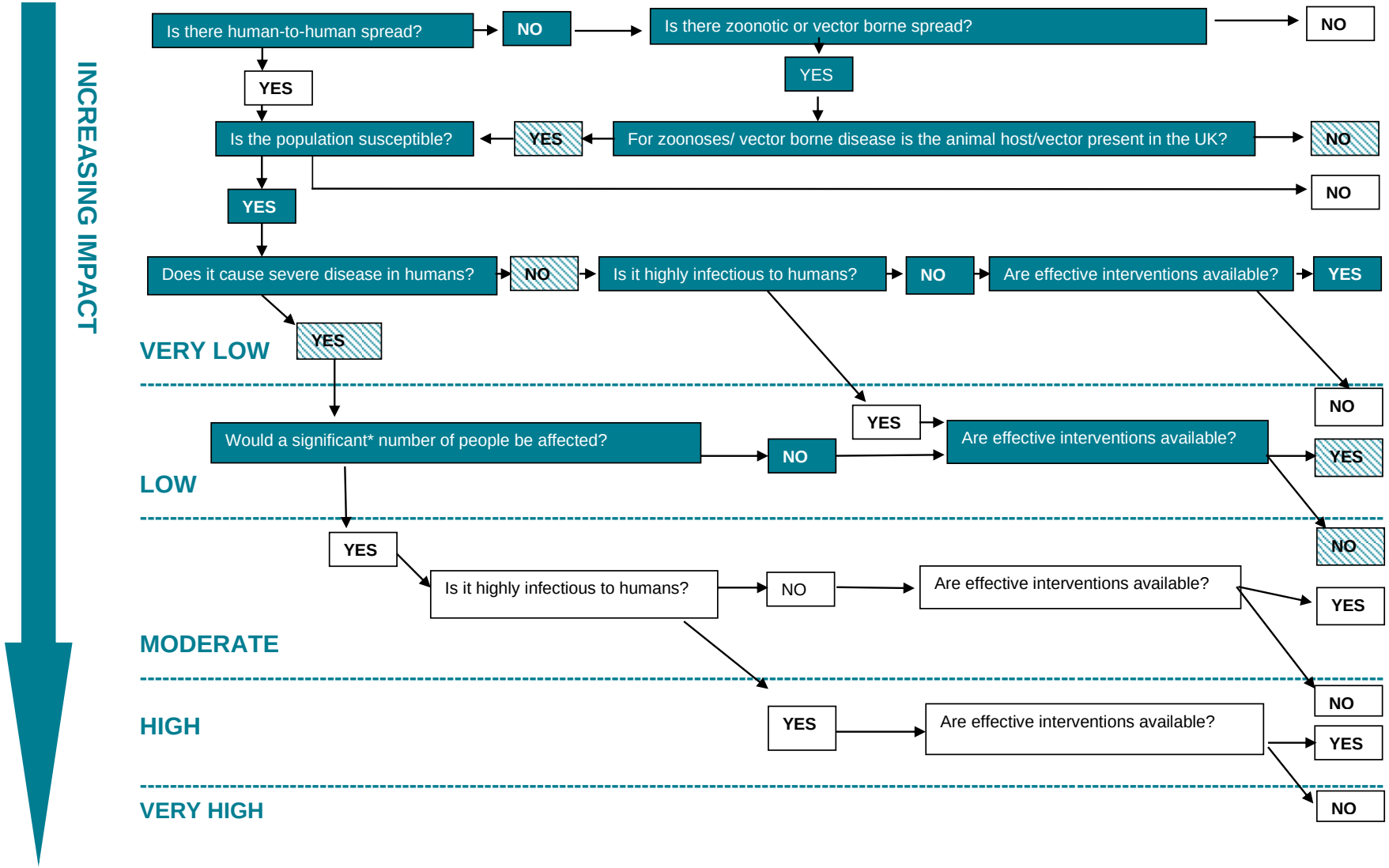
Question 8: Are humans highly susceptible?

Yes: go to question 9
No: probability of infection in UK population is low

Question 9: Is this disease highly infectious in humans?

Yes: probability of infection in UK population is high .
No: probability of infection in UK population is moderate.

Annex C. Assessment of the impact on human health algorithm



Annex D. Accessible text version of assessment of the impact on human health algorithm

Outcomes are specified by a ✓ (tick) beside the appropriate answer. Where the evidence may be insufficient to give a definitive answer to a question, the alternative is also considered with the most likely outcome shown with ✓✓ (2 ticks) and/or the alternative outcome(s) with a ✓ (tick).

Question 1: Is there human-to-human spread?

Yes: go to question 4
No: go to question 2 ✓ (tick)

Question 2: Is there zoonotic or vector borne spread?

Yes: go to question 3 ✓ (tick)
No: impact on human health in the UK is very low

Question 3: Is the animal host or vector present in the UK?

Yes (animal host): go to question 4 ✓ (tick)
No (vector): impact on human health in the UK is very low ✓ (tick)

Question 4: Is the population susceptible?

Yes: go to question 5 ✓ (tick)
No: impact on human health in the UK is very low

Question 5: Does it cause severe human disease?

Yes (immunocompromised individuals): go to question 8 ✓ (tick)
No: go to question 6 ✓ (tick)

Question 6: Is it highly infectious to humans?

Yes: go to question 9
No: go to question 7 ✓ (tick)

Question 7: Are effective interventions available?

Yes: impact on human health in the UK is very low ✓ (tick)
No: impact on human health in the UK is low

Question 8: Would a significant number of people be affected?

Yes: go to question 10
No: go to question 9 ✓ (tick)

Question 9: Are effective interventions available?

Yes: impact on human health in the UK is low ✓ (tick)
No: impact on human health in the UK is moderate ✓ (tick)

Question 10: is it highly infectious to humans?

Yes: go to question 12
No: go to question 11

Question 11: Are effective interventions available?

Yes: impact on human health in the UK is moderate
No: impact on human health in the UK is high

Question 12: Are effective interventions available?

Yes: impact on human health in the UK is high
No: impact on human health in the UK is very high

About the UK Health Security Agency

The UK Health Security Agency is an executive agency, sponsored by the Department of Health and Social Care.

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For queries relating to this document, please contact: HAIRS@phe.gov.uk

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