GLOBAL ARBOVIRUS INITIATIVE

Preparing for the next pandemic
tackling mosquito-borne viruses with epidemic and pandemic potential

World Health Organization

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Foreword

An effective response to public health emergencies entails being ready, being fast, and being agile. The Global Arbovirus Initiative brings together a collaboration of partners working on a range of viruses transmitted by Aedes mosquitoes and across disciplines to ensure these three attributes are harnessed in the most effective and efficient way. This Initiative outlines an integrated approach across these viruses and disciplines that will enable optimal use of limited resources to achieve the greatest impact, particularly in areas with the heaviest arboviral burden and in areas that are at risk of emergence of arboviruses.

The public health emergencies in recent years, including Zika in 2016 and more recently the COVID-19 pandemic, continue to humble us. As a society we remain susceptible to many recognized and some unrecognized infectious disease threats. However, these events have also highlighted the possibilities for effective collaboration, strengthening of evidence-based recommendations, and rapid progress in diagnostic and therapeutic innovation. I think that we need to be clear that

Many of us were responders in the Zika Public Health Emergency of International Concern in 2016, highlighting the havoc and potential for unexpected consequences of arboviral diseases when it was recognized that infection during pregnancy could result in neurodevelopmental disorders, including microcephaly. Large-scale endemic and epidemic transmission of dengue viruses contributes to significant morbidity throughout the tropics, with many affected areas struggling with insufficient healthcare resources to deliver clinical management known to reduce mortality. At the same time, communities in Africa and the Americas battle deadly yellow fever outbreaks despite the existence of a safe and effective vaccine. While Chikungunya continues to broaden the geographic footprint of disabling epidemic arthritis, recent resurgences with unprecedented case numbers in the Americas have highlighted the need for specialized health care for those at the extremes of age at risk of severe disease and even death.

For each of these diseases there have been gains in different aspects of surveillance, response, and research and development but sustainability is often limited to the scope and duration of disease-specific projects. There is an urgent need to re-evaluate the tools at hand and how those can be used across diseases to ensure efficient response, evidence-based practice, equipped and trained personnel, and engagement of communities. Therefore, we need to leverage the gains made during the COVID-19 pandemic for arboviruses as we are building this initiative - not just from past arbovirus outbreaks, but from the significant gains made across surveillance, testing, sequencing, infection prevention and control, clinical care pathways, scientific collaborations and coordination.

WHO and partners have been working to ensure a more integrated approach to Aedes-borne arboviruses, which comprise broad but related public health threats that can best be addressed by leveraging virus-specific advances in this technically challenging field. The publication of this Initiative outline document is the culmination of a series of regional and global consultations and the expert input of the Technical Advisory Group for Arboviruses that served to refine the priorities and key actions outlined under the Initiative.

WHO continues to support vulnerable countries in preparedness and response for health emergencies. Capacity building must extend from local to regional and global levels. WHO stands ready to lead and support these strategic pandemic preparedness plans and to build a global coalition of countries and partners to tackle the increased risk posed by these pathogens, guided by technical expertise from our partners on the frontlines. Achieving the objectives of the Initiative and ensuring the sustainability of efforts to prevent and mitigate ongoing transmission and outbreaks of arboviral diseases can only be accomplished through a collaborative approach that builds on existing effective programs and optimizes them to the needs of the populations we serve.

We look forward to you joining us in translating the Global Arbovirus Initiative into practice and ultimately, better preparedness and response.

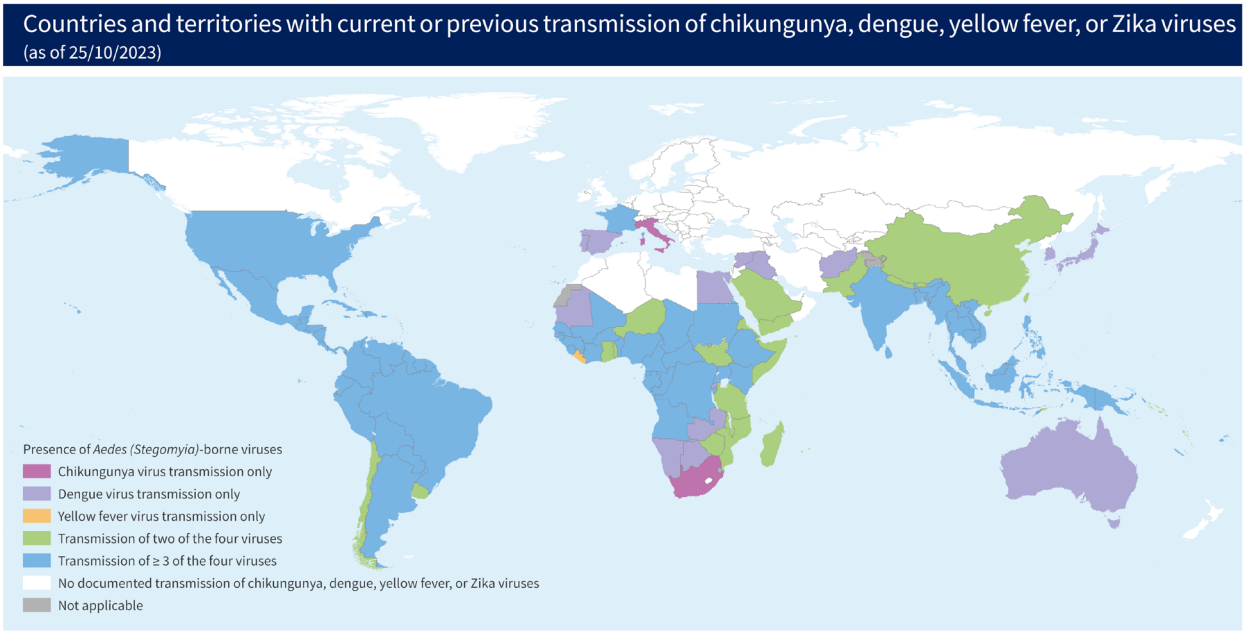
Dr. Michael J. Ryan
Chief Executive Director
WHO Health Emergencies Programme

Background

The risk of emergence and re-emergence of arboviruses with pandemic potential has increased as a global public health threat and will continue to do so in the years to come (Fig. 1). The geographical range of arboviruses will keep extending due to increased human movement, urbanization, environmental adaptation of the mosquito vectors due to climate change, and uncontrolled expansion of mosquito vector populations.

The coronavirus disease (COVID-19) pandemic has exposed worldwide vulnerability to devastating emerging infectious diseases. While the COVID-19 pandemic is ongoing and measures to strengthen the response are still warranted, the World Health Organization (WHO) is developing strategic plans for preparedness and response to general pandemics, those due to various pathogens and other health emergencies, in order to strengthen capacity in vulnerable countries and at regional and global levels.

Fig. 1. Countries affected by *Aedes*-borne diseases



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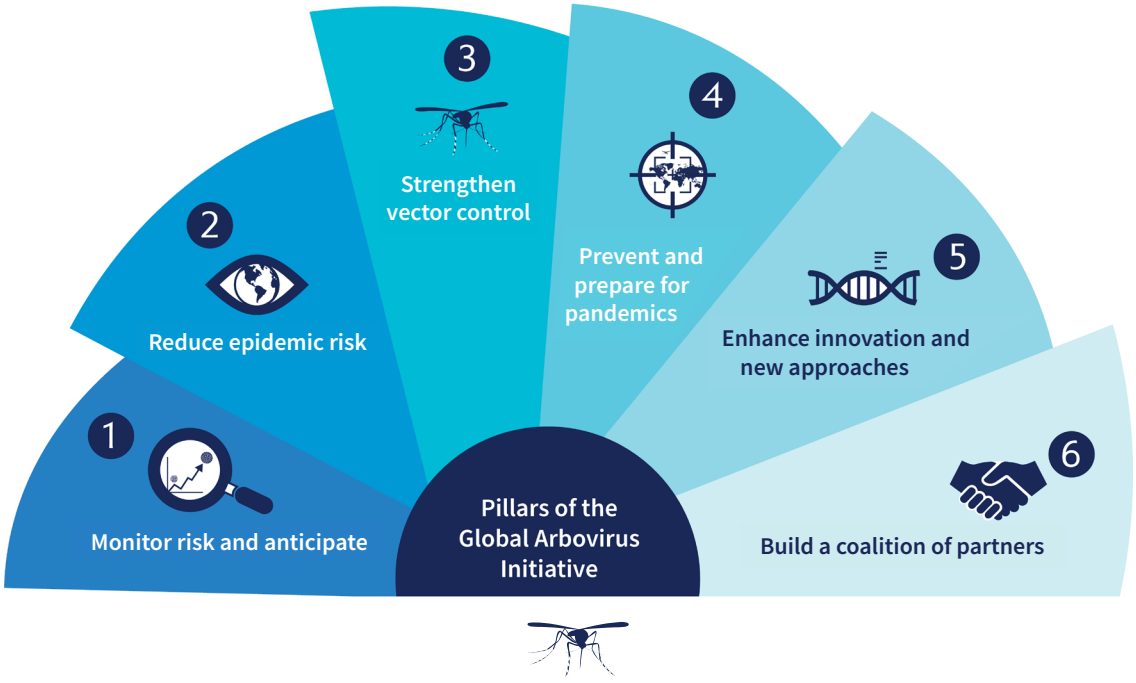
The Global Arbovirus Initiative

WHO is uniquely positioned to lead pandemic preparedness and build a global coalition of countries and strategic partners to tackle the increased risk of arbovirus transmission in an integrated, coordinated approach. The initiative will convene partners in various sectors, including health, agriculture, urban administration and environment, as well as national, academic and private-sector partners to collaborate in an approach based on existing disease-specific programmes to strengthen national integrated arbovirus disease programmes (Fig. 2). This will ensure optimal use of resources to achieve the greatest impact in both areas with the heaviest arboviral burden and areas at risk of emergence of arboviruses. Epidemic and pandemic response must be based on strengthening national surveillance of and responses to endemic transmission and local outbreaks. The strongest outbreak response will be based on systems that have been strengthened before or during an epidemic.

Fig. 2. Pillars of the Global Arbovirus Initiative



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The integrated approach will initially focus on *Aedes*-borne viruses, including chikungunya, dengue, yellow fever and Zika viruses. Although the level of threat posed by these arboviruses differs by region, they present a significant risk for global outbreaks of disease, especially in many vulnerable and under-resourced communities. From a global perspective, first addressing *Aedes*-borne arboviruses and then extending the work to other pathogens will allow phased development of effective approaches and scaling them up on the basis of the lessons learnt, particularly in many of the cross-cutting areas of prevention and control. While delayed extension may temporarily limit preparedness for outbreaks due to *Culex* and other mosquitoes, the narrower focus will permit robust, standardized evaluations of interventions. Furthermore, as need differs by country, a global document on arboviruses could be adapted for each country and region. Some regions are already working on strategies that may include other arboviruses or non-viral vector-borne pathogens. This initiative is intended to support and not override that work.

Inclusion of non-*Aedes*-borne zoonoses, with multiple reservoirs and vectors, will complicate implementation of the initiative but will be aligned with the One Health approach, an integrated, unifying approach to achieve a sustainable balance and optimize the health of peoples, animals and ecosystems. This approach mobilizes multiple sectors, disciplines and communities at many levels of society to work together to foster well-being and to tackle threats to health and ecosystems while addressing the collective need for clean water, energy, air, and safe and nutritious food, action on climate change, and contributing to sustainable development. Although the prevention and control strategies for some non-*Aedes*-borne arboviruses may be different, the One Health approach can provide a framework for interventions that can be adapted to specific pathogens and pathogen groups. Once ready for expansion, the Global Arbovirus Initiative will cover West Nile virus, Crimean-Congo haemorrhagic fever, Usutu virus, Rift Valley fever, Spondweni virus and other arboviral diseases. It will also consider their modes of transmission and measures to mitigate their effects, such as blood transfusion and organ or tissue transplantation. A further consideration will be exposure in laboratories.

Pillar 1. Monitor risk, and anticipate

The risk for *Aedes*-borne diseases is currently monitored from information on the presence and/or density of mosquitoes, surveillance of human disease and laboratory surveillance; however, there is no tool for real-time monitoring of risk that is based not only on data on human health but also on environmental and climate factors that affect mosquito density and the transmission of many pathogens locally, regionally and globally. The framework will support adherence to the International Health Regulations (2005) by Member States to prevent and respond to acute public health risks posed by arboviruses. This integrated tool will use the One Health approach integrating data from human and animal health, environmental variables, and mosquito surveillance and other relevant variables. The tool will inform risk monitoring and anticipate transmission through simulations and forecasting of potential epidemic and pandemic scenarios for arboviruses under current environmental conditions and anticipated extreme scenarios due to climate change.

The goal of this pillar is to develop and validate a tool for risk assessment and forecasting by establishing local, regional and global baselines and a dashboard to enable capture of real-time data and decisions with regard to several pathogens.

The two strategic objectives and priority actions for this pillar are listed in Table 1.

Table 1. Strategic objectives and priority actions for pillar 1: Monitor risk, and anticipate

Strategic objective	Priority actions
Develop a framework for monitoring the global risk of arboviruses with the One Health approach.	Review the drivers of transmission of arboviruses, focusing on *Aedes*-borne viruses, including vector, pathogen, host (including asymptomatic and secondary and sequential infections), environmental, human behavioural and socioeconomic variables.
	Develop an integrated system of present and past data from surveillance and other sectors with the One Health approach. Surveillance capacity at local and national levels should be assessed and sustainable funding be provided for strengthening surveillance infrastructure and reporting tools.
	Map the risks and areas that are vulnerable for *Aedes*-borne virus transmission, emergence or re-emergence.
	Establish an integrated global dashboard of the risks for *Aedes*-borne diseases.
Forecast and model potential scenarios for pandemics and epidemics due to arboviruses.	Build a model for understanding the transmission dynamics of *Aedes*-borne viruses, from local level and scaling up to national and regional levels, which includes their heterogeneity, local conditions and patterns of transmission.
	Validate the model for arbovirus transmission with local data.
	Recalibrate the arbovirus transmission model in validation exercises.
	Use the transmission model to simulate and forecast scenarios of arbovirus pandemic and epidemic potential that are also applicable for other high-threat pathogens.

Pillar 2. Reduce local risk of epidemics

Reducing risk depends on rendering environments unsuitable for transmission by reducing or eliminating infectious vectors, reducing human exposure to such vectors, and increasing the immunity of human populations. While working towards these longer-term objectives, rapid detection and response to prevent and contain *Aedes*-borne epidemics at an early stage are key to reducing the morbidity and mortality associated with arbovirus infections. The most effective way to improve early detection and response is to support countries in strengthening their capacity for surveillance, for laboratory confirmation and for immediate epidemiological investigations to guide an effective response to an outbreak to reduce its impact. In the case of yellow fever, specifically, the most effective means to reduce the risk of epidemics is vaccination, and the four objectives of this pillar are aligned with those of the WHO Eliminating Yellow fever Epidemics by 2026 strategy.

Strengthening integrated early warning surveillance will prepare the countries not only for the detection of re-emergence and outbreaks of known viruses but also to build capacity for early detection of emerging arboviruses with epidemic and pandemic potential.

The strategic objectives and priority actions for this pillar are listed in Table 2.

Table 2. Strategic objectives and priority actions for pillar 2: Reduce local risk of epidemics

Strategic objective	Priority actions
Strengthen early detection.	Initiate or enhance use of early warning systems for transmission of dengue, yellow fever, chikungunya and Zika viruses in countries at risk (adapted to the local context), and investigate use of sentinel surveillance and novel detection methods in areas at high risk.
	Strengthen early detection of *Aedes*-borne and other emerging and re-emerging arboviruses through syndromic surveillance of cases of febrile, rash or arthritic illness with validated diagnostic tests.
	Strengthen timely laboratory confirmation in at-risk countries, including for differentiating related viruses occurring in the same region. Networks of laboratories in which testing can be performed should continue periodic proficiency testing and assessments to ensure that their quality is maintained.
	Develop and implement standardized integrated arbovirus surveillance in humans.
	Increase the capacity of countries to diagnose and monitor arboviral diseases, particularly in areas with co-circulating arboviruses.
	Support continuous cross-border exchange of information in regions by developing a global network with WHO regional offices for the surveillance, prevention, diagnosis, treatment and control of *Aedes*-borne arboviral diseases. Surveillance and control of vectors at points of entry according to the International Health Regulations (2005) should be included in cross-border exchange of information.
	Develop or update tools for training clinicians and other health-care workers in early detection and notification according to standardized case definitions to promote both detection and reporting of cases.
Increase capacity to perform epidemiological investigations.	Develop standardized guidance and tools for collecting the necessary information during public health investigations, including epidemiological information (people, place, time), entomological data, and the capacity for vector control, laboratory investigation and clinical management of *Aedes*-borne arboviral diseases and emerging and re-emerging arboviruses.
	Design and facilitate training and capacity-building programmes for epidemiological investigations.

Strategic objective	Priority actions
Improve the response to arbovirus outbreaks.	Scale-up integrated vector control for arbovirus outbreak response.
	Develop an integrated strategy for response to outbreaks of circulating arboviruses and preparedness for potential emergence or re-emergence of new arboviruses for the region.
	Provide rapid, integrated technical and logistical (i.e. supply and transfer) assistance during outbreaks with the support of networks in the regions and WHO headquarters.
	Strengthen national and community health systems to improve clinical management of arboviral diseases.
	Reduce mortality from arbovirus infection through case management.
	Build case management capacity in vulnerable and at-risk countries by (i) updating guidance for clinical management of *Aedes*-borne arboviruses to enable rapid training of front-line workers, including management of sequelae of arbovirus infections; and (ii) addressing health system capacity and preparedness for triaging and managing rapid increases in the number of cases.
	Validate public health interventions for *Aedes*-borne arboviruses, including clinical management protocols and vector response, and assess the cost and benefit of interventions in order to advocate for commitment by policy-makers.
Improve population protection through vaccination in high-risk areas.	Through the Eliminating Yellow Fever strategy, increase the coverage of yellow fever vaccination in all districts at risk of yellow fever virus transmission through collaboration to improve access to and uptake of routine vaccination in childhood.
	Ensure a robust, sustainable, global supply of yellow fever vaccine for all areas that require ongoing protection and to be used in case of outbreaks.
	Explore options for introducing immunization programmes for dengue, chikungunya and Zika viruses as vaccines become available and are recommended by WHO.

Pillar 3. Strengthen vector control

Interrupting the mosquito–human–mosquito transmission cycle by reducing mosquito density remains the basis of traditional arbovirus control. *Aedes* mosquitoes are particularly well adapted to urban environments, where they breed in small collections of water in discarded waste and water containers around houses, schools and workplaces.

The aim of this pillar is to reduce mosquito densities to limit human infections and prevent transmission of arboviruses with epidemic and pandemic potential, in alignment with the Global vector control response 2017–2030.

The strategic objectives and priority actions for this pillar are listed in Table 3.

Table 3. Strategic objectives and priority actions for pillar 3: Strengthen vector control

Strategic objective	Priority actions
Enhance environmental and vector surveillance.	Support national capacity-building in medical entomology and vector surveillance and control. Start with an assessment of capacity to identify where development and training are necessary and establish national and regional institutional networks to facilitate training and/or education and provide technical support, including strengthening laboratory capacity for entomological surveillance.
	Support standardization and development of guidance on vector surveillance, including the use and scaling-up of innovative approaches.
	Advance the development or updating of assessments of the requirement for vector control and the corresponding resource mobilization plan, including for outbreak response.
	Establish and/or improve environmental and vector surveillance to monitor population trends in areas in which *Aedes* populations transmit arboviruses.
	Establish viral surveillance of vectors in sentinel sites to support early detection.
	Integrate data from environmental and vector surveillance in the data system for global risk monitoring for planning risk monitoring and preparedness.
	Strengthen the vector surveillance and control strategy and plan during outbreaks.
Strengthen cross-sectoral vector control.	Promote appropriate environmental modifications and reduction of mosquito breeding sites in affected areas by interdisciplinary engagement with municipal planners and environmental management departments.
	Advance national research in entomology and vector control, including validation of vector control tools for effective disease reduction, supported by laboratory investigations of vector and viral dynamics, randomized studies of data from the field, and ecological studies of the vectors as they adapt to changes in dynamics with changes to the environment and the climate.
	Improve guidance for evaluation and implementation of innovation and proactive, sustainable approaches for vector control in *Aedes* spp.
	Develop guidance on integration of vector control measures with other interventions, such as preventive vaccines (as they become available).
	Promote sustained community awareness programmes, and encourage adoption of vector control measures in and around houses and places of work.
	Establish and promote devolved vector control services, with intersectoral support for effective control.
	Align national targets for protection of populations at risk with appropriate vector control for all vector-borne diseases.
	Strengthen global partnership and coordination for collective prevention and control, including mitigation of the risks of pandemics.

Strategic objective	Priority actions
Increase preparedness in urban and other densely populated areas.	Create a national multidisciplinary *Aedes*-borne arbovirus task force for inter- and intra-sectoral coordination of integrated preparedness in areas at risk.
	Establish cross-sectoral engagement to mitigate the many factors that favour vector populations in urban settings, including water, sanitation and hygiene; climate change; development; and land use.
	Use community risk reduction measures to reduce breeding sites and to encourage personal protection in order to reduce vector populations and host exposure to *Aedes* mosquitoes.
	Pilot-test and implement strategies for sustained vector control in urban environments.
	Increase the resilience of urban and other densely populated centres and rural at-risk communities, through “readiness plans” and sustained vector surveillance and control programmes.

Pillar 4. Prevent and prepare for pandemics

Advance planning and preparedness are key to mitigating the risks of future pandemics. WHO has prioritized the development of a mechanism to keep the world safe and secure from arbovirus threats.

The strategic objectives and priority actions for this pillar are listed in Table 4.

Table 4. Strategic objectives and priority actions for pillar 4: Prevent and prepare for pandemics.

Strategic objective	Priority actions
Enhance global coordination.	Build a global, multisectoral partnership forum on *Aedes*-borne diseases of Member States, partners and other stakeholders.
	Map arbovirus activities currently or to be funded by partners and stakeholders.
	Extend existing strategic partnerships to guarantee implementation and sustainability of the strategy at all levels.
Strengthen global surveillance mechanisms for rapid response.	Strengthen communication channels for rapid reporting of risk events and to reduce delays in cross-border notification, for instance by examining previous work and experiences.
Strengthen community engagement and resilience.	Increase community awareness of arbovirus transmission and disease in countries and regions at risk, including global campaigns, such as Global Arbovirus Day (31 March) and social media. Develop risk communication materials for use during outbreaks. Build capacity for risk communication in communities affected by *Aedes*-borne arbovirus transmission. Build and strengthen multisectoral partnerships of service providers, the private sector and civil society groups to establish ownership of vector control activities.

Pillar 5. Enhance innovation and new approaches

A comprehensive, integrated research strategy should address gaps in understanding of the epidemiology, transmission patterns, clinical presentation, use of diagnostics, non-medical therapeutics, vaccines, and therapeutics for arboviral diseases, including antiviral agents that are safe for use in pregnancy. Research activities should address not only the prevention and treatment of affected people but also the development and testing of novel methods for vector control, modelling the potential impact of interventions against arboviruses, and social science research to improve risk communication and community engagement.

The strategic objectives and priority actions for this pillar are listed in Table 5.

Table 5. Strategic objectives and priority actions for pillar 5: Encourage innovation and new approaches.

Strategic objective	Priority actions
Develop an integrated public health research agenda on Aedes-borne arboviruses.	Identify and prioritize investigations to provide information on the transmission dynamics of *Aedes*-borne viruses, including the burden of disease, the main risk factors associated with transmission, circulating and co-circulating viral serotypes and genotypes, vector populations and seasonal patterns of transmission and disease.
Develop an integrated public health research agenda on Aedes-borne arboviruses.	Update, extend and implement global public health research agendas for Zika, chikungunya, dengue and yellow fever viruses.
	Integrate social sciences into the research agenda, including (i) beliefs, attitudes, understanding, knowledge, and awareness of threats; (ii) operational research to understand administration and management of the interaction of several local sectors; and (iii) understanding of barriers to collaboration among levels of the health system.
	Identify biomarkers of severity of disease and correlates of protection and antibody-dependent enhancement against arboviruses.
	Conduct research on supportive care and therapeutic interventions to reduce the high rate of case fatalities due to yellow fever (including the role of liver transplantation).
	Develop evidence-based case definitions, for instance by including the natural history of the disease in a patient, which can be used to improve the probability of a diagnosis and plan clinical care.
	Characterize the extent and burden of Zika, dengue, yellow fever and chikungunya virus infections, including by investigating the public health and clinical implications and determining population immunity with standardized methods and tools.
	Define the role of sequencing and guidelines for using sequencing at sentinel sites for monitoring the genotypes of arboviruses.
	Investigate the dynamics of arbovirus epidemics in various regions, and characterize the vectors implicated in transmission as a basis for evaluating and modelling interventions.
	Pilot the introduction of new vector control tools that can allow the estimation of effectiveness and inform global recommendations and research on scaling up interventions.
	Conduct implementation and operational research to develop an integrated, comprehensive, contextual implementation strategy for arbovirus prevention and control.

Strategic objective	Priority actions
Support development of innovative countermeasures against arboviruses.	Develop road maps to accelerate research and development on diagnostics, therapeutics and vaccines for Zika and chikungunya virus infections.
	Develop an investment case for potential therapeutics (antiviral agents) to target *Aedes*-borne arboviral diseases.
	Support development, licensing and WHO prequalification of high-quality, safe, effective vaccines against arboviruses to prevent serious clinical complications and ensure their availability and affordability for use in countries at risk of arbovirus transmission.
	Improve methods for generating evidence from combined interventions (e.g. vaccines and vector control) for which "gold standard" randomized clinical trials cannot be conducted.
	Monitor use of second-generation vaccines against dengue virus infections, and conduct implementation research to maximize the effect of the vaccines in reducing the burden of dengue.
	Integrate the One Health approach into investigations of the epidemiology of arboviruses and preparedness and response to outbreaks.
	Conduct implementation research to improve national and subnational coverage of yellow fever vaccination.
Develop new tools and approaches for public health preparedness and response.	Strengthen arbovirus laboratory networks; engage relevant stakeholders (governments, the private sector, academia, international organizations) in responding to outbreaks; and characterize the arboviruses circulating in various regions.
	Develop countermeasures to be used in various communities to prevent and prepare for pandemics.
	Conduct research on use of system or digital tools, with additional methods to track or trigger a response. Little evidence is available on communication of signals.
	Support and promote access to well-characterized specimens, sharing of data to accelerate investigation of arboviral outbreaks, quality control, diagnostic development, and characterize serotypes and genotypes at national and global levels.
	Advance research on priorities, including vaccine-induced and wild-type infections; cross-reactivity and co-circulation of arboviruses; the design, validation and implementation of diagnostic algorithms; and development of new diagnostics and the use of innovative technology
	Allocate adequate resources and technical expertise to ensure strong engagement of stakeholders involved in development and validation of diagnostics for arbovirus diseases.
	Develop an assay that distinguishes between serotype-specific and cross-reactive antibodies for clinical diagnosis and prognosis and to accelerate vaccine development.

Pillar 6. Build a coalition of partners

WHO will coordinate and provide organizational support and leadership to ensure effective implementation of the Global Arbovirus Initiative. The goals are to promote engagement of sectors and stakeholders, to raise awareness and to disseminate knowledge.

This pillar addresses advocacy for mobilization of resources at local, national, regional and global levels for implementation of the Initiative.

The strategic objectives and priority actions for this pillar are listed in Table 6.

Table 6. Strategic objectives and priority actions for pillar 6: Build a coalition of partners

Strategic objective	Priority actions
Strengthen coordination among stakeholders.	Strengthen coordination among partnerships, ideally by institutionalizing coordination mechanisms, and conjoin relevant stakeholders to mobilize global and local resources, stimulate investment and catalyse action.
	When arbovirus prevention and control are among the core activities of stakeholders, seek synergy, encourage ownership, and cultivate champions.
	Extend strategic partnerships to facilitate implementation and sustainability of the Initiative at all levels.
Enhance communication with stakeholders.	Develop a communication platform with information technology for timely dissemination of relevant information and achievements to disparate audiences and to share information.
	Allocate adequate human resources for the development of content, such as real-time messaging, guidance and advice.
	Map existing partnerships, identify missing links, and build new engagement with all relevant stakeholders (ministries, government agencies, the private sector, academia, international organizations, local councils and civil society organizations).
Build new partnerships.	Build a global partnership forum of multisectoral stakeholders working on *Aedes*-borne diseases to coordinate global work.
	Explore new partnerships.

Notes

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