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Human Animal Infections and Risk Surveillance (HAIRS) group

Qualitative assessment of the risk that chikungunya virus presents to the UK population

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Public Health England
Wellington House
133-155 Waterloo Road
London SE1 8UG
Tel: 020 7654 8000
www.gov.uk/phe
Twitter: @PHE_uk
Facebook: www.facebook.com/PublicHealthEngland

Prepared by: Human Animal Infections and Risk Surveillance (HAIRS) Group
For queries relating to this document, please contact: zoonoses@phe.gov.uk

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About the Human Animal Infections and Risk Surveillance group

This document was prepared by Public Health England (PHE) on behalf of the joint Human Animal Infections and Risk Surveillance (HAIRS) group.

This cross-government group is chaired by the PHE Emerging and Zoonotic Infections section. The HAIRS group acts as a forum to identify and discuss infections with potential for interspecies transfer (particularly zoonotic infections).

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

Qualitative risk assessment for chikungunya virus in the UK population

Date of this assessment	16 April 2018
Version	4.0
Reason for update	Further detection of *Aedes albopictus* eggs in the UK
Completed by	HAIRS scientific secretariat and members
Date of previous risk assessment	February 2017
Date of initial risk assessment	March 2006

Information on the risk assessment processes used by the HAIRS group can be found at https://www.gov.uk/government/publications/hairs-risk-assessment-process

<table>
<tr><th colspan="3">SUMMARY OF RISK ASSESSMENT FOR CHIKUNGUNYA VIRUS IN THE UK POPULATION</th></tr>
<tr><td colspan="3">Note: This risk assessment was completed to assess both the current risk that chikungunya virus presents to the UK as well as the risk that chikungunya virus would present if/when the competent vectors are established in the UK.</td></tr>
<tr><td>Overview</td><td colspan="2">Since the last chikungunya virus risk assessment in 2017, the geographical distribution of the virus has continued to expand. Following its introduction to the Caribbean in late 2013, more than 2.67 million cases have been reported in the Americas.
In Europe, autochthonous outbreaks were reported in both France and Italy in the summer of 2017.
Recorded imported cases of chikungunya in infected travellers in England, Wales and Northern Ireland have fluctuated in recent years.
Prior to 2016 there were no reports of Aedes albopictus in the UK. However in September 2016 and July 2017 a small number of eggs and larvae were detected in two locations in Kent. So far, there is no evidence that they have established. There continue to be routes of importation for these mosquitoes and local climate could support their establishment.
The current spread of these competent vectors elsewhere in Europe (particularly through France) is rapid, with new regions colonised each year. This is worrying and, therefore, this risk assessment considers both the current situation and a situation where competent mosquito species establish in the UK. Surveillance for these species in the UK is ongoing but needs to be enhanced. Incidents of local transmission in France and Italy highlight the risk from imported mosquitoes and imported cases.</td></tr>
<tr><td rowspan="2">Assessment of the risk</td><td>Probability</td><td>Current situation: Very low
Assuming competent mosquito species establish: Moderate (within the area where the vector is present)</td></tr>
<tr><td>Impact</td><td>Current situation: Very Low
Assuming competent mosquito species establish: High (within the area where the vector is present)</td></tr>
</table>

Level of confidence in assessment of risk	High
Action(s)/ Recommendation(s):	Early detection and eradication/control of mosquitoes is required - a cross-agency contingency plan is being developed. In the event that competent mosquito species become established, each imported case in that area would need to be followed up with local mosquito control, as currently occurs in France. This remains an evolving situation. The group will continue to monitor and review new evidence as it becomes available.

Assessing the risk to the UK population from new and emerging infections

Step One: Assessment of the probability of infection in UK population

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. 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 in solid colour and the alternative outcome in hatched colour.*
***Please note for this assessment the colour green is used to describe the current situation and the colour blue is used to describe the situation if/when competent vectors are established in the UK.**

QUESTION	OUTCOME*	QUALITY OF EVIDENCE
i) Is this a recognised human disease?	**Yes**	**Good**

Chikungunya is a disease caused by chikungunya virus (CHIKV), a single-strand, positive-sense RNA virus belonging to the Alphavirus genus. CHIKV is transmitted by *Aedes* mosquitoes between vertebrates, including humans. In Africa, where the virus originated, primates are the natural hosts, and the transmission cycle may also involve bats. There is no evidence of similar transmission cycles in Asia. Across most of its range, the virus is transmitted between humans by mosquitoes, with no local zoonotic source.

There are three genotypes of CHIKV; Asian, Indian Ocean and East/Centra/South African (ECSA) genotypes. One amino-acid change in the E1 glycoprotein (E1-A226V mutation) of ECSA CHIKV has been associated with increased vector competence and transmission by *Aedes albopictus* (1). This mutation has been found in ECSA CHIKV circulating in Europe (for example (2)).

In recent years there have been several major outbreaks: in 2005/06 in Réunion Island, Mauritius, and several Indian states; the first autochthonous outbreak in Europe in Italy in 2007 with more than 200 cases; and an ongoing major outbreak in the Caribbean since 2013 in which over 2.67 million cases have been reported to date (see latest PAHO data).

Since 2010, there have been a small number of autochthonous cases in southern France, transmitted locally by established populations of the invasive *Ae. albopictus* mosquito (3). In the summer of 2017, France and Italy reported autochthonous transmission of CHIKV, respectively in the Var department, France (2) and the Lazio and Calabria regions, Italy (4). The two

events were distinct, involving viral strains of different origin, with the French outbreak being caused by a ECSA sublineage that carries the adaptive E1-A226V mutation which facilitates the transmission by *Ae. albopictus* (2).		
ii) Is this disease endemic in the UK?	**No**	**Good**
There is no current evidence of local transmission of CHIKV in the UK.		
iii) Are there routes of introduction into the UK?	**Yes**	**Good**
Transmission of CHIKV in the UK is contingent on two factors: (1) the presence of infected humans, and (2) the presence of competent mosquito vectors. Recorded imported cases of chikungunya in England, Wales and Northern Ireland in infected travellers have fluctuated (2013 = 24; 2014 = 295; 2015 = 102), likely as a result of transmission in the Caribbean (5, 6). The UK is not believed to have established populations of competent vectors for CHIKV transmission. The exotic invasive mosquitoes responsible for transmission of CHIKV in Europe and the Caribbean in recent years are *Ae. albopictus* and *Aedes aegypti*. To date, there have been no reports of these species established in the UK (see below) despite active surveillance programmes run by PHE entomologists in collaboration with Port Health authorities (7, 8). Some studies have shown *Aedes vexans*, a species native to the UK, to be vector competent for CHIKV (7.7% infected, as compared to *Ae. albopictus* 75 - 90.3% infected) (9). In July 2017, dozens of host-seeking female *Ae. vexans* were identified in a residential area in Norwich (10). Occasionally observed in the past, this is the first notable population of *Ae. vexans* identified in the UK (Norwich) for 90 years. However, the current rarity of this species in the UK makes transmission of CHIKV by this species unlikely (7). Recent vector competence work showed that UK populations of *Aedes detritus* were not competent vectors of CHIKV (11). *Ae. albopictus* has now been reported in many European countries and continues to be found in new regions annually, notably in France and the Netherlands (see latest ECDC maps here). The main route of importation into Europe has been via the trade in used tyres. However, both *Ae. albopictus* and *Ae. aegypti* have been found to colonise new areas via main highway routes, having moved across regions in vehicles. In France, during the summers of 2012/14 the mosquito spread northward from the Côte d'Azur, to Lyon/Chalon-sur-Saone with eggs and adults now found in Paris and Strasbourg (2014 and 2015). It was therefore considered likely that within the next decade these species may be found in the UK, introduced via road and rail links with continental Europe (12). In September 2016, *Ae. albopictus* was detected in the UK for the first time. A small number of eggs of *Ae. albopictus* were found		

in one location in Kent, close to the motorway system (13). In late July 2017, eggs and larvae of *Ae. albopictus* were found in a second location in Kent (14). It is likely that these were laid by adult mosquito(es) imported from continental Europe in vehicles. So far there is no evidence that they have established, however surveillance of the area is ongoing. The focus of current PHE mosquito surveillance has shifted from sea ports and airports to motorway services stations in southern England to detect *Ae. albopictus* being imported through ferry ports and Eurotunnel in vehicles. This sampling strategy is being widely used across Europe to monitor for the extension of *Ae. albopictus* distributions (7, 15, 16).

In addition, one male *Ae. aegypti* was found in 2014 in Merseyside, however on further investigation, no more specimens were found (17). This is the third time that this species has been reported in the UK; having previously been reported in 1865 and 1919.

iv)	**Are there effective control measures in place to mitigate against these?**	**No/Yes**	**Good**

If or when *Ae. albopictus* or *Ae. aegypti* are found in the UK, a combination of habitat manipulation (removal of container habitat) and control (adulticides and larvicides) need to be implemented in order to reduce or eradicate the population. Both activities were carried out in Kent in 2016 and 2017 in response to the detection of *Ae. albopictus* eggs and larvae. A contingency plan for invasive mosquito control, based upon those used in France and the Netherlands, has been developed.

In the event of established competent mosquitoes, there may be a requirement for local mosquito control in the vicinity of imported human cases of CHIKV. This strategy to minimise autochthonous cases is currently instituted in France. However, local UK climate differs from southern France, making local transmission less suitable but still possible.

v)	**Do environmental conditions in the UK support the natural reservoirs/vectors of disease?**	**Yes**	**Good**

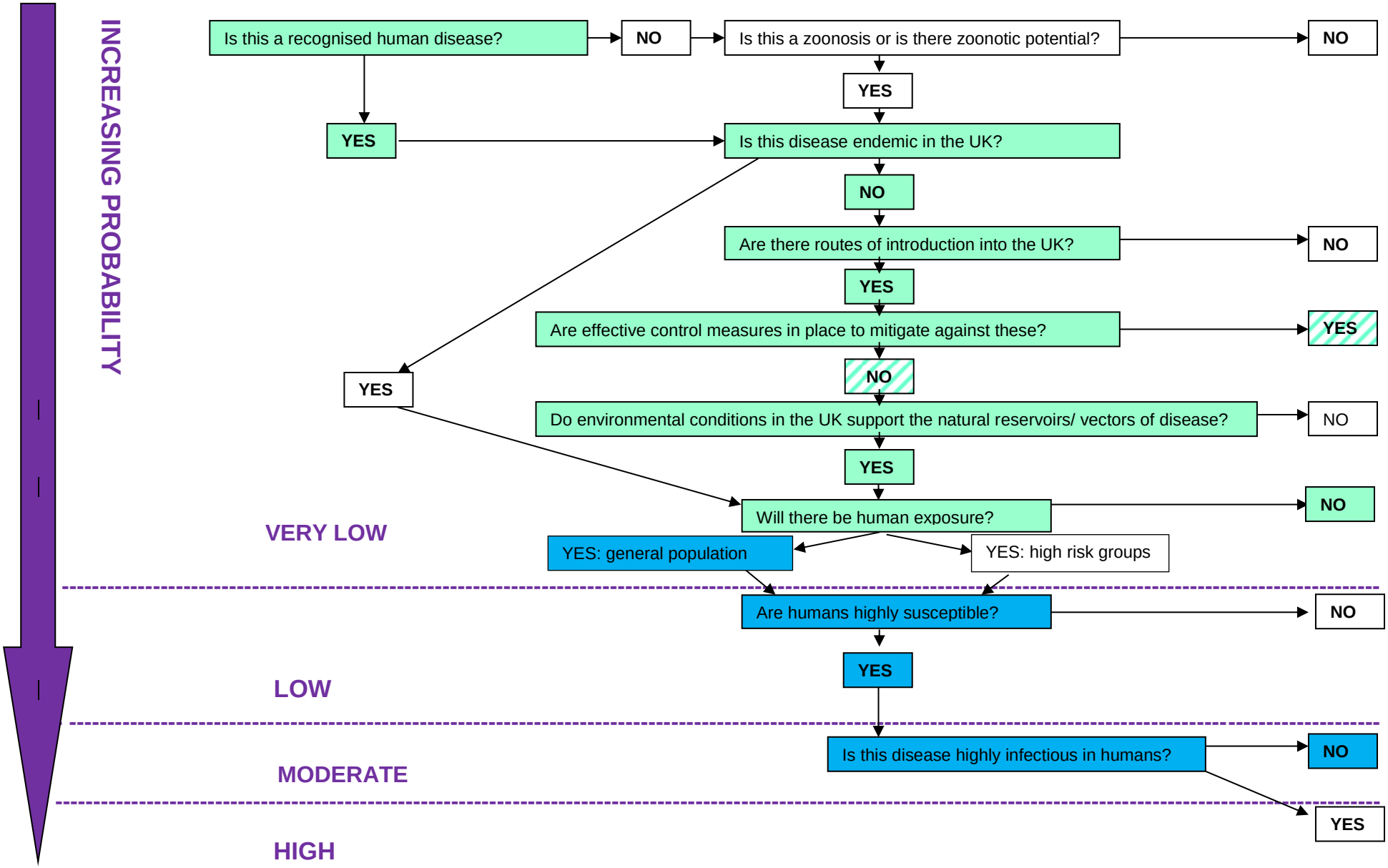
The UK climate is suitable to support the exotic invasive mosquitoes. The peak period of adult activity would be from July to September, depending on the seasonal weather. EU models of CHIKV transmission suggest that with climate change temperatures will be sufficient in London for at least one month of virus transmission by 2041-2070 and across most of south-east England for 1-3 months by 2071-2100 (18-20).

vi)	**Will there be human exposure?**	**No**	**Yes**	**Yes**

Vectors not established: No. Although imported cases of CHIKV will occur, without established populations of the mosquito vector humans will not be exposed in the UK.

Vectors established: Yes. If there are cases of CHIKV together with populations of *Ae. albopictus* mosquitoes, then it can be expected that there will be local transmission, although climate may be a limiting factor but not a barrier to transmission.		
vi) Are humans highly susceptible?	**Yes**	**Good**
Yes, given the epidemiology of human - vector - human transmission, humans are highly susceptible. Additionally, in a naïve population such as the UK, there would be no herd immunity. Recovered cases are likely to retain lifelong immunity protecting against further infections (1).		
vii) Is the disease highly infectious in humans?	**No**	**Good**
No. CHIKV does not spread person-to-person as infection is reliant upon transmission by *Aedes* mosquitoes. Therefore, the rate of infection is contingent on the size of the populations of susceptible humans, infected humans and vectors present. Since the emergence of CHIKV in the Caribbean in late 2013, more than 2.67 million human cases have been reported in the Americas, with a distribution from Florida in the north to Argentina in the south (see PAHO for latest data).		

The **PROBABILITY** of human infection with chikungunya virus in the UK population:
Current probability given competent vectors not established in the UK: **VERY LOW**
Potential probability should competent mosquito species establish in the UK: **MODERATE** *(within the area where the vector is present)*


INCREASING PROBABILITY
Is this a recognised human disease?
NO
Is this a zoonosis or is there zoonotic potential?
NO
YES
YES
Is this disease endemic in the UK?
NO
Are there routes of introduction into the UK?
NO
YES
Are effective control measures in place to mitigate against these?
YES
NO
YES
Do environmental conditions in the UK support the natural reservoirs/ vectors of disease?
NO
YES
Will there be human exposure?
NO
VERY LOW
YES: general population
YES: high risk groups
Are humans highly susceptible?
NO
YES
LOW
Is this disease highly infectious in humans?
NO
MODERATE
YES
HIGH

Step Two: 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. 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 in solid colour and the alternative outcome in hatched colour.*

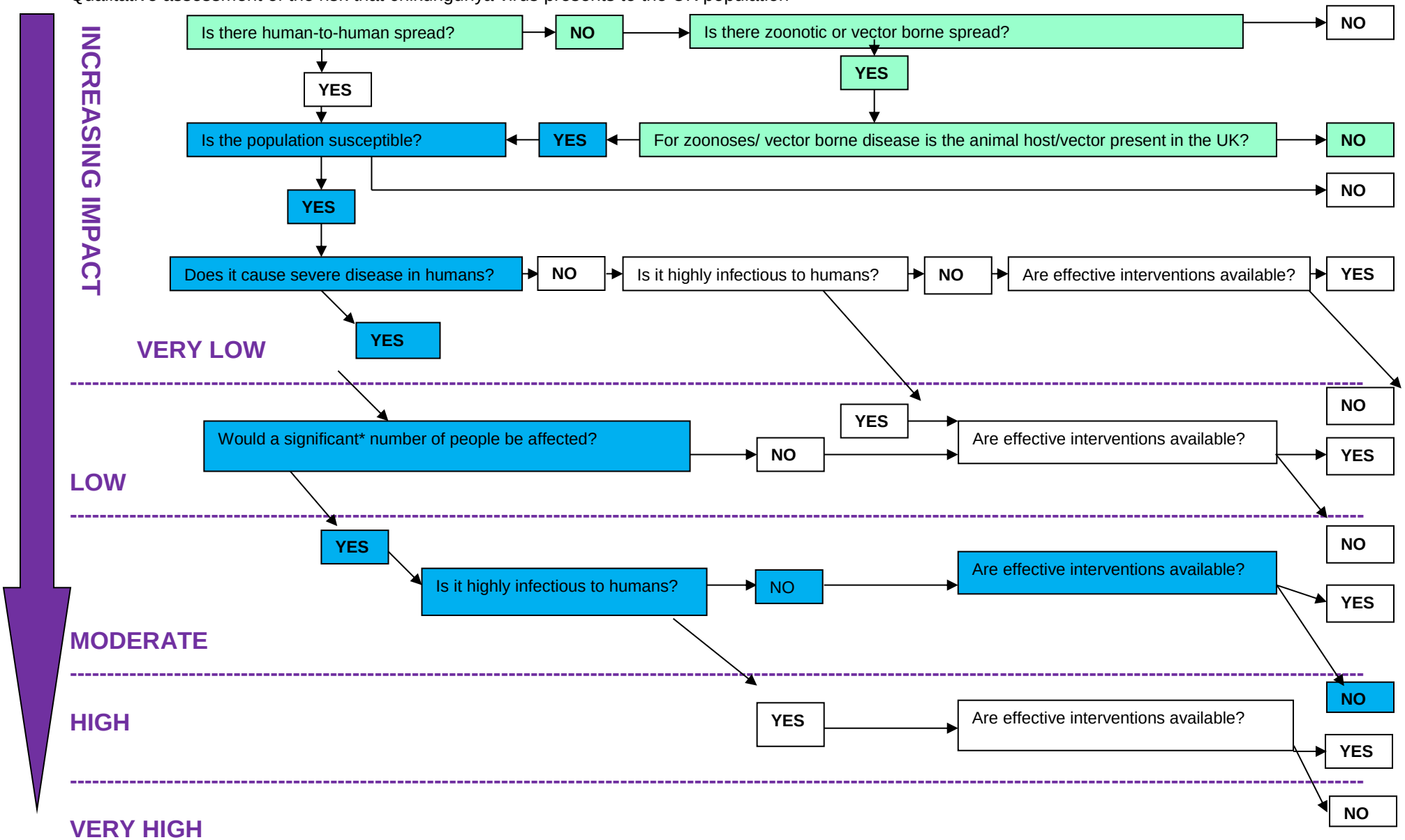
***Please note for this assessment the colour green is used to describe the current situation and the colour blue is used to describe the situation if/when competent vectors are established in the UK.**

Question		Outcome*		Quality of Evidence
i)	**Is there human-to-human spread?**	**No**		**Good**
Not to any significant degree. CHIKV is vectored by certain *Aedes* mosquitoes of the subgenus *Stegomyia*. Very occasional mother to child transmission has been reported. Transmission of CHIKV infection through transfusion and transplantation has not been reported in humans although animal models showed the possibility of such transmission using intravenous inoculation (1).				
ii)	**Is there zoonotic or vector borne spread?**	**Yes**		**Good**
CHIKV is vector-borne via *Aedes* mosquitoes.				
iii)	**For zoonoses/vector-borne disease is the animal host/vector present in the UK?**	**No**	**Yes**	**Good**
There are no established vector populations in the UK, although the first evidence of an incursion was detected in 2016 and again in 2017. Neither incursion led to establishment. However, given the close proximity of *Ae. albopictus* mosquitoes in France to the UK and the ability of the species to colonise new regions via road networks, it is likely that during the next decade the vector will continue to be introduced (7, 13, 16).				
iv)	**Is the population susceptible?**	**Yes**		**Good**
Humans are susceptible to infection following the bite of an infected *Aedes* mosquito and the population in the UK would be immunologically naive.				

v)	**Does it cause severe disease in humans?**	**Yes**	**Good**
Asymptomatic infections occur in 17-40% of cases. CHIKV causes a fever, joint pain, muscle pain, headache, and nose and gum bleeding. The incubation period is 1-12 days, with a mean of three to seven days. Symptoms may continue for weeks or months, and recurrent joint pain, lasting years in some cases, is experienced by 30-40% of those infected, causing significant morbidity within the community. Complications include myocarditis, hepatitis, ocular and neurological disorders. Viral load is high at the beginning of the infection and lasts 5-6 days after onset of fever. Deaths have been attributed to chikungunya infection but overall the case fatality rate is very low (0.02%). Recovered cases are likely to retain lifelong immunity to further infections (1).			
vi)	**Would a significant number of people be affected?**	**Yes**	**Good**
The number of people affected would be contingent on the following factors: (1) the number of infected people in the local area; (2) the presence of an invasive exotic *Aedes* mosquito: and (3) permissible climate for: a) establishment and abundance of the mosquito and b) extrinsic incubation of the virus in the mosquito.			
vii)	**Is it highly infectious to humans?**	**No**	**Good**
Human infection is reliant upon transmission by *Aedes* mosquitoes, and there is no direct person to person transmission.			
viii)	**Are effective interventions available?**	**No**	**Good**
No specific treatment or licensed vaccine are available.			

The **IMPACT** of chikungunya virus on human health in the UK:
Current impact given competent vectors not established in the UK: **VERY LOW**
Potential impact should competent mosquito species establish in the UK: **HIGH** *(within the area where the vector is present)*

Qualitative assessment of the risk that chikungunya virus presents to the UK population



*This question has been added to differentiate between those infections causing severe disease in a handful of people and those causing severe disease in larger numbers of people. 'Significant' is not quantified in the algorithm but has been left open for discussion and definition within the context of the risk being assessed.

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