UK Health Security Agency

Enclosure AB/24/045

UKHSA Advisory Board

Title of paper	Core preparedness for vector borne diseases
Date	19th November 2024
Sponsor	Isabel Oliver and Susan Hopkins
Presenter	Jolyon Medlock and Alexandra Bramley

1. Purpose of the paper

1.1. The purpose of the paper is to provide an update on UKHSA's core preparedness for vector borne diseases (VBD), covering UKHSA's capabilities and coordination for emerging health threats from VBD with a specific focus on vector surveillance. This paper has had contribution from teams across the organization but several public health incidents in recent weeks and months have impacted on the work in this area including this paper. The paper does not cover the detail of the management of cases of VBDs many of which are high consequence infection diseases. A well-established approach to this is in place.

2. Recommendations

2.1 The Advisory Board is asked to:

a) **NOTE** – the activities underway at UKHSA to build its core preparedness on vector borne diseases.
b) **COMMENT** – on the current work and development work underway in UKHSA including any gaps in the approach

3. Background

3.1. Vector-borne diseases (VBDs) are caused by infections with a range of pathogens (parasites, viruses and bacteria) which are transmitted to humans and animals by blood-feeding mosquitoes, ticks, midges, sand-flies and fleas. The World Health Organisation estimates that they cause around 17% of the global burden of communicable diseases and claim more than 700,000 lives every year with the burden highest in tropical countries. In recent years increased changes in patterns of these diseases has been observed globally and it is attributed to climate and environmental change and changes in human behaviours such as increased travel and trade, urbanisation and changes in land use. Several additional vector-borne diseases have recently emerged in Europe, facilitated by global travel, trade and climate change.

3.2. In the UK, the most common VBD is Lyme disease with over 3,000 new clinical cases reported annually in England and Wales. There are no mosquito-borne infections currently endemic in the UK that are currently causing human disease but several

hundred travel associated cases of infections such as dengue and malaria are detected every year.

3.3. UKHSA maintains surveillance of cases of VBD and undertakes risk assessments to the UK population. The Health Security Risk Assessment (HSRA) is a systematic assessment process that compares and contrasts the range of health threats for which the Agency is responsible, to support planning and preparedness activities. The Human Animals Infections Risk Surveillance (HAIRS) also perform horizon scanning and risk assessments. These risks from VBD to the UK population are increasing as a result of climate and environmental change, with all four of these infections reported from continental Europe, and Tick-Borne Encephalitis (TBE) recently emerged in the UK.

3.4. Changes in weather and climate can directly affect the biology and activity of vectors and the pathogens they transmit and, in the context of climate change, we need to expect warmer and wetter weather conditions, including weather such as flooding and heatwaves which will exacerbate VBD risk. Rain is vital to vector survival: mosquitoes need water for their development and humidity is also vital to the survival of certain tick species. Warmer temperatures result in faster vector development, increased survival, and increased biting rate. Vector distribution is altering with climate change: some countries that would previously have been too cold for mosquito vectors to establish, including the UK, are increasingly meeting the conditions necessary for them to breed and survive.

3.5. Over the past two decades there have been increasing numbers of vector-borne diseases acquired in parts of Europe in particular West Nile virus and Dengue but cases of other VBDs such as Crimean-Congo hemorrhagic fever (CCHF) and Zika virus are also being reported. Figures published by the European Centre for Disease Prevention and Control (ECDC) show that there have been more than 1200 locally acquired cases of West Nile virus (WNV) across 19 countries in Europe so far this year (to 2nd October), surpassing the number reported in the same period last year. A 8% case fatality rate has been recorded. Travel associated cases of many VBDs are also rising due to increases in endemic countries. There have been >200 dengue cases acquired in Italy this year, the highest record in recent times, with 85 reported in France. Annex A contains a map of the distribution of the Aedes mosquito that transmits some of these infections.

4. Vector borne diseases of public health importance in the UK.

4.1. VBD cause a range of different illnesses that vary in severity. Annex B has a summary of the VBD of particular public health importance in the UK.

- Lyme disease is the most prevalent VBD in the UK. It presents with a typical rash and fever, A short course of oral antibiotic therapy early in infection results in cure for the vast majority. However, if untreated, some cases of Lyme can cause a variety of complications including paralysis, meningitis, joint inflammation, and heart inflammation.

- Many people infected with WNV do not develop symptoms, however approximately 20% present with a causes a flu-like illness with headaches and muscle pains that can take a prolonged time to recover and about 1 in 150 people infected develop neurological disease, including meningitis and encephalitis with 10% of those who develop neurological disease, dying.

- Dengue is asymptomatic in most people. When symptoms occur, they can include high fever, muscle and joint pains, headache, nausea, vomiting and rash. Most people recover after a few days, however some people, particularly those infected for a second time, develop a severe form of disease including bleeding and organ damage.

- Infection with Chikungunya virus is associated with fever, rash and often disabling joint swelling and pain. Long recovery times of more than 3 months are seen in more than 40% of those infected, and complications involving the heart and eyes are possible.

- Zika is associated with non-specific flu-like symptoms, fever and rash. Most who are exposed will have infection with minimal or no symptoms. Zika infection, with or without symptoms, during pregnancy is associated with congenital abnormalities in the unborn child in up to 6% cases. Zika infection can also trigger Guillain Barre syndrome, which can cause life threatening and disabling paralysis.

- TBE virus, when symptoms occur, can comprise of fever, tiredness, headache, muscle pain and nausea. In 10% of people the disease affects the nervous system including meningitis and encephalitis resulting in confusion and/or paralysis.

- CCHF virus illness includes a pre-hemorrhagic phase with high fever, muscle pain, abdominal pain, vomiting and dizziness. And a hemorrhagic phase with bruising and internal bleeding. It is a cause of a severe illness that can result in fatal bleeding and organ damage, and death in up to 30% of those infected.

- Tularemia, the disease causes a wide range of clinical syndromes in humans, ranging from skin ulcers, painful glands to more severe lung infections including pneumonia and respiratory failure. Tularemia can be fatal if the person is not treated with appropriate antibiotics.

- Usutu virus is an emerging infection and the role in human infection is much less well understood. Infection in humans is believed to be most often asymptomatic or causes mild illness, however some cases of neurological complications such as encephalitis or meningoencephalitis have been reported. They are thought to be mild and often have no symptoms, however nervous system damage, similar to WNV, neuroinvasive disease has been reported in a few cases from Europe, typically in patients living with pre-existing conditions.

4.2. In this context, the UK must be prepared to respond to greater numbers of imported cases from VBDs including from new geographical areas such as Europe, and for vectors carrying these infections to be able to survive, allowing viruses to spread. If the establishment of new vectors is not controlled, then we would expect to see, in coming decades, locally acquired cases of these diseases in the UK. Prevention strategies include rapid recognition and diagnosis of imported human cases, wildlife and animal surveillance for potential reservoirs, and vector control to prevent transmission to humans from imported cases or animal reservoirs. For some VBDs (e.g. *F. tularensis),* environmental surveillance may also be necessary. Managing incursions of new vectors now will help contain and reduce the risk to public health. Delaying these incursions will also provide time for developments such as new vaccines for dengue and chikungunya and novel strategies for vector control to become available for public health control. UKHSA also needs to work with suppliers on development of diagnostics, vaccines and therapeutics for these diseases where there are gaps or improvement is required.

5. UKHSA's responsibilities

5.1. UKHSA is responsible for protecting health from infectious diseases and it has a responsibility for preparedness for Emerging Infectious Diseases. Our responsibilities in relation to VBD include surveillance both of vectors and the illnesses they carry as well as of human cases of VBD. We are responsible for detection and the diagnosis of rare VBDs. We assess the risk to public health, investigate and control risks of transmission working with The Animal and Plant Health Agency (APHA) and other partners and provide public health guidance and advice. We work with partners to understand and control the risks to public health. In the context of the increasing risk from VBD UKHSA has established a task and finish group to map its capabilities and assess any gaps.

6. Detection of VBDs in the UK to date

6.1. The *Aedes* family of mosquitoes is the vector for important diseases such as dengue, chikungunya and Zika. The distribution of the Asian tiger mosquito (*Aedes albopictus*) has expanded very significantly in recent decades, and parts of the UK are already suitable environments for *Aedes albopictus.* Since 2022, Europe has detected ~100-300 locally acquired dengue cases each year with the first locally acquired case of dengue reported in Paris in 2023, and again in 2024.

6.2. UKHSA's Centre for Climate and Health Security (CCHS) Medical Entomologists have been working with local partners to manage incursions of this mosquito. Since 2016 invasive mosquitoes have been detected on eight occasions, most recently Aedes albopictus on a main highway station in Kent in August 2024 and Aedes aegypti in a cargo warehouse at Heathrow in 2023. UKHSA has managed these as standard incidents.

6.3. Deer serosurveillance studies by UKHSA Virology team demonstrated the presence of TBEV in the UK and within the past 4 years The Rare and Imported Pathogens Laboratory (RIPL) have detected for the first-time cases of Tick-borne Encephalitis (TBE) in the UK. Since 2019, there have been 5 cases of confirmed or probable TBE acquired within the UK, linked to tick exposures in Hampshire, Scottish Highlands and the North York Moors. The cases map to areas where tick and deer surveillance has previously identified the presence of TBE virus.

6.4. In 2023, a confirmed case of tularemia was identified with investigations involving teams across UKHSA and partner. The source of the infection remains unclear, however it is seems to have probably been acquired in the UK. If established in the UK, vectors including ticks and mosquitos will likely contribute to the transmission of this infection.

6.5. Our surveillance has detected a continued increase in where the Lyme Disease vector is found, with an associated increase in Lyme disease cases. Our surveillance system has also detected the presence of exotic ticks in local species (*Hyalomma* vectors of Crimean Congo Haemorrhagic Fever virus) during heatwave events, and non-native ticks acquired through imported pet movements, which provide an indication of future risk. The importation of pets (primarily dogs) provides a risk of importing ticks, as well as a number of other blood borne VBD infections such as *Leishmania* and *Dirofilaria*, both of which can cause human disease.

6.6. We are working with academic partners to understand the driving forces behind this continued increase in tick numbers in the UK. There is clear evidence that the spread of the Lyme disease vector is linked to changes in deer populations, which are currently at very high densities. Recent research by UKHSA and academic partners teams has shown the impact of gamebirds on increasing infection rates of Lyme bacteria in ticks.

6.7. We are working with animal and environmental health partners to monitor the emergence of mosquito-borne Usutu and West Nile viruses in southeast England since its detection in 2020. This work is setting the bar for multi-disciplinary one health collaborations which are critical to preparedness and response to emerging zoonotic infections, with UKHSA providing entomological surveillance expertise and human surveillance testing. This work will now be expanded through the new Health Protection Research Units.

6.8. Since the start of 2023, there have been seven cryptic malaria cases (locally acquired in people who have not travelled outside the UK with no clear source) reported to UKHSA with subsequent investigations to assess the potential for local transmission of malaria. To date, all cases have been attributed to baggage, airport or transfusion transmission, although with imported malaria cases increasing and with increasing summer temperatures, the potential for local transmission will increase.

7. UKHSA's vector surveillance programmes

7.1. Since the establishment of UKHSA and CCHS, there has been a three-fold increase in vector surveillance capacity through increases in core budget and external research funding from UK Research and Innovation (UKRI). The team manage more than 1100 invasive mosquito traps each year, receive up to 1000 tick submissions from the public, organize, Borrelia/tick surveillance across 75 sites in National Parks/landscapes and run nationwide mosquito traps at >250 locations.

7.2. We are currently involved in a number of academic research partnerships funded by both UKRI and NIHR HPRU on tick-borne diseases. These include understanding the impact of woodland creation schemes and gamebird releases on Lyme disease ecology, as well as several landscape scales studies on the importance of deer and landscape connectivity of tick-borne disease transmission. These projects are one health, working with ecologists in the Centre for Ecology and Hydrology, and veterinary colleagues in the APHA, including investigations into tick-borne disease transmission and novel interventions at farms and in national parks and landscapes.

7.3. ***Invasive mosquito surveillance***: UKHSA coordinates invasive mosquito surveillance in England working with local authorities (LAs), APHA, academia, the Chartered Institute of Environmental Health (CIEH) in England. Our activities were scaled up after the global Zika outbreak and have been enhanced further as part of the establishment of the CCHS. We undertake point of entry surveillance (sea-, airports, inland border facilities, distribution warehouses, truck stops) and enhanced surveillance in urban centres in London and the Southeast, particularly where environmental conditions could currently support survival of invasive mosquitoes. All detections are controlled through Health Protection Team (HPT) led incident response, in collaboration with the LA and technical support from UKHSA entomologists. See Annex C for a photograph of how mosquitoes are managed at truck stops.

7.4. ***Tick surveillance*:** Existing UKHSA Tick Surveillance programmes have detected a continued expansion in the range of the Lyme disease tick vector, coupled with an increase in Lyme disease cases and the emergence of TBEV. This data is enabling UKHSA to develop metrics on tick-bite incidence, in order to raise awareness of tick-bites and tick-borne, directly to the public, as well as to local authority public health teams.

7.5. Although UKHSA's remit is specific to England, UKHSA has been supporting the four nations, crown dependencies and overseas territories at both a national and local level. No other UK Government public body has a specific medical entomology team or comparable capability. UKHSA shares surveillance data with the devolved administrations (DAs), and we support vector surveillance in the DAs upon request. Specific initiatives with DAs include:

- supporting the set-up of Mosquito Scotland, a project to conduct vector and arbovirus surveillance for mosquito-borne disease in Scotland, funded through UKRI.
- Providing training and support to local authorities in Wales for invasive mosquitoes at the request of Welsh government.
- UKHSA also supports Northern Ireland to coordinate invasive mosquito surveillance.
- At the request of Jersey and Guernsey, UKHSA provides assistance in tick and invasive mosquito surveillance, as well as detections of Lyme Borrelia in ticks in Jersey.
- As part of the Foreign, Commonwealth and Development office (FCDO)-funded work in the UK Overseas Territories (UKOTs), UKHSA supports Gibraltar and the six UKOTs in the Caribbean on dengue prevention and control. This also includes responding to emerging outbreaks of mosquito-borne disease, provide support post hurricanes, as well as procuring UKRI funds to develop research on nature-based solutions to mosquito-borne disease management.

7.6. ***Sentinel surveillance:*** Previously sentinel surveillance (surveillance that is conducted at certain sites) has been used for academic research projects in limited studies/geographic areas. The UK-wide approach used in the deer serosurveillance study showed the value of this approach identifying a new pathogen, TBE, which had been imported into the UK through migrating birds and has become established in distinct parts of the country. This would not have been detected by tick surveillance alone. Mammalian sentinels provide geographic location as well as extended sampling timescales due to the extensive vector exposure and burden over successive seasons of vector activity. This approach needs to be expanded to cover gaps in geographic coverage and aligned with APHA as the same sample set has utility for surveillance of both VBD affecting livestock and zoonotic infections e.g., deer serosurveillance samples have been used to screen for SARS-CoV-2 exposure following reports of deer as wildlife reservoirs in the USA. Sampling is undertaken voluntarily by wildlife managers as part of existing deer management making surveillance affordable.

8. Vector control programmes

8.1. VBD pathogens of public health importance have been mapped in a Horizon Scanning Exercise (Annex D). Vector-borne disease activities and capabilities across are currently being mapped to assess capabilities across relevant disciplines for these pathogens.

8.2. We have a national plan for invasive mosquitoes that defines how incursions are managed and guidance developed in collaborations with the Chartered Institute for Environmental Health (CIEH). As mentioned above, UKHSA has led surveillance and response to increasing detections of Usutu virus (>90 positive mosquito pools in 2024) and 7 locally acquired cryptic malaria cases since the start of 2023, working with local authorities to, in the case of invasive mosquitoes, implement the existing contingency plan. UKHSA is working with partners including port health, APHA and local authorities to strengthen contingency plans to manage incursions of dengue and it is anticipated they will require additional UKHSA vector surveillance capacity. Through funding from UKRI (i.e., not core-funded), UKHSA have supported enhanced One health surveillance projects to detect mosquito-borne viruses as part of ongoing transmission of Usutu virus.

8.3. Currently the dengue, chikungunya and Zika surveillance programmes are set up for imported cases only. Lyme disease surveillance is well established. Integrated surveillance bringing together data from vectors, VBD cases, and vector control measures to inform response currently does not currently exist within UKHSA, although it is being developed.

9. Detection and management of cases of VBD

9.1. The UKHSA Rare and Imported Pathogens Laboratory (RIPL) provides a frontline specialist testing service for HCIDs and many of the vector borne infectious diseases found in travelers coming into the UK. In addition, it also hosts the specialist Lyme testing service for England and Wales and links to the Public Health Scotland Lyme reference laboratory at Raigmore. RIPL has sets of diagnostic tests based on PCR and Serology methods for all the major vector borne diseases that it covers. The Laboratory is also a WHO Collaborating Centre for VHFs and Special Pathogens and has extensive links within Europe and equivalent labs across the world, enabling sample exchange and access to control material for IQA in addition to global External Quality Assessment schemes. The number of imported VBD cases per year vary depending on outbreaks but are increasing over time. On average, 1000-1200 imported VBD cases are detected through RIPL every year.

9.2. Diagnosis of imported and endemic VBD cases is undertaken by a combination of laboratory methods. A new project is underway looking at DNA sequencing of imported fever cases to confirm and improve diagnostic panels routinely used for acute infections. Further developments to improve serological diagnostic panels and differential diagnostics for related VBD pathogens and Lyme subspecies would provide better diagnostic accuracy and information on public health risks to both those travelling abroad and resident in the UK – these would require further funding for staff, training and equipment and collaboration with industry and academic groups.

9.3. For rare infections including high consequence ones, the Imported Fever Service (IFS) provides 24-hour, 7-days a week telephone access to expert clinical and microbiological advice. Hospital doctors across the UK can contact the IFS after discussion with the local microbiology, virology or infectious disease consultant. When a HCID has been confirmed by appropriate laboratory testing, cases in England should be transferred rapidly to a designated HCID Treatment Centre for clinical management.

10. VBD risk assessments

10.1. There are 4 VBD risks within the Health Security Threat Assessment (HSRA). These are zika, dengue, West Nile virus (WNV) and tick-borne encephalitis (TBE). These risks are assessed as scenarios which describe either an increased exposure to circulating pathogens in native vectors (i.e., TBE), the introduction and establishment of a non-native vector in the UK (i.e., Zika and dengue), or the introduction of a non-native pathogen within a native vector (i.e., WNV). Whilst the VBDs assessed within the HSRA pose a minor impact within the next 5 years, their impact will likely increase over time.

10.2. This year, using outputs from the HSRA, a deep dive into our capabilities against Dengue was conducted resulting in a range of VBD related recommendations through the Emergency Preparedness, Resilience, and Response preparedness cycle. This assessment has resulted in key recommendations to improve resource allocation, resilience and workforce agility, such as distributing expertise across Health Protection Teams (HPTs) nationwide to avoid regional bottlenecks, enhancing infrastructure to improve surveillance activity and speed up response times, and clarifying responsibilities between UKHSA and local partners to streamline and improve collaboration.

10.3. To date, scenarios from the HSRA have been used to support UKHSA's preparedness cycle (i.e., dengue risk), and form part of UKHSA's input to the Emerging Infectious Disease (EID) risk (R79) in the National Security Risk Assessment (the government's assessment of the most serious risks facing the UK). Whilst the Department of Health and Social Care (DHSC) are the risk owners for R79, UKHSA retains ownership of policy for EIDs and is therefore responsible for ensuring cross government readiness for an R79 risk.

10.4. Mathematical models have provided key evidence to support the control of VBDs: Our work includes producing commissioned reports on specific VBD threats (both present and future) based on mechanistic models of disease dynamics. These reports form part of the quantitative evidence base for systematic risk assessments.

10.5. The implications of climate change for VBD risk in the UK was most recently assessed in the UKHSA's 2023 publication, 'Health Effects of Climate Change in the UK' report. Highlights from this assessment were presented in the March 2024 Advisory Board paper, Core Preparedness for Environmental Hazards update. The paper emphasized that vector borne disease risk to the UK is increasing largely due to effects of climate and environmental change, particularly for mosquitoes, and our climate is now suitable for vector establishment. Experience from elsewhere in Europe has shown that once a non-native invasive mosquito species is established, it is difficult for it to be eliminated, highlighting the critical role of early and robust vector surveillance and control. As part of this, CCHS are working with the Data Dashboard team to host VBD data, as per recommendations from the Science and Research Committee.

10.6. An updated assessment, presented jointly by the UKHSA VBD Working Group is anticipated in 2025-26 and will integrate cross-Agency preparedness and response.

10.7. Work is underway across UKHSA and with partners to update the Contingency Plan for Invasive Mosquitoes which includes roles and responsibilities across both local and national partners should invasive mosquitoes become established.

11. International Comparison

11.1. There is significant international comparison to draw on from France's recent experience of managing dengue following an increase in dengue fever cases and our teams have visited France to learn from their experience. Specific learning includes:

- Legislation mandating that following a suspected human case of mosquito borne disease, the public health agency is responsible for coordinating and funding vector surveillance and control. This links to an emergency plan with multi-agency components and a dedicated budget of 5.5M Euros.

- Clear division of roles and responsibilities between national, regional and local teams.

- Formation of a permanent expert working group on vectors including epidemiology, entomology, vets, physicians, ecologists, virologists, and social sciences.

- Integrated surveillance and response data system, providing a view of cases, laboratory results, vectors, breeding sites, areas where controls have been applied with automated notifications to healthcare providers, vector control teams, and blood safety.

12. Strengthening our preparedness and response to VBDs.

12.1. We are bringing together skills and expertise across UKHSA into a programme of work to strengthen our preparedness to the growing risk from VBDs and are working with international partners such as France to learn from their experience. We have assessed the capabilities required to strengthen preparedness and response and identified that further investment is needed to strengthen lab facilities and capacity to enable upscaling of vector surveillance, sentinel surveillance and rapid testing of vectors for emerging VBD pathogens in line with increasing risk. To further increase our preparedness, currently being developed is the Emerging Infectious Disease (EID) Response Plan which sets out the key actions and processes specific to an EID incident response.

12.2. A programme of work has been scoped as part of preparedness for Emerging Infections and agreed with DHSC. Response to VBDs requires a One Health approach bringing together data on pathogens, animals, and humans with environmental data. UKHSA works with the Department of Environment, Food and Rural Affairs (DEFRA), APHA, local government and other partners it should be noted that some responsibilities lie outside UKHSA, such as routine vector control, which sits with local authorities.

12.3. Horizon scanning has been put in place as a first step to identify changing risk to the UK. Due to competing demands for response to the Mpox public health emergency of international concern (PHEIC), Marburg outbreak in Rwanda, and influenza A(H5N1), the vector borne disease preparedness work has been slowed. With the continued high pace of emerging infection events, designated resource for preparedness will need to be secured to ensure this can progress whilst new threats are managed.

12.4. The risks from VBDs are feeding into priorities for research and development. Priorities were identified in the Health Effects of Climate Change response and as part of our pandemic and epidemic preparedness work. Key VBD risks are included in our priority pathogen family's approach to inform R&D funding and shape the

programmes of work of teams across UKHSA including VDEC and the diagnostics accelerator. For example, UKHSA works closely with academia, industry and international partners including the Coalition for Epidemic Preparedness Innovations (CEPI) and the World Health Organisation (WHO) to support vaccine development and deployment to strengthen preparedness for VBD. UKHSA are working on tools which ensure that we have the capability to evaluate vaccines as they come into development and to enable support to safely speed up clinical trials.

12.5. As referenced in point 3.3, work is underway to enhance our internal resilience and ensure that UKHSA's core capabilities are prepared to respond effectively to evolving vector-related public health challenges. This includes key initiatives from the preparedness cycle now integrated into business planning, such as improving data integration across systems, expanding laboratory capacity, updating the National Invasive Mosquito Plan, developing operational procedures for rapid response, and strengthening communication strategies. These efforts are essential to building a robust and agile response framework within UKHSA, enabling us to manage risks more proactively and efficiently in collaboration with external partners. See Annex E for the key recommendations from the preparedness cycle.

12.6. Further modelling is required to inform the Reasonable Worse Case Scenario on VBD as described in the NSRA to inform contingency planning across Government and the healthcare sector. For example, the NHS may need to consider and plan for additional clinical capacity and the demand for public advice and information.

12.7. Climate change adaptation work by national and local government should incorporate consideration of VBD risks for example into urban and rural planning framework to build resilient communities and natural habitats. The UKHSA Centre for Climate and Health Security is working with partners to ensure that health impacts of climate change inform policy and action. Action is needed across sectors including, for example, the pest control industry that should be ready and trained for emerging vector issues.

13. Requirements and next steps in strengthening preparedness

13.1. UKHSA holds core response capabilities enabling it to respond at pace to a range of health security threats, it regularly reviews and exercises these capabilities, and where necessary will seek Ministerial decisions on allocating additional funding to improve our response capacity.

13.2. Additional funding is required to strengthen VBD capabilities in surveillance, detection and control. Spending review work will support proactive engagement with DHSC and His Majesty's Treasury (HMT) on opportunities for UKHSA to go further with new funding, and potentially in support of missions (for example the health mission by reducing the burden of infectious diseases and protecting NHS resources, and the growth mission through discovery research of new vaccines and treatments for these diseases).

13.3. **Surveillance**: There are existing human VBD case surveillance programmes run by UKHSA, as previously described, however when considering changing epidemiology, significant gaps exist. Currently the dengue, chikungunya and Zika surveillance programmes are set up for imported cases only. There is a recognised need to develop and implement enhanced surveillance systems for a range of emerging VBDs, e.g., West Nile virus, as well as augmenting existing surveillance for dengue

so that it can detect locally acquired cases in a sensitive and timely way and inform incident response. Gold standard systems integrate data from vectors, VBD cases, and vector control measures to inform response. This capability currently does not exist within UKHSA. There is also a need to develop epidemiological study protocols so they can be rapidly deployed once the threat level is raised.

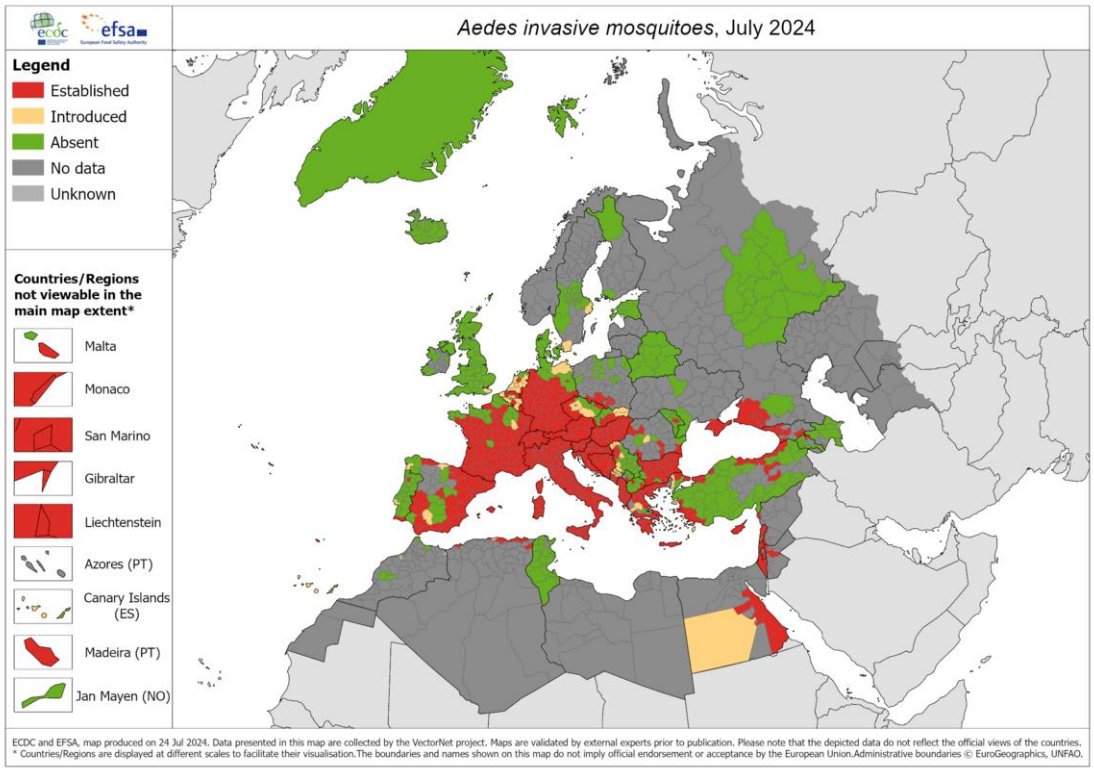
13.4. **Detection**: Increased vector identification and pathogen testing demands have meant the need for increased laboratory space at UKHSA's Porton site. Work is underway to secure additional laboratory space to support both morphology and molecular work required to meet growing vector surveillance commitments. Increased capacity to procure additional vector surveillance equipment and storage has been achieved.

13.5. Improved differential diagnostics for clinical cases would provide greater diagnostic accuracy along with scalable testing through transfer of assays onto high throughput platforms in case of increasing numbers of imported cases, which could also be used for environmental, vector and sentinel samples to address increased demand for sample testing by use of automated sample processing and ensure International Organisation for Standardisation (ISO) accredited testing.

13.6. **Control**: Local Authorities (LAs) have a key role in vector surveillance and control. This is a critical step in preventing invasive mosquitoes from becoming established. UKHSA health protection teams and specialist functions will provide advice to LAs in the management of any VBD incident. Greater awareness is needed among LAs including roles and responsibilities. This is being addressed through the development of an updated version of the Invasive Mosquito Contingency Plan. While vector control measures may involve relatively simple activities such as litter picking, there are financial implications for LAs and so UKHSA is actively working with the Ministry of Housing, Communities and Local Government (MHCLG), to understand the implications further. Exploring novel interventions for vector control in the event of future establishment of the vector, and local cases of the pathogens, is now critical, so that we can respond with the latest tools for disease control.

Alexandra Bramley
Clinical fellow to Professor Isabel Oliver
October 2024

ANNEX A Distribution of Aedes mosquitoes (vectors of dengue, Zika, Chikungunya) in July 2024. Source ECDC



UK Health Security Agency

Enclosure AB/24/045

ANNEX B: Table of vector-borne diseases and their severity

Disease	Vector type	Species	Vaccine available	Global cases (Appropriate global estimates not found)	Global estimated disability adjusted life years per 100,000 people (- appropriate data not found)	Case fatality rate
West Nile Virus	Mosquitoes	Culex, Cx Pipiens/modestus	No	-	-	5%*(1)
Dengue	Mosquitoes	Aedes Aegypti and Aedes Albopictus	Yes	>13 million(2)	26.1(3)	<0.1%(2)
Zika	Mosquitoes	Aedes Aegypti Aedes Albopictus Aedes detritus	No – phase 1 trial	169,000(4)	-	<0.05%(5)
Usutu	Mosquitoes	Culex	No	-	-	-
Malaria	Mosquitoes	Anopheles	Yes	249 million (total)(6) 242,028,000 (P.Falciparum)	806.9(7)	0.25%(P.Falcip) 0.038% (P.Vivax) (6)
Chikungunya	Mosquitoes	Aedes Aegypti and Aedes Albopictus	Yes	460,000(8)	24.45(9)a	<0.1%(8)
Tularemia	Ticks, deer flies	Ixodes	No	-	-	5-15% (with most severe sub-type, reduces to 2% with antibiotics)(10)
CCHF	Ticks	Hyalomma	Nil approved by EMA or FDA – 2 vaccines in phase 1 trials	10,000-15,000	-	Up to 40%(11)
Lyme	Ticks	Ixodes	Yes – but discontinued. VLA15 candidate in phase 3 trials	-	0.6(12)	<0.01%(13)
TBE	Ticks	Ixodes	Yes	10,000-15,000(14)	-	<1%(14)

Summary characteristics of VBDs, for many actual global case numbers will be underestimates, due to reporting, access to testing and asymptomatic cases.
*Case fatality ratio likely to be lower when accounting for untested people with minimal or no symptoms. **a** calculated from single study from Latin America, may not be representative of global burden

ANNEX C: Managing mosquitoes at bus stops.

ANNEX D: Horizon Scanning Matrix of key vector borne pathogens.

Composite vector and pathogen risk grade		Mosquito borne pathogens with no significant animal reservoir in UK (Group 1)	Mosquito borne pathogens with animal reservoir (Group 2)	Tick-borne pathogens (Group 3)	Other vectors (Group 4)
Grade 0: Vector not detected			• Equine encephalitis viruses • Ross river virus		• Oropouche virus • *Leishmania spp* • *Schistosoma spp* • *Trypanosoma spp* • Filaria: *Onchocerca volvulus, Wuchereria bancrofti, Brugia spp* • *Loa loa, Mansonella spp* • Sand fly fever viruses • *Orientia tsutsugamushi*
Grade 1: Vector present	**a) Detected**	• Dengue virus • Chikungunya virus • Zika virus • Yellow fever virus • Mayaro	• Japanese encephalitis virus • Inkoo virus	• Other spotted fever group rickettsioses (*R. rickettsia, R. conorii conorii, R. conorii indica, R. africae*)* • Crimean-Congo Haemorrhagic Fever virus	
	b) Established	• *Plasmodium* spp	• Rift Valley virus • West Nile virus • Ťahyňa virus • Sindbis virus • *Dirofilaria* spp.		• *Yersinia pestis* (bubonic and pneumonic plague) • *Rickettsia typhi* (Murine typhus) • *Borrelia recurrentis* (Louse-borne relapsing fever) • *Rickettsia prowazekii* (Epidemic typhus)
Grade 2: Pathogen present in vector (will only be detected if there is enzootic transmission)		N/A	• Usutu virus	• *Rickettsia raoultii* • *Rickettsia massiliae* • *Rickettsia helvetica* • *Borrelia miyamotoi* (Tick-borne relapsing fever) • Louping ill virus	• *Rickettsia felis* (Flea-borne spotted fever)
Grade 3: One or more autochthonous case in single geographical area				• *Anaplasma phagocytophilum* • *Babesia divergens* • *Francisella tularensis*	
Grade 4: Geographically spread sporadic autochthonous transmission and outbreaks				• *Borrelia burgdorferi* • Tick-borne encephalitis virus	

ANNEX E: Key recommendations from the preparedness cycle

- Beyond external partnerships, work is also underway to strengthen our core capabilities. Key recommendations from the preparedness cycle, now underway and integrated into UKHSA business planning, include:
- Data integration: establish a Data Operations-led task force to define data requirements, assess EDAP and HISS for surveillance compatibility, and explore using the French system for improved data linkage.
- Lab Capacity: review and optimise entomology labs to meet future testing needs, aligning with capital investment plans.
- Planning: update the National Invasive Mosquito Plan for various risk levels, define roles for LAs and UKHSA, address legal and financial frameworks, and hold a stakeholder workshop to improve coordination and clarify responsibilities.
- Standard Operating Procedures: Develop SOPs for mosquito vector detection and autochthonous cases, using tools from French health practices to improve readiness.
- Enhanced surveillance: Create new surveillance questionnaires and align them with protocols for travel-related cases, ensuring they meet standards through pilot testing.
- Innovation: assess market options, including drone tech, to identify effective control methods, and build a model to evaluate intervention efficacy, considering environmental and behavioral factors.
- Public Awareness: Develop a communication plan to inform the public about mosquito risks, ensuring response-ready materials for outbreaks.
- Resource surge planning: Develop a framework for forecasting and deploying specialist personnel resources during peak periods to ensure responsive capacity.