POLICY BRIEF

On Urgently Tackling the Mosquito-Borne Diseases in the European Union

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Abstract

Context: According to a recent Lancet report the world is dangerously close to reaching climate-driven points of no return. Climate change, together with other drivers, contributed to a large diffusion of mosquito-borne diseases (MBDs) in the last decades. The intensity of such a phenomenon led various mosquito species to migrate to new areas, outside their historical habitats. Europe is among the affected territories. Moreover, the problem is projected to rise and expand within the continent, including populations who have never been exposed to MBDs and impacting the whole society, especially the most vulnerable groups. As Europe is a relatively new area for the diffusion of MBDs, no strong and unified measures have been put into practice yet. Meanwhile, MBDs surveillance experiences implemented across Europe report gaps, such as the absence of entomological research and legal support, the capacity limitation for surveillance, and variability in entomological and epidemiological surveillance systems. Hence, it could be necessary to use the experiences from Latin America, Asia and Africa. Given the aforementioned overview, this policy brief aims to provide policy options in order for the European Union to address MBDs, with a particular emphasis on strengthening surveillance across the Member. States given recent attention drawn to this issue by the ECDC's 2021 report on vector control and surveillance.

Policy Options and recommendations: This advisory group conducted a non-systematic literature review to determine three policy options, with a specific focus on surveillance, to address the issue of MBDs. 1. Surveillance systems for mosquitoes and MBDs should be implemented in all member states, and case definitions for these MBDs should be harmonised to enable coordination and consistency of MBDs surveillance across the European Union (EU). 2. Create an EU-level networks umbrella for financial and organisational coordination of Member States (MS)' multi-sectoral collaboration on MBDs surveillance. 3. Developing the competencies for surveillance and research professionals for mosquitoes and MBDs surveillance.

Keywords: *Mosquito-borne diseases, Europe, Climate change, One Health, Preparedness, Surveillance.*

Introduction

Diseases that are spread between humans and animals through the bite of infected mosquitoes are known as "mosquito-borne diseases" (hereafter MBDs) (1). The most commonly transmitted pathogens worldwide are Malaria, Dengue, West Nile Virus (WNV), Chikungunya, and Zika (1). More specifically, viruses such as WNV, Chikungunya, and Dengue have started to expand in the Mediterranean Basin, especially in the places where *Aedes Albopictus* or *Aedes Aegypti* mosquitoes are present (2).

This is evidenced by recent World Health Organization (WHO) Europe reports which indicate that MBDs represent 17% of communicable diseases with 700,000 deaths annually attributed to them worldwide (3). Moreover, no effective treatments or vaccines have been developed for all MBDs, a condition that highlights the importance of prevention (4). It is as well relevant to note that MBDs are likely to impact the most vulnerable members of society, i.e., the elderly, those with poor socio-economic status (for poorer populations display higher morbidity and mortality rates (5), and those with comorbidities. Despite being more prevalent in tropical countries, MBDs have been spreading in Europe in the last decades (6).

The diffusion of MBDs is facilitated by non-climate drivers such as globalisation, urbanisation, environment, socio-demographics (for instance, living lower social conditions is associated with increased vulnerability to health risks and lower healthy lives), public health systems (i.e., poor financial investment and lack of effective vector control strategies, and weak political commitment) and vector and pathogen characteristics (7,8). Climate change, which has been acknowledged by the WHO as the most serious public health threat of the 21st century, is a notable climate driver facilitating the expansion of MBDs and, specifically, *Aedes* mosquitoes (9). Indeed, the increase in temperature not only contributes to mosquitoes' migration to new areas but also allows for greater incidence of MBDs and longer transmission periods (7). The combination of the aforementioned factors contributes to altering the environmental and ecological conditions of several areas of the world, thus

allowing new places to become suitable for mosquitoes (7).

The complexity and urgency of the phenomenon warrant prevention and control strategies. Thus, a One Health approach is crucial for addressing the multifaceted nature of MBDs. This type of approach contributes to integrated human and animal surveillance and response systems and facilitates multi-sectoral collaboration across several fields (10). Furthermore, the One Health has benefits as evidence shows that the approach can save costs of hospitalizations and compensation for transfusion-associated diseases (11).

In recent years, there has been an increasing engagement between health and climate experts, the scientific sector, the corporate sector, and politics. This has led to the implementation of mitigation and adaptation measures to alleviate the effects of climate change, albeit the intersection between health and climate change is relatively low compared to the overall engagement (6). In the specific context of climate change and MBDs, enhanced intersectoral cooperation among experts in MBDs drivers, climate and health sector as well as between these professionals and policymakers, represents a pivotal first step in investigating the complexity of the phenomenon and allowing for the mutual exchange of ideas and building on the body of evidence on MBDs.

Context

Narrowing the perspective to the sole European context, it is evident that climate change consequences are becoming intensified. In 2022, Lancet reported that Europe suffered the hottest summer ever recorded and an alarming increase in health-related hazards. Indeed, given the rise in ambient temperatures, the vector capacity of *Culex* species and the establishment of *Aedes* mosquitoes are expanding, leading MBDs to be notably on the rise in Europe (6).

Regarding MBDs diffusion within the European continent, several outbreaks have been witnessed in the last decade. Sporadic autochthonous Dengue outbreaks have been reported in Spain and France. In 2018, was reported the largest outbreak of WNV with 1584 locally acquired infections, mainly in South and East European countries (6).

Chikungunya and Zika have been reported also in France and Italy since 2019 (12).

Projections from the modelling of MBDs highlight that this issue will continue to rise. The length of the transmission season (LTS) is predicted to increase over the Balkans and in northern Italy by 2100. Specifically, the malaria-epidemic and Dengue-epidemic belts are predicted to increase northward to include Central Northern Europe. If MBDs expand into populations unexposed to these diseases or in ill-prepared health systems - with limited public health workforce training in MBDs and epidemiological and entomological MBDs surveillance- this situation may lead to outbreaks (13).

The prevention measures across Europe are still suboptimal (14). For instance, the limited entomological research, legal support, the capacity limitation for surveillance, and variability in entomological and epidemiological surveillance systems represent some of the gaps in the European response. To address these and other gaps, the Member States (MS) must incorporate prevention, surveillance, and control of re-emerging MBDs into the political agenda and develop effective national plans (15,16).

Coordinated actions between the MSs and other European institutions such as the European Commission, the European Centre for Disease Prevention and Control (ECDC), the Health Emergency Preparedness and Response Authority (HERA), and WHO Europe are also crucial. Therefore, given the aforementioned overview on the significant rising threat of MBDs three key areas were identified that require improvement to address the challenges around preparation and coordination of control and prevention within the EU. The areas were identified after a broad literature review of the following databases: PubMed and Google Scholar. In doing so, the literature review consulted peer-reviewed articles, grey literature and reports and aimed to identify existing gaps and evaluate Europe's preparedness to tackle rising MBSs to develop the following policy options.

1. Surveillance for mosquitoes and MBDs is not present across the EU. Harmonised surveillance is also

hindered by the lack of implementation of common case definitions.

2. Intersectoral collaboration is insufficient in some MS due to a lack of organisational and human resources, and the existing EU-level networks which aim to support MS are not sustainable and often have overlapping objectives.
3. Treatment and detection of MBDs are hindered by a lack of entomologists and entomological research, as well as a low-risk perception of MBDs by healthcare professionals.

The policy options suggested are underscored by the current WHO strategy: 'Global Vector Control Response 2017-2030 (GVCR)'. This strategy is grounded in four pillars. First, strengthening inter- and intra-sectoral within and outside the health sector. Second, engaging and mobilising existing MBD-related networks. Third, scaling up and integrating vector control tools and approaches. Lastly, enhancing entomological surveillance and monitoring and evaluation. Furthermore, GVCR is supported by a foundation of vector control capacity strengthening and increased basic and applied research and innovation. There are enabling factors, including country leadership, advocacy, resource mobilisation, partner coordination, and regulatory, policy, and normative support (5). Against this background, the following recommendations are proffered.

Policy recommendation 1: Surveillance systems for mosquitoes and MBDs should be implemented in all member states, and case definitions for MBDs should be harmonised to enable coordination and consistency of MBDs surveillance across the EU

Surveillance:

Surveillance is critical for the prevention of MBDs (17). Although as is demonstrated below in Figure 1, vector surveillance for mosquitoes is not fully present across the EU. The countries without this surveillance include Slovakia, Romania, and Estonia. While in Estonia and Slovakia, there is not yet local transmission, Romania does have local transmission of WNV, and the vector

is currently present for Dengue, Chikungunya, and Zika. However, the threat of these diseases is growing and could reach these areas in the future, requiring action now (14).

In addition, according to the ECDC, six countries lack surveillance specifically for Dengue/Chikungunya/Zika, and three countries lack WNV surveillance. Countries, where surveillance should be particularly supported, include Romania, Slovakia, and Hungary, where it is reported that surveillance for all the above-mentioned diseases is lacking (14).

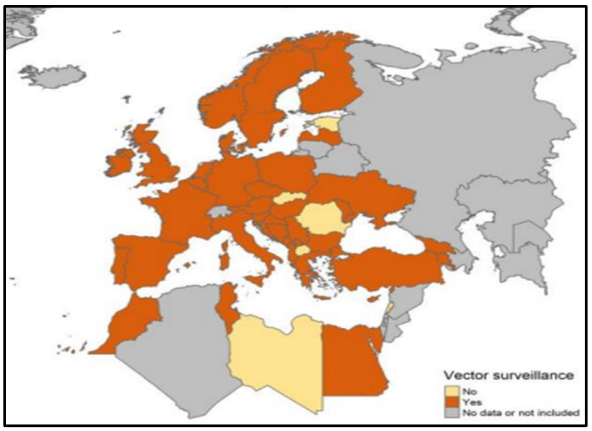

Figure 1: Mosquito control and surveillance in Europe (14).

Case Definitions:

To ensure that the severity of MBDs can be compared across Europe and support policy decisions in relation to this, case definitions must be harmonised across the EU. Common case definitions have been established to be critical for the sensitivity of a surveillance system (16). Particularly within the context of the EU, it has been long recognised that the free movement of people and goods increases the need for common case definitions and clear communication between MS (18,19).

While Dengue, Chikungunya, Malaria, Zika, and WNV European Union Case Definitions (most recently from 2018) are available, not all European countries use these definitions, which can lead to possible issues in comparison. As demonstrated by Figure 2, WNV and Malaria are key diseases for which no case definition harmony exists.

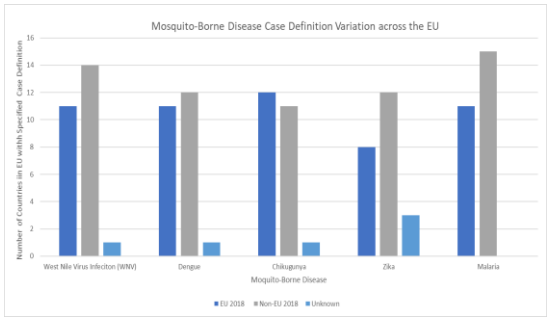

Figure 2: Mosquito-Borne Disease Use of Official EU Case Definitions across the EU (20)

Additionally, Figure 3 shows that Germany, the Czech Republic, the Netherlands, and France are the specific countries which do not use an EU case definition for surveillance. Please see Appendix 1 for further information.

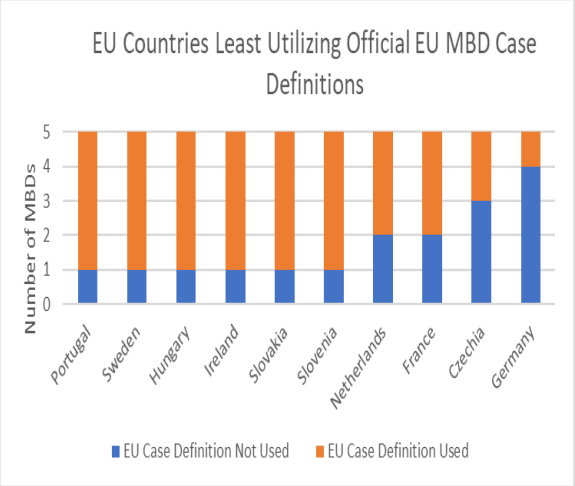

Figure 3: EU Countries Least Utilizing Official EU MBD Case Definitions (20)

How to achieve policy option 1:

The fundamental aspects of such a harmonised system are already available through the common EU case definitions. However, leadership is needed to adopt these case definitions, and clearly identify and address barriers to their implementation to utilise these existing frameworks.

The EU can look to the Americas, where vector-borne diseases have been a significant issue and where agreements and resolutions across countries have resulted in action. For example, Resolution CD55 R.6 of the WHO/PAHO arboviral disease prevention and control and resulting meetings. This resolution urged signing members to improve their surveillance systems for MBDs (21). A number of meetings were held for this resolution. Of note is the meeting organised by the WHO/PAHO where health ministers shared experiences of surveillance and control of MBDs (22). Sharing experiences at this level would be helpful for European countries specifically as many of the states without mosquito surveillance systems state that it is because of a lack of a legal framework, which other states have, giving them the opportunity to learn from each other. Resolution CD55 R.6 resulted in many other actions, such as countries developing their own One Health oriented ministries, standardising the evaluation of vector surveillance across countries and mobilising financial resources to assist states in technical aspects such as training

personnel and obtaining necessary laboratory supplies (19).

The EU must investigate these efforts by the Americas and start by working together at the health ministry level, through the Council of Europe, to dedicate themselves to sharing experiences and improving surveillance and in turn prevention. Health ministers have the opportunity to lead this change through recommendations. Council Recommendations in the area of health have been successful in the past in directing future action, for example through the Conclusions on alcohol-related harm reduction (17).

Surveillance systems and common case definitions are critically intertwined with the following policy options and improvements in these areas will also contribute to improvements in surveillance through further sharing of experiences and improving technical capacities for surveillance across the EU.

Policy recommendation 2: Create an EU-level networks umbrella for financial and organisational coordination of MS multi-sectoral collaboration on MBD surveillance

The COVID-19 outbreak shone a light on the importance of EU collaboration to not leave any country with a lack of resources behind and became a reason for establishment of the EU subsidy Health Programme (EU4HEALTH), for strengthening healthcare and promoting innovation (23). Moreover,per WHO GVCR framework, inter- and intra-sectoral action and collaboration is the first pillar to achieve locally adapted and sustainable vector control (5). At the moment, the level and areas of collaboration in terms of the One Health approach dramatically vary from one MS to another. For instance, Spain has no MBD control collaboration between public and veterinary health sectors, and France faces the same issue in addition to a lack of collaboration with the environmental sector. While Italy has multiple areas of collaboration (vector surveillance design, vector control design, data collection, data sharing, data management or/and storage, data analysis and interpretation, and communication), Greece asserts only data

sharing (14). Please see Appendix 2 for further information.

Furthermore, the ECDC recent report has shown that the most significant challenges for tackling MBDs are related to funding and human resources (14) in European countries (14). Hence, the above-mentioned challenges could be avoided with the coordination and funding of networks of the cross-sectoral workforce at a pan-European level, according to the ECDC technical report (14).

Though, despite the range of existing voluntary, created, or supported by EU MBD-related networks, their objectives are overlapped (please see Appendix 3). For instance, PREPARE4VBD (Grant by Horizon Europe) and EarlYWArning System for Mosquito-borne diseases (part of EuroGEO Action Group) both intend to become a gold standard tool for Vector-Borne Diseases in terms of model-based surveillance for early detection, forecasting and monitoring MBDs. Furthermore, MBDs networks are based on a different pool of experts, fields, and institutions for the same aim (24, 25).

This case exemplifies the problematic separation of experts and duplications in network objectives, scopes, and processes. Finally, collaboration would also be beneficial for existing networks involved. An EU-umbrella coordination of the existing networks will bring added value in terms of:

- Avoiding duplications and redundancy among the networks;
- Sustainable collaboration;
- An advisory role for MS harmonised surveillance actions;
- Facilitating the cross-border knowledge, data and workforce exchange.

How to achieve policy option 2:

An example of a good practice from which the EU can learn from is the establishment of the African Network on Vector Resistance to insecticides (ANVR) in 2000 and coordinated by the Regional Office for Africa. Malaria prevalence in the African Region declined by 68% of the clinical cases between 2000 and 2015 (5). ANVR has played an important role in MBD prevention

in the African Region for 22 years as a platform for successful partnerships between research institutions, national vector control programs, NGOs and the private sector.

ANVR initiative has driven the development of a medical entomology network, standardising protocol for testing malaria vector susceptibility to insecticides, training activities, collection of preliminary data on the status of malaria vector susceptibility to insecticides. As well, ANVR created guidelines for planning implementation and monitoring of vector resistance for countries in the African Region (26).

With regards to ANVR-specific terms of reference and the WHO Europe framework, the umbrella network should be based on the following objectives:

1. Collaboration with all relevant institutions in order to standardise and harmonise methodologies, protocols, and guidelines for analysis of data and interpretation of results to enhance evidence-based policy and strategy development
2. Assistance for MS in capacity building for vector surveillance and epidemic preparedness and response
3. Building consensus on approaches to the surveillance and control of MBD and preparing practical guidelines at the national level
4. Coordination of network activities, facilitating and promoting the dissemination and exchange of information on MBD surveillance and control
5. The development and assessment of new monitoring tools and the continuous production of updated vector distribution and resistance maps for each country and for the whole region.

Policy recommendation 3: To develop capacity for surveillance and research professionals for mosquitoes and mosquito-borne disease surveillance.

The WHO GVCR 2017-2030 has recognised the need for capacity building as a pillar of the GVCR framework (5). The capacity to address emerging MBD threats is reliant upon the readiness of the healthcare system

(27). This is made evident with adequate infrastructure, standard guidelines, equipment, diagnostic capacity, and trained personnel (27). Due to the intersectionality of current issues, a range of professionals - entomologists, virologists, and public health workers- are required to ensure detection and treatment of MBDs.

However, there is a low to medium-risk perception of MBDs among healthcare professionals in Europe, a shortage of medical entomologists worldwide, and an absence of entomological research (28). Therefore, capacity building on MBD surveillance through training healthcare and public health workforce is paramount to ensure preparedness.

Trained personnel: The role of healthcare professionals in the MBD

A study undertaken in France assessing the perceived risk of three MBDs (Dengue, Chikungunya, and Zika) identified a low to medium risk perception among Infectious Disease physicians (29). Factors such as professional training, tropical experience, and knowledge of the national plan against the spread (NPS) of Dengue, Chikungunya, and Zika influenced physicians' disease risk perception. This study and many others have pointed to a need to "assure a competent workforce," (30).

Training on MBDs diagnosis, treatment, and surveillance is particularly important. Healthcare professionals have a key role in promoting and adopting disease-prevention behaviours (20). Additionally, capacity can be built in emergency preparedness training across all sectors (28). This highlights a need for modification and, in turn, the application of a training manual of this kind across the EU.

Trained personnel: The role of entomologists in MBD

Among the seventeen activities established by WHO to mitigate MBDs, two are related to entomologist capacity. The first is training of relevant staff from health ministries or supporting institutions in public health entomology. The second activity is developing national and regional institutional networks to support training

and education in public health entomology and technical support (5).

However, across the EU there is a need for more information on how many entomologist workforces are available, and how entomologist training is developing through the public health workforce in the Member States (MS). Furthermore, creating entomologist capacity across the EU has been limited by a short-term surveillance vision and the lack of financial and human resources. During the Covid-19 pandemic, some European countries stopped or did not implement their entomological surveillance strategies (16, 31).

How to achieve policy option 3:

Creating capacity building in healthcare professionals in MBD

Capacity building can be achieved through training with the aid of a manual. Research suggests that training relevant personnel plays a key role in mitigating MBDs (27). However, presently, in the EU, there is no harmonised guideline or training manual for which surveillance, research and healthcare professionals can be trained on MBDs.

Whilst the WHO established a training manual in 2016, aimed at providing knowledge to European professionals and supporting their skills in dealing with mosquito-borne diseases (32).

Creating capacity building in public health entomology:

To create preparedness and entomological capacity, it is fundamental that European countries inform the entomologist workforce available to the ECDC and include this information in the technical report of vector surveillance and control in Europe.

Secondly, a long-term entomological surveillance strategy, with financial and legislative support, must be encouraged to ensure success even through crises such as COVID-19 pandemic. Furthermore, specific actions to create capacity building must be suggested to MS, and at different levels and sectors. For instance, the vector control program against Dengue in Singapore has included capacity development as one of its strategic pillars and implemented it among the public health workforce, intersectoral, and community (33).

Overall, the program has included ongoing professional development through courses organised by the National Environment Agency (NEA). It provided staff rotations between departments other than health, courses to the community, financial support, and leave to attend higher education, establish contacts with academic and research institutions to offer degrees, and develop research in entomology (33).

Recommendations:

1. Surveillance systems for mosquitoes and MBDs should be implemented in all member states, and case definitions for MBDs should be harmonised to enable coordination and consistency of MBDs surveillance across the EU

2. Create an EU-level networks umbrella for financial and organisational coordination of MS' multi-sectoral collaboration on MBD surveillance

3. To develop capacity for surveillance and research professionals for mosquitoes and mosquito-borne disease surveillance

There are methodological limitations of this paper. Given that this is a non-systematic literature review, all policy options for the given problem were not analysed. The search strategy for this paper was limited to searches conducted primarily in English. Given the One Health nature of this paper, it is also a limitation that all authors come from the public health field, thus there is potential for a lack of consideration of the problem from the point of view of other sectors.

Conclusion

MBDs are a growing threat that Europe must be prepared to address. The nature of MBDs requires prevention and control to be the primary strategy. A One Health approach, bringing together stakeholders such as entomologists and public health professionals, across sectors can optimise these preventative measures. European countries need to commit to this action specifically in the areas of surveillance,

coordination of efforts and capacity building of professionals. The EU can look on other countries experiences for successful examples and utilise guidance from the WHO to build on their existing networks and take additional measures to address this issue and prepare for the approaching danger of MBDs

Conflicts of interest: None declared

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Appendix 1. Table No.1: Case Definitions of Mosquito Borne-Diseases across the EU (34,35)

Mosquito-Borne Diseases (MBDs)	Official Case Definition: Confirmed Case	Clinical Criteria	Laboratory Criteria	Epidemiological Criteria	Countries included in Analysis	Case Definition Used					Sum	Other: Which Countries	Unknown: Which countries
						EU 2008	EU 2012	EU 2018	Other	Unknown			
West Nile Virus Infection (WNV)	Must meet the laboratory criteria	One of the below 1. Encephalitis 2. Meningitis 3. Fever	At least one of the below: 1. Isolation of WNV from blood or CSF 2. Detection of WNV nucleic acid in blood or CSF 3. WNV specific antibody response (IgM) in CSF 4. WNV IgM high titre AND detection of WNV IgG, AND confirmation by neutralisation	At least one of the below: 1.Animal to human transmission 2. Human to human transmission through vertical transmission, transplants, or blood transfusion	EU except for Denmark	7	6	11	1	1	26	France	Germany
Dengue	Must meet the laboratory criteria	Fever	At least one of the below: 1. Dengue virus from clinical spectrum 2. Detection of Dengue viral nucleic acid 3. Detection of Dengue viral antigen 4. Detection of Dengue specific IgM antibodies in a single serum sample and confirmed by neutralisation Seroconversion or four-fold antibody titre increase of Dengue specific antibodies in paired serum samples	Travel to/residence in area with on-going transmission of Dengue documented in the past two weeks from the start of the symptoms	EU except for Denmark, Cyprus, Bulgaria	3	5	11	4	1	24	Czechia, Germany, and Netherlands, and Portugal	France

Chikungunya	Must meet the laboratory criteria	Fever	At least one of the below: 1. Isolation of Chikungunya virus 2. Detection of Chikungunya viral nucleic acid 3. Detection of Chikungunya specific IgM antibodies in a serum sample AND confirmation by neutralisation 4. Seroconversion or four-fold antibody titre increase of Chikungunya specific antibodies in paired serum samples	Travel to/residence in area with on-going transmission of Chikungunya documented in the past two weeks from the start of the symptoms	EU except for Denmark, Cyprus, Bulgaria	4	4	12	3	1	24	Czechia, Germany, Sweden	France
Zika	Must meet the laboratory criteria	Rash	One of the below: 1. Detection of Zika virus nucleic acid 2. Detection of Zika virus antigen 3. Isolation of Zika virus 4. Detection of Zika virus specific IgM antibodies in serum sample(s) AND confirmation by neutralisation test 5. Seroconversion or four-fold increase in the titre of Zika specific antibodies in paired serum samples	Travel to/residence in area with on-going transmission of Dengue documented in the past two weeks fromthe start of the symptoms OR sexual contact with a person exposed/confirmed to Zika	EU except for Bulgaria, Denmark, Poland, Sweden	1	3	8	8	3	23	Czechia, Germany, Hungary, Ireland, Netherlands, Slovakia, Slovenia (Portugal: EU Case Definition which is legacy/depre cated)	Croatia, France, Malta
Malaria	Any person meeting the clinical and the laboratory criteria	Fever or a history of fever	One of the below: 1. Demonstration of malaria parasites by light microscopy in blood film 2. Detection of Plasmodium Nucleic Acid 3. Detection of Plasmodium antigen 4. Detection of Plasmodium antigen	NA	EU except for Denmark	8	5	11	2	0	26	France and Germany	

Appendix 2. Table No.2: Organisation of surveillance on MBDs in Southern European countries in terms of the One Health Approach (17)

One Health	Italy	France	Spain	Grece
Is there a formalised collaboration between public and veterinary health sector related to vector surveillance or vector control?	Vector surveillance, Vector control	Vector surveillance, Vector control	Vector surveillance	Surveillance, control
If yes, please specify the area(s) of collaboration	Vector surveillance design, Vector control design, Data collection, Data sharing, Data management or/and storage, Data analysis and interpretation, Communication	Data sharing, Data management or/and storage, Data analysis and interpretation, Communication	Vector surveillance design, Data collection, Data sharing, Communication	Data sharing
Is there a formalised collaboration between public/veterinary health sector and the environmental sector related to vector surveillance or vector control?	Vector surveillance and control	No formalised collaboration exists	Vector surveillance, control	Vector control
If a formalised collaboration exists, please specify the area(s) of collaboration	Other	None	Biocides regulation	Biocides regulation

Appendix 3. Table No.3 The intersection of existing MBDs networks across the European Union (24,25, 36,37)

Network purpose	EU Network
Providing **expert advice** on the optimal diagnosis and management of imported tropical and infectious diseases	TropeNet/ VectorNet
Providing a **platform for collaborative research** on travel-related infectious and non-infectious diseases	TropeNet/ EYWA
Providing **evidence-based recommendations** on key issues related to Tropical and Travel Medicine in Europe.	TropNet
To set the basis for Pan-European administrative unit **distribution maps** of the major arthropod vectors of diseases	VBORNET /VectorNet
To define **priority strategic topics** concerning the **public health perspective** of vector-borne diseases and vector surveillance	VBORNET
To improve **preparedness and response** for vector-borne diseases following one health approach	VectorNet/ PREPARE4VBD
Collection of data on vectors and pathogens in vectors related to human and animal health	VectorNet

Database (medical, veterinary experts and organizations) on the presence and distribution of vectors and pathogens in vectors	VBORNET/ VectorNet
Ad-hoc scientific advice to support ECDC and EFSA with technical questions on vector surveillance and vector-borne diseases in humans and animals	TropNet/ VectorNet
Combines interdisciplinary scientific fields (entomology, epidemiology, ecology, EO, Big Data Analytics, AI/ML, Ensemble Dynamic/Hybrid vs Data-Driven models, Data Fusion, and Citizen sciences) towards **building new directions in applied research** and **innovative services for public health**, such as **outbreak forecasting and decision support modeling for vector control applications** and other mitigation actions	EYWA/ TropNet
Offer a scalable, reliable, sustainable, and cost-**effective Early Warning System (EWS**) relying on big Earth Observation (EO) data in conjunction with environmental, climatic, and meteorological essential parameters, socioeconomic and population data, ecosystem and morphological related parameters, as well as **epidemiological and entomological data to forecast and monitor** MBDs.	EYWA/ PREPARE4VBD
Developing of new knowledge, detection tools, and surveillance systems to improve **preparedness** for VBDs	PREPARE4VBD/ VectorNet
Developing of improved tools for rapid detection and state-of-art model-based surveillance for early **detection and forecasting** to form a blueprint for best practices for optimized VBD **surveillance strategies** for the targeted diseases	PREPARE4VBD/ EYWA