ZIKA VIRUS
Technical report

World Health Organization
REGIONAL OFFICE FOR Europe

Interim Risk Assessment
WHO European Region

May 2016

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Cover photo: Outline of the map of the WHO European Region (design by João Duarte)

Acknowledgements

The authors would like to thank Siff Malue Nielsen, Raissa Tjon-Kon-Fat, Jessica Fiddy and Loiuse Treloar of the WHO Regional Office for Europe for their support in data collection and for comments on earlier drafts of this report. The authors thank Christopher Dye, Gaya Gamhewage, Stéphane Hugonnet and Raman Velayudhan at WHO headquarters, the Zika Incidence Management Team at the WHO Regional Office for Europe and Herve Zeller, Wim van Bortel and Bertrand Sudre at the European Centre for Disease Prevention and Control for comments on earlier drafts.

Executive summary

Background

On 1 February 2016, the WHO Director-General declared that recent clusters of cases of microcephaly and neurological disorders associated with Zika virus disease constitute a public health emergency of international concern under the International Health Regulations (2005). In light of the current widespread outbreak occurring in Latin America and the Caribbean, the risk for Zika virus importation and spread in the European Region should not be underestimated. To support countries in the European Region in targeting preparedness work and to guide prioritization of activities, the risk for a Zika virus disease outbreak was assessed.

Methods

The risk for an outbreak was considered to be the function of two main components: (1) the likelihood of local Zika virus transmission and (2) the capacity of countries to contain transmission at an early stage. A local transmission likelihood score was derived from the presence of and climatic suitability for *Aedes aegypti* and *Ae. albopictus* (the two species of *Aedes* mosquitos known to be competent vectors for Zika virus) and factors related to the introduction and onward transmission of Zika virus, such as a history of previous arboviral outbreaks, shipping and air connectivity, population density and urbanization. A country capacity score was derived by evaluating four main factors: integrated vector management, clinical surveillance, laboratory capacity and emergency risk communication.

Main limitations

After the declaration that microcephaly and neurological disorders associated with Zika virus represents a public health emergency of international concern, a rapid assessment of country capacity in relation to Zika virus was required. Therefore, the questionnaire used to collect data could not be pilot-tested, and the responses with regard to country capacity could not be validated. Thus, we cannot exclude the possibility that some questions might have been subject to interpretation and reporting biases. In addition, country capacity to respond to Zika virus has probably increased since the time of data collection; however, it was not possible to account for these changes in the analysis. The capacity score presented is therefore intended to serve as a baseline indicator at regional level. Countries are in the best position to assess their capacity in line with WHO recommendations according to their respective levels of likelihood of local Zika virus transmission.

In the absence of transmission models for Zika virus in the European Region (at the time of reporting), proxy indicators were used to derive the likelihood score for local transmission. The real probability that the pathogen will be disseminated once introduced is unknown. Comprehensive transmission models are required to estimate the probability of Zika virus transmission more accurately.

Results and conclusions

Many countries extending from the Mediterranean Basin are at moderate risk for local Zika virus transmission. In addition, three geographical areas (Madeira Island belonging to Portugal, and the Black Sea coastal areas of Georgia and the Russian Federation) with established populations of *Ae. aegypti*, were classified as having high likelihood for local Zika virus transmission. Although there was good overall capacity in the Region to contain Zika virus transmission at an early stage, capacity reported for specific activities (integrated vector management, surveillance, laboratory and emergency risk communication) varied substantially at country level. Reported capacity to prevent and rapidly control Zika virus transmission was fairly robust in countries with localized areas of high transmission likelihood.

Recommendations

Countries and regions at high or moderate likelihood of local Zika virus transmission should strengthen and/or maintain their vector control activities, with improved entomological surveillance and source reduction strategies. This will be particularly relevant in the three areas with *Ae. aegypti* before the active mosquito season starts, with enhanced clinical surveillance to rapidly detect local Zika virus transmission. Further, countries are advised to ensure that they have the laboratory capacity to test for Zika virus or have protocols in place to ship samples abroad for testing. Lastly, it is recommended that countries advise populations at risk on protecting themselves against infection and mitigating the effects of Zika virus infection and its complications.

Background

Zika virus is a flavivirus that is transmitted through the bite of an infected mosquito of the *Aedes* genus. Infection is followed by an incubation period estimated to be between 4 and 7 days (*1*) before development of clinical symptoms, which occur in only a minority of infected individuals (estimated at 20%) (*2*). The symptoms of Zika virus infection are similar to those of other arbovirus diseases, such as dengue, and include fever, skin rash, conjunctivitis, joint inflammation and pain (*3*). The symptoms are usually mild and last for 2–7 days. No specific treatment or vaccine is currently available. The best form of prevention is protection against mosquito bites.

It is widely accepted that the primary *Aedes* species vector of the Zika virus outbreak in the Americas is *Ae. aegypti* (*4,5*), which can transmit other viral diseases, such as dengue, chikungunya and yellow fever. *Ae. albopictus* has been shown to transmit Zika virus in field settings in Africa (*6*) and in a laboratory setting in Singapore (*7*). The vector competence (a vector's biological capability to transmit a virus) (*8*) of *Ae. aegypti* and *Ae. albopictus* is similar (*9*). Notwithstanding, differences in mosquito susceptibility to Zika virus infection and in their ability to disseminate the virus have been shown within the same species of *Aedes* mosquito from distinct locations (*9*). Evidence is still lacking on how the European population of *Aedes* mosquitos will adapt to Zika virus. *Ae. albopictus* is considered to have lower vector capacity[1] than *Ae. aegypti* for transmitting arboviruses, including Zika; however, *Ae. albopictus* is established in many countries in the European Region (*10*) and has been implicated in recent arboviral outbreaks in continental Europe (*8*).

Zika virus was first identified in 1947 (*11*) in rhesus monkeys in the Zika forest of Uganda, and human disease was first identified in 1952 in Uganda and the United Republic of Tanzania. The virus has since caused sporadic disease in Africa and Asia. Zika virus disease outbreaks were reported for the first time in the Pacific in 2007 and 2013, on Yap Island and in French Polynesia, respectively. The geographical spread of Zika virus has since increased steadily. In 2015, the virus was detected in continental parts of the WHO Region of the Americas, initially in Brazil in May 2015. It then spread widely throughout the area. As of 5 May 2016, 38 countries or territories had reported local Zika virus transmission (*12*). Zika virus was also circulating during 2015–2016 in countries in the WHO African, South-East Asian and Western Pacific regions.

Circulation of the virus in Brazil in 2015 was temporally and geographically associated with steep increases in the numbers of infants born with microcephaly and of cases of Guillain-Barré syndrome, a poorly understood condition in which the immune system attacks the nervous system, sometimes resulting in paralysis. In response, on 1 February 2016, the WHO Director-General declared that the recent clusters of cases of microcephaly and neurological disorders in Latin America and the Caribbean constitute a public health emergency of international concern under the International Health Regulations (2005).

Imported cases have been reported in several European countries. The European Centre for Disease Prevention and Control (ECDC) is collecting data on cases imported into the European Union and the European Economic Area from the media and official government communications. As of 29 April 2016, ECDC had recorded 452 imported cases in 17 countries, including 23 in pregnant women (*13*). These data are important, as travellers returning from abroad who are infected with Zika virus could initiate local transmission if there are established competent vectors. As of 15 April 2016, no autochthonous case of Zika virus transmission had been reported in the WHO European Region.

A growing body of research has led to scientific consensus that Zika virus is a cause of microcephaly and Guillain-Barré syndrome (*14–27*). The magnitude of the risk and the full spectrum of congenital malformations and neurological complications caused by Zika virus infection are, however, still unknown. The public health impact of a Zika virus disease outbreak should nevertheless be considered serious; therefore, Member States should enhance their preparedness and readiness according to their individual risks for a Zika virus disease outbreak.

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[1] Vector capacity is the efficiency with which a mosquito transmits a disease, which is determined by its preferred host, the number of bites (feedings) per cycle of egg production, its longevity, the density of the mosquito population and other factors (*5*).

Objectives

The main objectives of this analysis were: to assess the likelihood of local Zika virus transmission at country level in the WHO European Region; to evaluate capacity in the Region to prevent, mitigate and rapidly control local transmission to avoid a large outbreak; and to assess the composite risk of a Zika virus disease outbreak in the Region. Assessment of the likelihood of transmission at country level will inform preparedness for Zika virus in the Region and guide the prioritization of country activities to prevent a large outbreak of Zika virus disease.

The specific objectives were:

- to assess the epidemiological likelihood of local Zika virus transmission on the basis of information on the presence of the *Aedes* vectors (specifically, *Ae. aegypti* and *Ae. albopictus*) in countries in the Region, the ecological and environmental viability of vector presence in areas where vector surveillance is absent or in areas where the vector is not present and factors related to Zika virus introduction and transmission;
- to evaluate regional capacity to prevent, mitigate and rapidly control local transmission using information on the capacity of each country to detect Zika virus and local transmission and to rapidly respond before an outbreak occurs;
- to develop a framework for assessing both the likelihood of local Zika virus transmission and country capacity in order to assess the risk for a Zika virus outbreak in the Region; and
- to provide recommendations aligned with published WHO guidelines based on each country's likelihood score for Zika virus transmission.

Assumptions made in the risk assessment

- According to the available evidence, only *Aedes* species of mosquitos are capable of transmitting Zika virus, therefore other species of mosquitos were not evaluated.
- According to the available evidence *Ae. albopictus* is considered to have lower vector capacity than *Ae. aegypti* for transmitting arboviruses, including Zika virus.
- Vector-borne transmission of Zika virus was assumed to be the determinant form of transmission and other forms of transmission were not incorporated. In particular, sexual transmission of Zika virus remains beyond the scope of this risk assessment, but is taken into account in the recommendations.
- Climatic suitability models provide information on the potential risk for vector presence.
- Countries that share a border with a country with established populations of *Aedes* mosquitos are at higher risk for Zika virus transmission.
- The capacity reported by a country to detect and respond to a potential outbreak is the same throughout its territories, including localized areas with different likelihoods of Zika transmission.

Methods

The risk for a Zika virus disease outbreak in the WHO European Region varies widely by country and depends on multiple factors. The risk of an outbreak was considered to be a function of two main components: the likelihood of local Zika virus transmission and the capacity of countries to contain transmission at an early stage.

Likelihood of local Zika virus transmission

The presence of the vector (*Ae. aegypti* and/or *Ae. albopictus*) in countries was considered to be the most important determinant of likelihood of local Zika virus transmission. Countries were assigned a base score according to whether *Ae. aegypti* and/or *Ae. albopictus* was currently present or whether the climatic conditions were suitable for the vector if it was not present. The highest score was given to countries with presence of *Ae. aegypti,* which is considered to be the primary vector of the current outbreak in the Americas. The vector variable was weighted

10:1 in relation to additional factors related to the introduction and onward transmission of Zika virus, such as history of previous arboviral outbreaks, shipping and air connectivity, population density and urbanization. These factors were weighted equally, and the scores for each were added to the base score to generate an overall Zika transmission likelihood score according to the following equation:

> Local transmission likelihood = (vector base score + history of previous arboviral outbreak + shipping connectivity + air connectivity + population density + urbanization)

For those countries in which the climatic conditions were unsuitable for vector presence, the scores for additional variables were not taken into account, and these countries were classified as being at no risk for a Zika virus disease outbreak. Although the factor "previous history of arboviral outbreaks" is a composite variable and encompasses other factors also evaluated in the analysis (and as such is a collinear variable), we interpreted it as providing an additional indication of the facility with which arboviral outbreaks could occur in countries with the same or similar vector presence, climatic suitability, etc. This variable therefore captures additional information that is not fully captured in the other variables. As the transmission likelihood score is derived from an additive rather than a regression model, collinearity was judged not to be a limitation for inclusion of this factor.

As only three localized geographical areas in the WHO European Region currently have established populations of *Ae. aegypti*, these areas were evaluated separately from, and in addition to, the countries in which they are sited. The three additional areas were Madeira Island (Portugal), the Black Sea coastal area of Georgia and the Black Sea coastal area of the Russian Federation.

Table 1 describes the factors and the sources used to derive each factor score, which were then used to calculate the overall likelihood score of local Zika virus transmission and the scoring framework. From the likelihood score, countries and the three additional geographical areas were classified as having: no likelihood (score = 0), very low (> 0 to ≤ 3), low (> 3 to ≤ 7), moderate (> 7 to ≤ 9) or high (> 9) likelihood. The scoring categories correspond principally to the vector variable subcategories.

Capacity of countries to contain transmission at an early stage

In order to assess the capacity of the Region to contain transmission of Zika virus at an early stage, a questionnaire (with official translations into French and Russian) was sent to all 53 Member States plus the Principality of Liechtenstein. The first-round questionnaire was sent to the National International Health Regulations (2005) Focal Points of the non-European Union Member States in the WHO European Region on 12 February 2016 to assess the establishment of competent vectors in the Region, the integrated vector management strategies in place, clinical surveillance capacity for early detection of local transmission of Zika virus, laboratory capacity for diagnosis of Zika virus disease and emergency risk communication. On 17 February 2016, the same questionnaire but without the questions on laboratory capacity, was sent to the Member States of the European Union and the European Economic Area in coordination with the ECDC and complementary to the ECDC laboratory questionnaire, which was sent to laboratories in Member States of the European Union and the European Economic Area and some non-European Union Member States on 4 February 2016.

Four main factors were evaluated in order to derive a country capacity score: integrated vector management, clinical surveillance, laboratory capacity and emergency risk communication. These factors were equally weighted, and the scores for each factor were added to obtain the capacity score. As countries without vector presence might reasonably be expected not to have an integrated vector management plan, they were scored higher than those in which the vector was present but which had no integrated vector management plan. The factors used to calculate the overall capacity score are summarized in Table 2. Countries were classified as having very low (≤ 2), low (> 2 to ≤ 4), reasonable (> 4 to ≤ 6), good (> 6 to ≤ 8) or very good capacity (> 8).

The questionnaire responses regarding the establishment of competent vectors were validated against ECDC vector maps of *Ae. aegypti* and *Ae. albopictus* (*10*).

In order to assess the regional risk of a Zika virus disease outbreak, the median transmission likelihood score was plotted against the median country capacity score.

Data management and analysis

Derived variables associated with the likelihood of transmission and data on country capacity from the returned questionnaires were first double-entered into a Microsoft Excel® file and then imported into Stata 12 (StataCorp®). Stata was used for all analyses. The categories of all the variables were mutually exclusive, i.e. countries could not be classified in more than one category.

Table 1. Factors and sources used to derive the Zika virus transmission likelihood score

	Factor	Description	Score	Explanation and sources
Risk of local Zika virus transmission	**Vector** (*Ae. aegypti* or *Ae. albopictus*)	Climatic conditions not suitable* for vector presence (No risk for Zika virus outbreak)	0	**Explanation:** Estimated areas of environmental suitability for *Ae. albopictus* and *Ae. aegypti* in continental Europe; *Ae. albopictus* or *Ae. aegypti* is established in a neighbouring Member State **Sources:** ECDC http://ecdc.europa.eu/en/publications/publications/ter-climatic-suitablility-dengue.pdf (*29*) http://ecdc.europa.eu/en/healthtopics/vectors/vector-maps/Pages/VBORNET_maps.aspx (*10*)
		Vector not introduced, climatic conditions only moderately suitable* for *Ae. aegypti* or *Ae. albopictus,* and country has no border with a country with established vector presence	1	
		Vector not introduced, climatic conditions only moderately suitable* for *Ae. aegypti* or *Ae. albopictus*, and country has a border with a country with established vector presence	2	
		Vector not introduced, climatic conditions suitable* for *Ae. albopictus*, and no border with a country with established vector presence	3	
		Vector not introduced, climatic conditions suitable* for *Ae. albopictus*, and country has a border with a country with established vector presence	4	
		Vector not introduced, climatic conditions suitable* for *Ae. aegypti*, and country has no border with a country with established vector presence	5	
		Vector not introduced, climatic conditions suitable* for *Ae. aegypti*, and country has a border with a country with established vector presence	6	
		Ae. albopictus is established in the country	7	
		Ae. aegypti is established in the country	8	
	Capacity for arbovirus transmission	Previous local transmission of dengue or chikungunya (Yes/No)	0/1	**Source:** WHO Regional Office for Europe http://www.euro.who.int/en/health-topics/communicable-diseases/vector-borne-and-parasitic-diseases/dengue-and-chikungunya (*29*)
	Shipping connectivity	Liner shipping connectivity index	0–1	**Explanation:** The liner shipping connectivity index measures how well a country is connected to global shipping networks on the basis of: number of ships, their container-carrying capacity, maximum vessel size, number of services and number of companies that deploy container ships in a country's port. The maximum index is 100 (represented here as a decimal between 0 and 1). The index is computed by the United Nations Conference on Trade and Development. Source**:** World Bank http://data.worldbank.org/indicator/IS.SHP.GCNW.XQ (*30*)
	Air connectivity	Air connectivity index	0–1	**Explanation:** The air connectivity index (as a percentage, represented here as a decimal between 0 and 1) measures the full range of interactions among all countries. Source**:** World Bank https://www.openknowledge.worldbank.org/handle/10986/3486 (*31*)
	Population density	People per km²	0–1	**Source:** World Bank 2014 http://data.worldbank.org/indicator/EN.POP.DNST (*32*)
	Urbanization	Percentage of urban population	0–1	**Source:** World Bank http://data.worldbank.org/topic/urban-development (*33*)

Likelihood categories according to transmission score: no likelihood, 0; very low, > 0 to ≤ 3; low, > 3 to ≤ 7; moderate, > 7 to ≤ 9; high, > 9
***ECDC probability of suitability model: not suitable, ≤ 0.5; moderately suitable, > 0.5 to ≤ 0.7; suitable, > 0.7 to ≤ 1.0**

Table 2. Factors used to derive the country capacity score

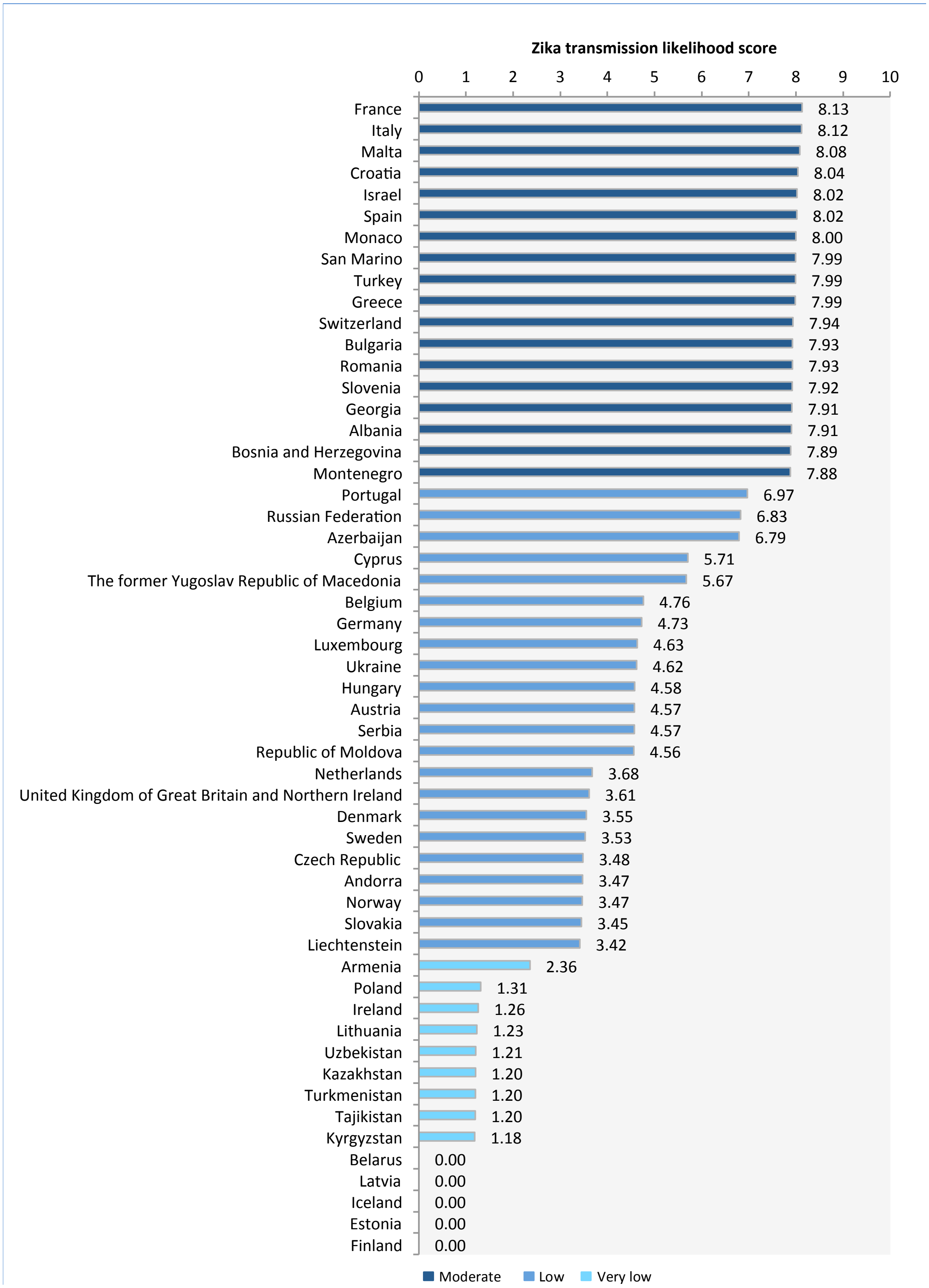
	Factor	Description	Explanation
Capacity for early containment	**Integrated vector management** **(maximum score, 2.5)**	Entomological surveillance and a plan for integrated vector management	Final score calculated from whether a country had a national entomological surveillance system in place. If the presence of competent vectors was established, countries were also scored on the existence of integrated vector management programmes. No country had a plan for integrated vector management without entomological surveillance.
		Entomological surveillance without a plan for integrated vector management (for countries without established vector presence)	
		Entomological surveillance without a plan for integrated vector management (for countries with established vector presence)	
		No entomological surveillance or plan for integrated vector management	
	Clinical surveillance **(maximum score, 2.5)**	Surveillance system for clusters of fever and rash and a vector-borne disease surveillance system	The final score for clinical surveillance was calculated on the basis of whether the country had a surveillance system to detect clusters of fever and rash (e.g. early warning system) and a dedicated surveillance system for vector-borne diseases.
		Surveillance system for clusters of fever and rash, without a vector-borne disease surveillance system	
		Vector-borne disease surveillance system without a surveillance system for clusters of fever and rash	
		Neither a surveillance system for clusters of fever and rash nor a vector-borne disease surveillance system	
	Laboratory **(maximum score, 2.5)**	PCR and ELISA for Zika virus	For non-European Union countries, the final score for this variable was calculated from the capacity for Zika virus diagnosis, assessed by the availability of diagnostic methods (PCR and/or ELISA). If countries had no capacity, they were assessed from whether they had protocols to ship blood samples abroad for diagnosis. For European Union countries, data on those variables were retrieved from the ECDC *Survey of laboratory capabilities for the diagnosis of Zika virus in Europe: interim report*.
		PCR and ELISA for arboviruses but not for Zika virus	
		Protocols to ship blood samples abroad for diagnosis	
		No laboratory capacity	
	Emergency risk communication **(maximum score, 2.5)**	Dedicated communications officer or team	The final score for this variable was calculated from whether there was a dedicated communications officer or team for Zika virus-related communications; the groups targeted (general public, travellers, pregnant women, health care workers, other sectors and partners); the channels being used (web, social media, telephone help lines, etc); the messages being delivered, including information, public health advice and preparedness; and whether a mechanism was in place to understand public perception.
		Groups targeted	
		Communications channels being used	
		Messages being delivered	
		Mechanism in place to understand public perception	

Categories according to capacity score: very low, ≤ 2; low, > 2 to ≤ 4; reasonable, > 4 to ≤ 6; good, > 6 to ≤ 8; very good, > 8
PCR, polymerase chain reaction; ELISA, enzyme-linked immunosorbent assay

Results

Likelihood of local transmission
Fig. 1 and the corresponding map show countries classified according to their score for the likelihood of Zika virus transmission. The map does not represent the risk of a Zika virus outbreak as it does not take into account countries' mitigation measures. Three localized geographical areas with established *Ae. aegypti* populations were categorized as having a **high likelihood** for transmission: Madeira Island, the Black Sea coastal area of Georgia and the Black Sea coastal area of the Russian Federation. Eighteen countries (33%) were classified as having a **moderate likelihood**, as they have established populations of *Ae. albopictus*. Twenty-two countries (41%) were classified as having a **low likelihood**, as they have no known established populations of *Aedes* mosquitoes. Of the countries in this category, three have suitable climatic conditions for *Ae. aegypti* and share borders with a country with established populations of *Aedes* mosquitoes, two have suitable climatic conditions for *Ae. aegypti* but no border with a country with established populations, eight have suitable climatic conditions for *Ae. albopictus* and borders with a country with established populations, and nine have suitable climatic conditions for *Ae. albopictus* and no border with a country with established populations of *Aedes* mosquitoes. Nine countries (17%) were classified as having a **very low likelihood**, as the climatic conditions are moderately suitable for the presence of *Aedes* mosquitoes. Of these, one borders a country with established populations of *Aedes* mosquitoes. Finally, five countries (9%) were classified as having **no likelihood** of Zika virus transmission because the climatic conditions are not suitable for the presence of *Aedes* mosquitos.

Fig. 1. Classification of countries according to likelihood score for Zika transmission*



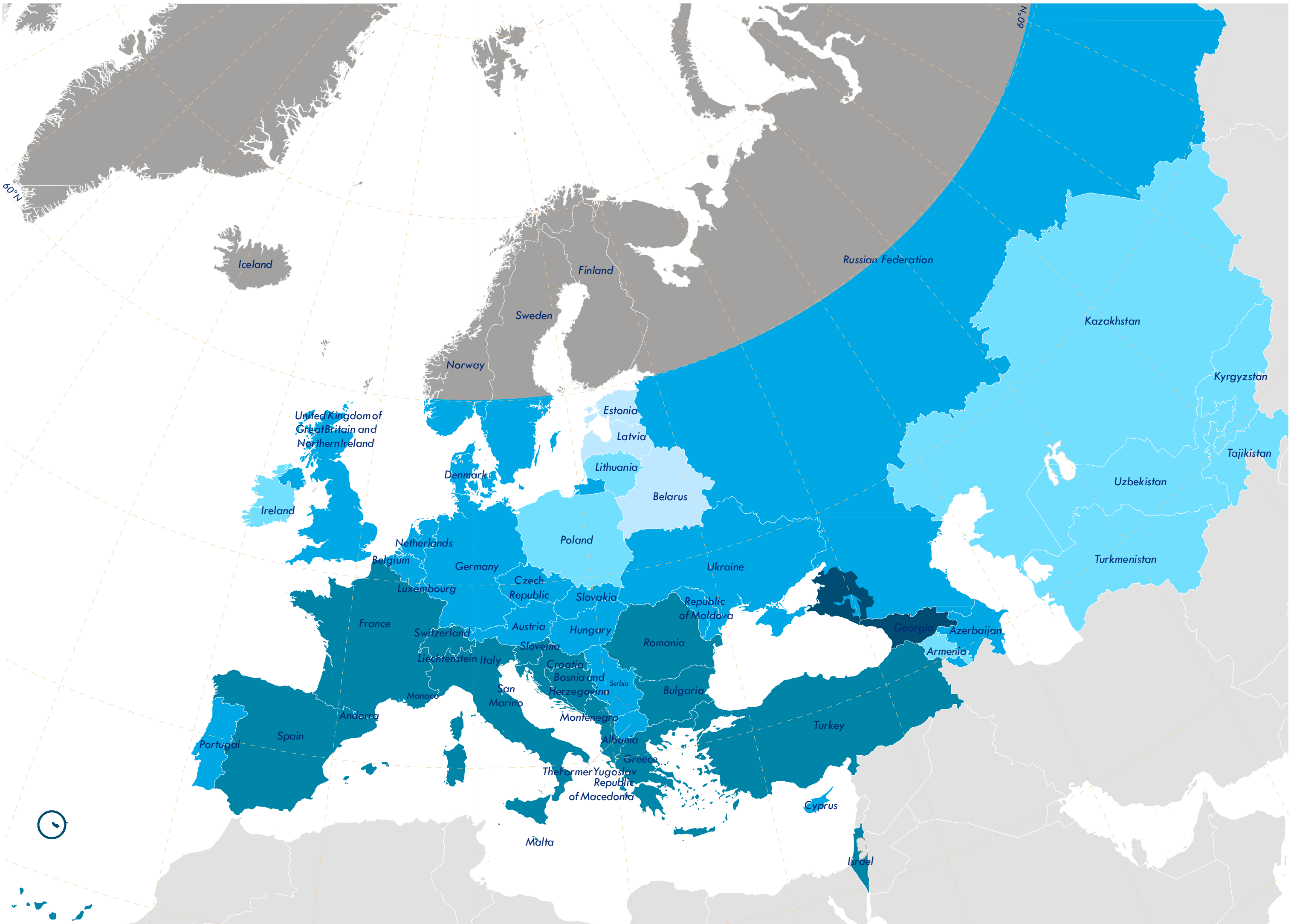
*Three localized geographical areas with established *Ae. aegypti* were categorized as having a high likelihood for Zika virus transmission: Madeira Island, the Black Sea coastal area of Georgia and the Black Sea coastal area of the Russian Federation.

Countries in the WHO European Region classified according to likelihood of Zika transmission

(This map does not represent the risk of a Zika virus outbreak, as it does not take into account countries' mitigation measures.)

World Health Organization

MAP DATE: 03 May 2016



Zika transmission likelihood categories

High | Moderate | Low | Very Low | No likelihood | Data is not available above 60°N | Madeira Island | Disputed Borders

Map Scale (A3) :1:30,000,000
1 cm = 300 km

Coordinate System: ETRS 1989 LAEA
Projection: Lambert Azimuthal Equal Area
Datum: ETRS 1989

Variables used to assess likelihood were the presence of Aedes aegypti mosquitos, presence of Aedes albopictus, climatic suitability for Aedes species of mosquitos, bordering a country with established Aedes aegypti or Aedes albopictus, history of previous arboviral outbreaks, shipping connectivity, air connectivity, population density and urbanization.

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Country capacity
Fifty-one Member States (and the Principality of Liechtenstein) of the 53 Member States (96%) responded to the questionnaire on country capacity. At the time of reporting, five (9.6%) were in the low-capacity category, six (11.5%) in the reasonable-capacity category, 27 (51.9%) in the good-capacity category and 14 (26.9%) in the very good-capacity category.

Integrated vector management: Twenty-one countries (40%) reported having no entomological surveillance in place, eight (15%) reported entomological surveillance systems but no vector management plans, and 26 (50%) reported both entomological surveillance and vector management plans in place. Of the countries with no entomological surveillance, 15 had a low likelihood for local Zika virus transmission, two had a very low likelihood, and four had no likelihood. Of those with entomological surveillance but no vector management plans, five countries had a low likelihood for local Zika virus transmission, two had a very low likelihood, and one had no likelihood. All the countries with localized areas that have a high likelihood of local Zika virus transmission reported both entomological surveillance and vector management plans in place.

Clinical surveillance: One country (2%) reported having neither early warning surveillance for rash and fever nor surveillance for vector-borne diseases; 18 countries (35%) reported surveillance for vector-borne diseases but no early warning surveillance for rash and fever, including one localized area classified as having a high likelihood for Zika virus transmission; one country (2%) reported only surveillance for rash and fever; and the remaining 35 countries (67%) reported having both surveillance for rash and fever and vector-borne diseases, including two of the localized areas classified as having a high likelihood for transmission.

Laboratory capacity: Three countries (6%) reported having no established PCR or ELISA capacity for detecting Zika virus or other arboviral infections and no protocol in place to ship blood samples abroad; however, all these countries have a very low or low likelihood of Zika virus transmission. Four countries (8%) reported no established PCR or ELISA capacity for Zika virus or other arboviral infections but had protocols in place to ship blood samples abroad; one was a localized area with a high likelihood for Zika virus transmission. Four countries (8%) reported having established PCR and ELISA capacity for detection of other arboviral infections (except Zika) but had no protocol to ship blood samples abroad; two of these have a moderate likelihood of Zika virus transmission. Ten countries (19%) reported having established PCR and ELISA capacity for other arboviral infections (excluding Zika) and protocols in place to ship blood samples abroad. Finally, 34 countries (65%) reported having established PCR and ELISA capacity for Zika virus; these included the remaining two localized areas with a high likelihood for Zika virus transmission.

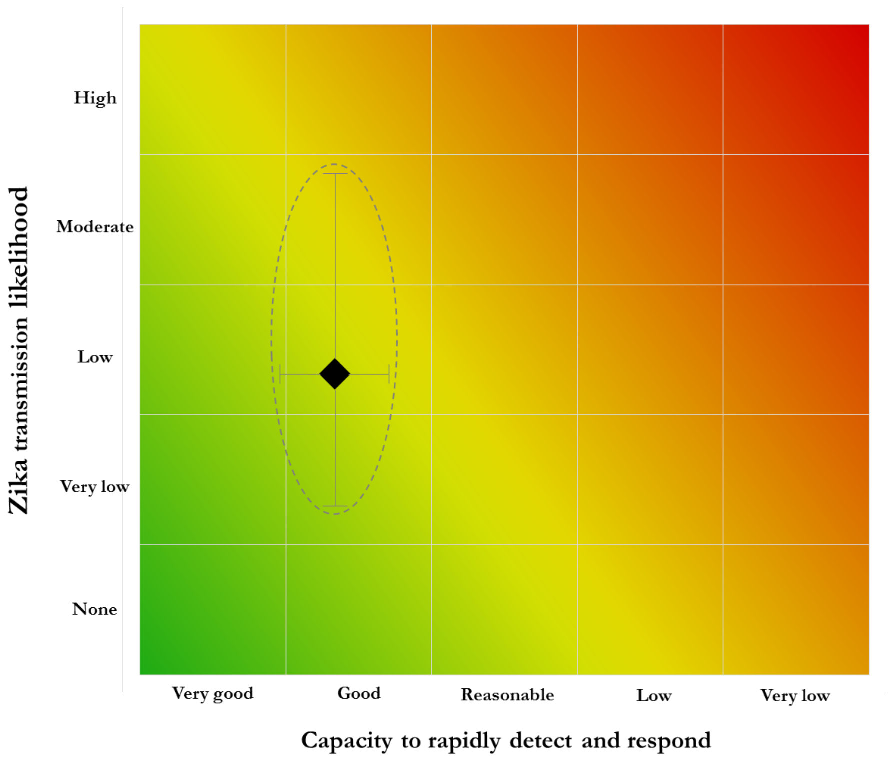
Emergency risk communication: The questionnaire responses indicated generally reasonable emergency risk communication capacity across the Region, which, however, varied by country. Two thirds of countries (68%) had a dedicated Zika virus communications officer or team and over half (57%) had a risk perception mechanism in place. Most countries indicated the involvement of health care workers, a trusted source of public health advice, who support early detection of cases of Zika virus disease. In particular:

- Audiences: All countries segmented the audience, and most targeted groups at risk (travellers and pregnant women) in addition to the general public; 45 countries (87%) specifically targeted health care workers.
- Channels: Almost all countries indicated use of the Internet and 48 (92%) the use of media channels; only half the countries indicated use of social media, but most (81%) channelled messages through health care workers; over one third (38%) used telephone lines to establish a direct link with the public, and very few used community channels (e.g. radio or television) or smartphones.
- Messages: Almost all countries provided information on Zika virus disease and the link with congenital malformations and neurological disorders, as well as public health advice to travellers; two thirds focused on government action, but only 18 countries (35%) provided advice to the community on strategies to eliminate mosquito breeding sites before spring.

Composite risk for an outbreak of Zika virus disease in the WHO European Region

The risk matrix shown in Fig. 2 represents the composite risk for an outbreak of Zika virus disease in the European Region. It is based on the median Zika transmission likelihood score (y axis) and the median country capacity score (x axis). The median transmission score was 4.6 (interquartile range (IQR) = 5.3), which corresponds to an overall low likelihood for local Zika virus transmission. The overall median capacity score was 7.3 (IQR = 1.7), which corresponds to good capacity overall to contain Zika virus transmission at an early stage. Comparison of these two components indicates that the overall risk for an outbreak in the Region is **low to moderate**.

Fig. 2. Composite risk for an outbreak of Zika virus disease in the WHO European Region



The bars represent the interquartile ranges (between the 1st and 3rd quartiles) of the Zika virus transmission risk score (y axis) and the country capacity score (x axis).

Limitations

Several limitations of this risk assessment should be noted. After the declaration that microcephaly and neurological disorders associated with Zika virus represents a public health emergency of international concern, a rapid assessment of country capacity in relation to Zika virus was required. Therefore, the questionnaire used to collect data could not be pilot-tested, and the responses with regard to country capacity could not be validated. Thus, we cannot exclude the possibility that some questions might have been subject to interpretation and reporting biases, and additional country capacity might not be accounted for. Furthermore, country capacity to prevent, mitigate and respond to Zika virus has probably increased since the time of data collection; however, it was not possible to account for these changes in the analysis. Given these limitations, the results for country capacity should be interpreted with caution.

As models for the transmission of Zika virus in the European Region had not yet been developed at the time of reporting, vector presence, climatic suitability for the vector and factors for the introduction and onward transmission of Zika virus were used as proxy indicators to derive country-level scores of the likelihood of local transmission. However, the real probability that the pathogen will be disseminated once it is introduced is currently unknown. Comprehensive transmission models are required to estimate the probability of Zika virus transmission more accurately.

Another limitation was that although available published sources were used to determine the establishment of *Ae. aegypti* and *Ae. albopictus*, gaps in data exist where entomological surveillance is not well implemented. Although the effect of this limitation was lessened by accounting for climatic suitability for the vector, this indicator was given a lower base score than known vector establishment. Thus it cannot be excluded that the likelihood of local transmission might be higher in some countries, particularly in the Mediterranean Basin and Black Sea regions, for which there were no data on the presence of *Ae. aegypti* or *Ae. albopictus* and where the likelihood of transmission was assessed only on climatic suitability and other contributory factors.

Additionally, as data were available only at national level, countries were categorized as a whole for the likelihood of transmission, although it is likely that vector characteristics vary within countries. This limitation is particularly important for large countries such as the Russian Federation, which covers an extensive area and a wide range of latitudes with varying climatic conditions.

Lastly, "capacity enablers", such as national policies and the availability of resources, could not be evaluated comprehensively. Therefore, there may be an inherent gap between reported capacity and the practical ability of some countries to implement prevention and response activities.

Conclusions

The results of this risk assessment show that while the overall likelihood of local Zika virus transmission and subsequent risk for a widespread Zika virus disease outbreak is generally low to moderate in the WHO European Region as a whole, the risk varies at country level. Many countries extending from the Mediterranean Basin have a moderate likelihood of local Zika virus transmission, while geographical areas with established populations of *Ae. aegypti*, have a high likelihood.

Although the countries in the Region have good overall capacity to contain Zika virus transmission at an early stage, the specific capacities reported (integrated vector management, surveillance, laboratory and emergency risk communication) varied substantially among them. It was encouraging to observe that countries with a high likelihood of transmission in localized areas had fairly robust capacity to prevent and rapidly control Zika virus transmission, although not all had clinical surveillance and/or laboratory capacity in place at the time of reporting.

Recommendations

The tables below list the main recommendations according to the level of likelihood for transmission and the four pillars of prevention and rapid response to a potential outbreak (integrated vector management, surveillance, laboratory capacity and emergency risk communication). Likelihood categories are divided in two groups: (i) high and moderate and (ii) low, very low and no likelihood. The first comprises countries with established populations of either *Ae. aegypti* or *Ae. albopictus* that would benefit by strengthening their capacity rapidly to detect and respond to local Zika virus transmission; the second category applies to the remaining countries, which have moderate, low or no suitable conditions for the presence of *Aedes* species and that would benefit by strengthening their capacity for rapid detection of imported cases. These recommendations are not exhaustive, and further guidance is available in specific WHO guidance documents for each area.

Countries with high or moderate likelihood of transmission

Countries with high or moderate likelihood should strengthen or maintain integrated vector management activities to prevent local transmission of Zika virus and thus mitigate the risk, by enhancing vector surveillance and control strategies to decrease vector density, according to WHO guidance (*34*). This is particularly relevant in the three regions in which *Ae. aegypti* is established and should be completed before the active mosquito season, from June onwards (*35–37*). This group of countries should also reinforce their clinical surveillance systems to ensure prompt detection of local transmission of Zika virus and be ready to report to WHO according to current recommendations (*38*). These countries should also ensure that they have either sufficient national capacity and expertise for diagnosis of Zika virus disease according to WHO guidance (*39*) or established protocols for shipping samples abroad for diagnosis (*40*). Capacity for emergency risk communication and community engagement should also be enhanced, so that people at risk can make informed decisions in order to protect themselves and others from infection and mitigate the effects of Zika virus and the potential complications of the disease (*41*).

High or moderate likelihood of local Zika virus transmission

Integrated vector management (*34*)

- Establish or maintain sentinel surveillance of *Aedes* mosquitoes, and collect data regularly.
- If an increase in *Aedes* mosquito density is detected, target breeding sites with source reduction strategies.
- Ensure that contingency stocks of nationally approved insecticides and equipment and human resources and funding are available to respond to any outbreak of diseases caused by arboviruses.
- Target control measures to the most productive breeding sites.

Clinical surveillance (*38*)

- *Aims:* Detect imported cases of Zika virus disease; detect initiation of autochthonous transmission; detect modes of transmission of Zika virus other than through vectors (e.g. sexual transmission).
- *Tools:* Event-based surveillance and indicator-based surveillance, including syndromic surveillance (i.e. rash and fever); retrospective analysis of stored samples when feasible and applicable.
- *Reporting requirements:* First confirmed autochthonous case within 24 hours of confirmation; all confirmed cases imported from a country or territory in which autochthonous transmission has **not** previously been documented within 24 hours of confirmation; any case of Zika virus infection with atypical clinical presentation as per the WHO case definition (*3*); cases of infection via transmission other than through vectors; and other cases that provide new information to guide the national or global risk assessment (weekly reporting).

Laboratory capacity (*39*)

- *In countries that are establishing laboratory capacity for diagnosis of Zika virus disease:* Nucleic acid testing (NAT) of samples from patients presenting with onset of symptoms < 7 days; serology and/or NAT in patients presenting with onset of symptoms ≥ 7 days. Serology is the preferred method for examining specimens from patients with onset of symptoms > 7 days.
- *In countries that are not establishing laboratory capacity for diagnosis of Zika virus disease:* Arrangements should be made to ship samples abroad for diagnosis as per WHO guidance (*40*).

Emergency risk communication (*41*,*42*)

- Focus on five main interventions: public communication, translational communication, stakeholder coordination, community engagement and dynamic listening.
- Establish a dedicated communications staff or unit on Zika virus.
- Target messages to key groups (i.e. travellers, pregnant women, the general public, health care workers and local policy-makers, using the most appropriate channels to reach each group.
- Assess the size of at-risk groups (e.g. women of reproductive age), and assess community knowledge and policies on reproductive health.
- Develop or strengthen a mechanism for evaluating risk perception, including sexual and reproductive health concerns and services relevant to Zika virus disease and religious views, for use in the emergency risk communication strategy.
- Focus messages on information on Zika virus disease and neurological complications; public health advice for at-risk groups, including travellers and pregnant women; recommendations on protective measures, including vector control and prevention of sexual transmission; and government action.
- Be flexible and adaptable as the Zika virus disease outbreak situation and evidence evolve.
- Engage other sectors, in particular, air, shipping and tourism industries, in discussions of issues and advice on travel, passenger and cargo aircraft and shipping.

- Conduct operational research to target the response in areas in which there are outbreaks or cases and to better understand high-priority groups and communities; use the WHO resource pack on knowledge, attitudes and practice (KAP) surveys with regard to Zika virus disease and potential complications (*43*).

Countries with low, very low or no likelihood of transmission

Countries with low, very low or no likelihood of transmission should focus on emergency risk communication (*41*) to travellers, so that those at greatest risk can make informed decisions to protect themselves when travelling to affected countries. Engaging with health professionals is key for ensuring early detection of imported cases of Zika virus disease and potential complications. Countries in this group that wish to establish laboratory capacity should follow WHO guidance on laboratory diagnosis of Zika virus infection (*39*), whereas countries that do not wish to do so should ensure that they have established protocols for shipping samples abroad for diagnosis (*40*). Integrated vector management strategies should be adopted in accordance with countries' likelihood of Zika virus transmission, as described below.

Low, very low or no likelihood of local Zika virus transmission

Integrated vector management (applicable only for countries with low or very low likelihood) (*34*)

- Enhance entomological surveillance in border areas.
- Monitor imported goods (e.g. used tyres, plants) from countries endemic or receptive for *Aedes*, and use quarantine to avoid entry of invasive species of mosquitoes.
- Conduct vector surveillance and control at points of entry as per the International Health Regulations (2005), preferably with non-chemical interventions, such as source reduction.

Clinical surveillance (*38*)

- *Aims:* Detect imported cases of Zika virus disease; detect modes of Zika virus transmission other than by vectors (e.g. sexual transmission).
- *Tools:* Event-based surveillance, indicator-based surveillance including syndromic surveillance, retrospective analysis of stored samples when feasible and applicable.
- *Reporting requirements:* All confirmed cases imported from a country or territory in which autochthonous transmission has **not** previously been documented within 24 hours of confirmation; any case of Zika virus infection with atypical clinical presentation as per the WHO case definition (*3*); cases of infection via transmission other than through vectors; and other cases that provide new information to guide the national or global risk assessment (weekly reporting).

Laboratory capacity (*39*)

- *In countries that are establishing laboratory capacity for diagnosis of Zika virus infection:* Nucleic acid testing (NAT) of samples from patients presenting with onset of symptoms < 7 days; serology and/or NAT in patients presenting with onset of symptoms ≥ 7 days. Serology is the preferred method for examining specimens from patients with onset of symptoms > 7 days.
- *In countries that are not establishing laboratory capacity for diagnosis of Zika virus disease:* Arrangements should be made to ship samples abroad for diagnosis as per WHO guidance (*40*).

Emergency risk communication (*41*,*42*)

- Focus on five main interventions: public communication, translational communication, stakeholder coordination, community engagement and dynamic listening.
- Target messages mainly to travellers, the general public and stakeholders through suitable channels.
- Focus messages on information on Zika virus disease, modes of transmission (including sexual transmission) and neurological complications; public health advice for travellers (including sexual behaviour); and government action.
- Be flexible and adaptable as the Zika virus disease outbreak situation and evidence evolve.
- Engage other sectors, in particular, air, shipping and tourism industries, in discussions of issues and advice on travel, passenger and cargo aircraft and shipping.

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