Public Health England

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Human Animal Infections and Risk Surveillance (HAIRS) group

Qualitative assessment of the risk that West Nile virus presents to the UK human population

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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 West Nile virus in the UK population

Date of this assessment	November 2017
Version	2
Reason for assessment	The continued outbreaks in Europe and neighbouring countries, as well as the expansion of *Culex modestus* in southern England.
Completed by	HAIRS Secretariat and members
Date of previous risk assessment	31 October 2012
Date of initial risk assessment	31 July 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 WEST NILE VIRUS IN THE UK POPULATION</th></tr>
<tr><td colspan="3">Note: This risk assessment was completed to assess the current risk that West Nile virus presents to the UK population</td></tr>
<tr><td>Overview</td><td colspan="2">West Nile virus infections have long been recognised in Europe where there is annual surveillance for human and equine disease. In the USA, large numbers of human infections were recorded annually following its introduction in 1999, and it is now endemic. There is no evidence that WNV is present in the UK and very few travel related cases have been reported to date. Populations of competent mosquitoes (Culex modestus) have, however, been detected in areas of Essex and Kent.</td></tr>
<tr><td rowspan="2">Assessment of the risk of infection in the UK</td><td>Probability</td><td>Low</td></tr>
<tr><td>Impact</td><td>Low/Moderate</td></tr>
<tr><td>Level of confidence in assessment of risk</td><td colspan="2">High</td></tr>
<tr><td>Action(s)/ Recommendation(s):</td><td colspan="2">• continue to monitor vector and host populations
• continue surveillance
• raise awareness amongst clinicians and encourage testing in relevant areas of the UK
The assessment will be reviewed as further evidence becomes available.</td></tr>
</table>

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 following the boxes shaded green. 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.*

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

WNV is a viral infection of birds transmitted by mosquitoes, although humans can also be infected. The virus was first isolated in 1937 from a woman with fever in the West Nile district of Uganda and it was later recognised as a cause of meningo-encephalitis (1). WNV strains are characterised into several lineages, of which lineage 1 is globally widespread. Lineage 2 strains, endemic in southern Africa, appeared in Europe for the first time in Hungary in 2004. Over subsequent years lineage 2 viruses have been found in eastern Austria, Greece, Italy and several countries in Eastern Europe (2-4).

In 1999, WNV was introduced into the eastern US, where human cases were preceded by large numbers of bird deaths (5). The virus spread westwards causing increasing numbers of human cases and deaths, peaking in 2003 with 9862 cases and 264 deaths. Case reports and deaths have since reduced but there are substantial fluctuations year on year. Between 1999 and year end 2015, a total of 43,937 cases and 1911 fatalities were reported (6). WNV is considered endemic in the US (7).

Europe has experienced sporadic cases and outbreaks of WNV in humans and horses since the 1960's (1). After the first large outbreak in Romania in 1996, WNV was recognised as a public health concern in Europe. West Nile virus infection in animals must be reported to the OIE (8), and human cases are notifiable to ECDC (9). In 2016, 214 probable and confirmed human cases were recorded in the EU (Austria, Bulgaria, Croatia, Cyprus, Hungary, Italy, Romania and Spain) and 267 in neighbouring countries (10). Monitoring of cases in Europe continues annually throughout the transmission season (11).

ii) Is this disease endemic in the UK?	No	Good
Mosquito-borne diseases and transmission of mosquito-borne viral infections, in humans, are virtually unknown in the UK, unlike many parts of Europe and the USA. Between 2002 and 2012, surveillance for human cases of West Nile virus in the UK took place each year between 01 June and 31 October, the critical period for WNV transmission in Europe, and only travel-related cases were identified (12). A total of four confirmed cases of WNV infection in humans have thus far been recorded in UK residents, all acquired through travel: two to Canada, one to Egypt and one to the USA. No indigenous cases of WNV have been reported (13, 14)		
iii) Are there routes of introduction into the UK?	**Yes**	**Good**
A qualitative assessment of potential risk factors and the likelihood for introduction into the United Kingdom was conducted by Defra in 2012 (15). All routes (including the importation of infected animal germplasm; the legal trade of live poultry and captive birds; infected mosquitoes being blown across to the UK from infected countries; migrating birds; mosquitoes imported via plants; or by means of transport vehicles) were deemed to present a negligible to very low risk. No change in these risks has been determined to date (APHA personal communication, August 2017). Viraemic horses or individuals would not constitute a route of introduction as each is considered a dead-end host.		
iv) Are there effective control measures in place to mitigate against these?	**No**	**Good**
The implementation of mitigation strategies to prevent the introduction of WNV by bird migration or mosquitoes is impractical. Proposed or currently applied measures to minimise the risk of WNV to the UK population concentrate on the early detection of infections in human or animal hosts and vectors, education and possibly vector control in the event of an outbreak. The WNV contingency plan in the UK (16) includes enhanced surveillance for birds, mosquitoes and humans and sets out an action plan in the event of a WNV incident, including advice on control of mosquitoes to reduce or eliminate the vectors. If there is an outbreak of WNV infection at a time when mosquitoes are active, measures to control mosquito populations, by either targeting their breeding sites or, more rarely, killing adult mosquitoes, will be considered. The action required will be determined by health risk assessments locally and nationally. It is acknowledged that in the presence of indigenous widely established competent vectors, an outbreak could be difficult to manage. A vector-borne diseases plan focussing on invasive mosquito species is nearing completion. Currently the primary strategy to minimise the risk of WNV to the UK population is surveillance. Monitoring and testing of potential cases of WNV in humans, horses, birds and mosquitoes is undertaken in the UK during the critical period for WNV transmission		

in Europe. No cases of bird, equine or human UK-acquired WNV have been detected thus far (9).

To monitor the distributions of mosquito vector populations in the UK, PHE and the Chartered Institute of Environmental Health have developed Mosquito Watch (17), a dedicated database to record the incidences of mosquitoes nationally. PHE also runs a nationwide recording scheme (18) with enhanced surveillance at 30 sites in England.

v)	**Do environmental conditions in the UK support the natural reservoirs?**	**Yes**	**Good**

A study looking for evidence of infection with WNV amongst both migratory and non-migratory birds suggested that virus was already present in resident (non-migratory) birds in the UK (19). However, subsequent studies have not supported these findings. There have been no detections of WNV through the annual testing of wild birds in the UK (approximately 200 per year) by APHA. (20)

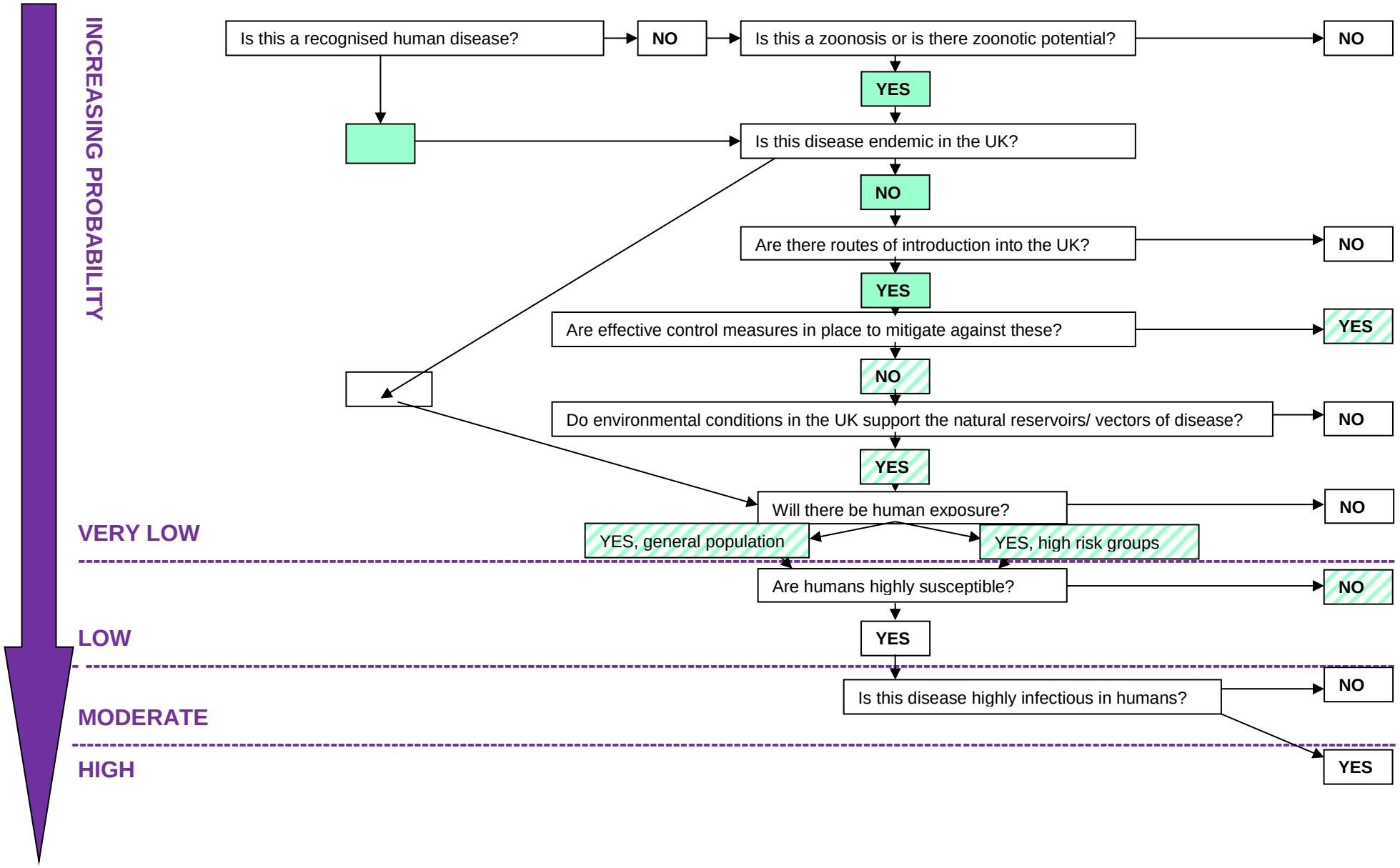
Of the 36 recorded species of mosquito in Britain, at least 9 species could potentially transmit WNV and 13 could act as bridge vectors as they bite both birds and humans (21). Should WNV be introduced to the UK, the most likely vectors would be mosquitoes belonging to the widely distributed Culex pipiens complex. Until recently, except for localised urban infestation of Cx. pipiens molestus, there appeared to be few situations in the UK where humans and livestock are exposed to sustained risks of exposure to potential WNV vectors (22).

However, an established population of Culex modestus was discovered in the North Kent Marshes in 2010 (23). It is a recognised bridge vector of WNV. This was the first time this species had been detected in the UK since 1944. In 2012, evidence of low numbers of Cx. modestus were found in the Cambridgeshire Fens (24). Since then PHE with academic colleagues have reported the presence of Cx. modestus across a number of wetland sites in North Kent (from Swanscombe to Canterbury) and in coastal Essex (from Rainham to Tollesbury) (25).

These recent findings highlight that this species may be more widespread in the UK than previously realised, and in some locations they are abundant. The presence of Cx. modestus in the UK suggests that WNV risk to humans and horses may be higher in these locations; however, further research on biting rates, host preference and dispersal, in addition to nationwide and targeted surveillance is ongoing (25, 26).

vi) Will there be human exposure?	Yes	Good
WNV is maintained in a mosquito-bird-mosquito cycle. However, in favourable environmental conditions mosquitoes can proliferate and the risk of transmission to humans increases. The vast majority of infections are acquired through the bite of an infected mosquito. People can protect themselves by taking appropriate anti-mosquito measures (1). Human exposure in the eastern US was linked to transmission by a hybrid form of Cx. pipiens which exhibited both bird and human biting tendencies. Cx. pipiens pipiens in the UK is believed to be predominantly bird biting and is unlikely to act as a bridge vector (22). Cx. pipiens molestus does bite humans, but evidence of bird biting is limited. Therefore, human exposure to the transmission of WNV by Cx. pipiens in the UK is likely to be different (much less) than has occurred in the US (22), even though vector competence for European variants of Culex pipiens has been demonstrated (27). Cx. modestus is a recognised bridge vector in Europe. However, as the human population is low in the North Kent Marshes and little is known about the dispersal ranges of Cx. modestus in the UK, it is difficult to quantify the significance of this vector to human exposures (23). Some initial data is now available on host preference, confirming that Cx. modestus do seek blood meals from birds (including migratory) as well as humans (28). Laboratory studies of vector competence of other British mosquitoes for WNV, such as Ochlerotatus (Aedes) detritus, have shown the potential for experimental infection in the laboratory (29). However, there is no evidence to suggest they are currently involved in transmission in the field.		
vii) Are humans highly susceptible?	**Yes**	**Good**
Approximately 80% of humans infected have no symptoms at all and 20% have a mild influenza-like illness which generally lasts 3 to 6 days. A small proportion (less than 1%) can develop more severe disease such as, aseptic encephalitis, meningitis or meningo-encephalitis. Increasing age, particularly in those over 70 years, is the greatest risk factor for the development of serious disease and death (1).		

The **PROBABILITY** of human infection with WNV in the UK population: **LOW**


INCREASING PROBABILITY
Is this a recognised human disease?
NO
Is this a zoonosis or is there zoonotic potential?
NO
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
Do environmental conditions in the UK support the natural reservoirs/ vectors of disease?
NO
YES
Will there be human exposure?
NO
YES, general population
YES, high risk groups
Are humans highly susceptible?
NO
YES
Is this disease highly infectious in humans?
NO
YES
VERY LOW
LOW
MODERATE
HIGH

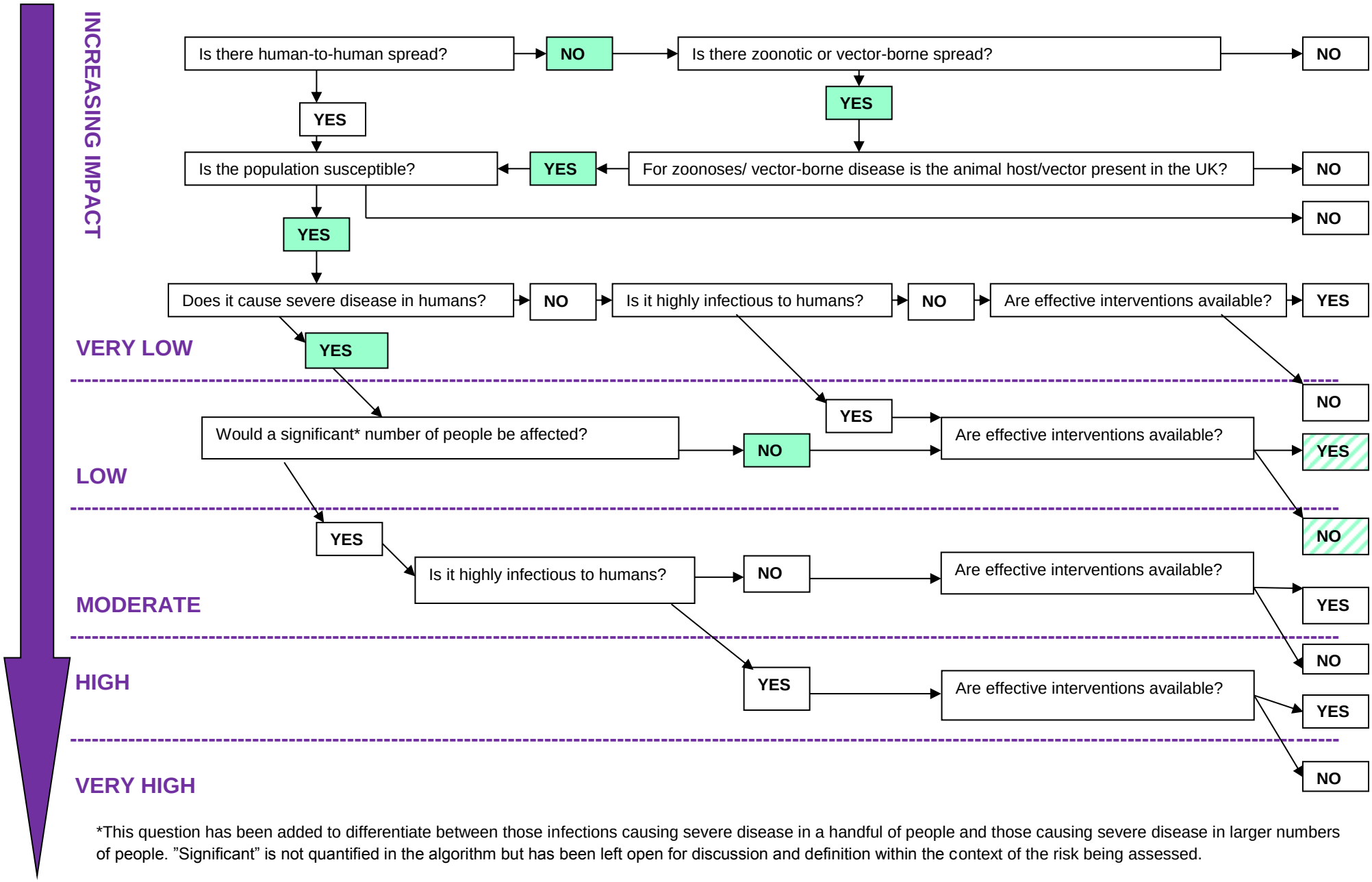
Step two: Assessment of the impact on human health

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 following the boxes shaded green. 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 hatching.*

QUESTION		OUTCOME	QUALITY OF EVIDENCE
i)	**Is there human-to-human spread?**	**No**	**Good**
There is no direct person-to-person spread. WNV transmission through blood transfusions and organ transplants from infected donors has been reported, but these methods of transmission contribute small numbers of cases to the overall burden of the disease. It is also possible for WNV to be transmitted from mother to unborn child or through breast milk (1, 30), but such cases are rare.			
ii)	**Is there zoonotic or vector borne spread?**	**Yes**	**Good**
WNV is maintained in an enzootic cycle between Culicidae mosquitoes and birds. Bridge-vector mosquitoes (those that feed on both birds and mammals) can spread the virus to humans, horses and other incidental hosts. Rare cases of zoonotic transmission have been described during horse or bird autopsy (1). Mosquitoes are responsible for the vast majority of human transmissions.			
iii)	**For zoonoses / vector-borne disease is the animal host/ vector present in the UK?**	**Yes**	**Good**
The main host of WNV are birds and the vectors are mosquitoes, principally Culex species. Both hosts and vectors are present in the UK (15, 22).			
iv)	**Is the population susceptible?**	**Yes**	**Good**
Yes. There is currently no vaccine licensed to protect humans. WNV infections acquired abroad have been recorded in a limited number of individuals in the last ten years (13, 14).			

v)	**Does it cause severe disease in humans?**	**Yes**	**Good**
The majority of people infected (80%) are asymptomatic and around 20% have a mild flu-like illness. Less than 1% of cases can develop more severe disease such as aseptic encephalitis, meningitis or meningo-encephalitis. The case fatality rate in patients with neuro-invasive illness ranges from 4% to 14%; it can reach 15 to 29% in patients over 70 years old (1). Both WNV lineages 1 and 2 are associated with clinical disease in humans (2, 3).			
vi)	**Would a significant number of people be affected?**	**No**	**Good**
Only those who are exposed to and bitten by infected mosquitoes. Although there is limited information on the incidence of mosquito biting in the UK, sustained human biting is currently considered to be a localised event (31).			
vii)	**Are effective interventions available?**	**Yes/No**	**Good**
The risk of contracting WNV infection can be reduced by preventing exposure to mosquitoes (use of repellent, long sleeves, avoiding being outside at dusk and dawn when *Culex* mosquito vectors are most active). There is currently no human vaccine available and there is no specific antiviral therapy only supportive care (1). If there is an outbreak of WNV infection at a time when mosquitoes are active, measures to control mosquito populations, by either targeting their breeding sites or, more rarely, killing adult mosquitoes, will be considered based on local and national risk assessments. (16)			

The **IMPACT** of WNV on human health in the UK: **LOW / MODERATE**



*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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