Meeting of programme managers and the Regional Technical Advisory Group on dengue and other arboviruses in the South-East Asia Region

Kathmandu, Nepal, 14–16 June 2023
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Meeting of programme managers and the Regional Technical Advisory Group on dengue and other arboviruses in the SEAR
### Abbreviations and acronyms

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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AGO</td>
<td>autocidal gravid ovitrap</td>
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<tr>
<td>ASEAN</td>
<td>Association of Southeast Asian Nations</td>
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<td>ATVDs</td>
<td>Aedes-transmitted viral diseases</td>
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<td>CCHFV</td>
<td>Crimean-Congo haemorrhagic fever</td>
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<td>CDC</td>
<td>Centre for Disease Control</td>
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<td>CDS</td>
<td>Department of Communicable Diseases</td>
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<tr>
<td>CFR</td>
<td>case-fatality rate</td>
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<td>CHIKV</td>
<td>chikungunya virus</td>
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<tr>
<td>CYD-TDV</td>
<td>chimeric yellow fever virus tetravalent dengue vaccine</td>
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<td>DENV</td>
<td>dengue virus</td>
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<td>DF</td>
<td>dengue fever</td>
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<tr>
<td>DGHS</td>
<td>Directorate General of Health Services</td>
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<tr>
<td>DHF</td>
<td>dengue haemorrhagic fever</td>
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<tr>
<td>DHO</td>
<td>District Health Office</td>
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<tr>
<td>DNDi</td>
<td>Drugs for Neglected Diseases Initiative</td>
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<tr>
<td>DPR Korea</td>
<td>Democratic People’s Republic of Korea</td>
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<tr>
<td>EBS</td>
<td>event-based surveillance</td>
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<tr>
<td>EDCD</td>
<td>Epidemiology and Disease Control Division</td>
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<td>EEV</td>
<td>equine encephalosis virus</td>
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<td>EMA</td>
<td>European Medicines Agency</td>
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<td>EWARS</td>
<td>Early Warning Alert and Response System</td>
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<td>FBC</td>
<td>full blood count</td>
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<tr>
<td>FDA</td>
<td>(US) Food and Drug Administration</td>
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<td>FHI</td>
<td>Family Health International</td>
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<td>FIND</td>
<td>Foundation for Innovative New Diagnostics</td>
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<tr>
<td>GDP</td>
<td>gross domestic product</td>
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<tr>
<td>GIS</td>
<td>geographic information system</td>
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<tr>
<td>GLAI</td>
<td>Global Arbovirus Initiative</td>
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<tr>
<td>GVCR</td>
<td>Global Vector Control Response</td>
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<tr>
<td>HDU</td>
<td>high dependency unit</td>
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<tr>
<td>HIM</td>
<td>health emergency information and risk assessment</td>
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<td>HR</td>
<td>human resource/s</td>
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VCAG Vector Control Advisory Group
VCRC Vector Control Research Centre
VE vaccine efficacy
VRDL Viral Research and Diagnostic Laboratory
WHE World Health Organization’s Health Emergencies Programme
WHO World Health Organization
WHO-AFRO WHO Regional Office for Africa
WHO-AMRO WHO Regional Office for the Americas
WHO CC WHO Collaborating Centre
WHO-EMRO WHO Regional Office for the Eastern Mediterranean
WHO-EURO WHO Regional Office for Europe
WHO HQ WHO headquarters
WHO-SEARO WHO Regional Office for South-East Asia
WHO-WPRO WHO Regional Office for the Western Pacific
WNV West Nile virus
YF yellow fever
Dengue and other arboviral diseases have shown an increasing trend over the past decade. Although there is a cyclical trend in dengue incidence with epidemic years and interepidemic years, in recent times, more epidemic years are recurring, compared with interepidemic years. The year 2019 witnessed the highest ever recorded number of dengue cases globally. Although there was a decline in case reporting with the COVID-19 pandemic, resurgence of cases have been observed since 2022. Several Member States in the South-East (SE) Asia Region also showed signs of high case reporting during the first six months of 2023. In addition to dengue, outbreaks of chikungunya have also been reported, especially from the Region of the Americas, and these should be considered a warning for the SE Asia Region indicating the possibility of similar outbreaks; therefore, close monitoring and prompt action are needed.

To detect arboviral disease outbreaks early, an integrated disease, vector and laboratory surveillance is necessary. Although dengue disease surveillance exists in almost all Member States in the SE Asia Region, chikungunya and Zika virus surveillance of comparable strength has not been established. Either establishment or strengthening of entomological surveillance and integration of laboratory surveillance into disease surveillance are needed in most of the Member States. The Early Warning Alert and Response System (EWARS), which combines information from various surveillance methods for timely response in emergencies, may be a useful tool for control of arboviral disease outbreaks.

The COVID-19 pandemic has provided an opportunity to scale up laboratory testing capacity in all Member States. This can be either expanded or repurposed for laboratory diagnosis of arboviral diseases, which is an essential component for early detection and control of outbreaks. Furthermore, the SE Asia Region Roadmap for diagnostic preparedness, integrated laboratory network and genomic surveillance for the years 2023–2027 aligns with the WHO resolution on strengthening diagnostic capacity and emphasizes technical guidance to Member States, focusing on health emergency preparedness, response and resilience. Key components of the plan include a Regional network of laboratories responsible for overseeing workplans and a diagnostic task force providing technical advice to WHO and the Working Groups for developing specific workplans. Opportunities to improve arbovirus laboratory surveillance include better access to testing; training; procurement and pricing; support for genomic surveillance; validation of new technologies; leveraging expertise in virus isolation and neutralization; and contributing to the SE Asia Region Diagnostic Reference Laboratory Network.

The Global Arbovirus Initiative (GLAI), launched by WHO in 2022, is built on six pillars and addresses the growing threat of arboviral diseases, which currently place nearly 4 billion people worldwide at risk. A primary objective of the Initiative is to establish a global dashboard for sharing up-to-date data, with a focus on local-level utility to inform decision-making. The Initiative seeks preparation for future pandemics caused by mosquito-borne viruses.

The Initiative focuses on creating a global risk monitoring framework using a One Health approach, incorporating environmental, human and vector surveillance. The framework aims to enable the modelling of potential epidemic and pandemic scenarios based on surveillance data.
WHO collaborates with modelling groups, such as the London School of Hygiene and Tropical Medicine, to develop comprehensive risk mapping of arboviral diseases. However, existing risk maps often lack high resolution and are outdated, necessitating regular updates as new occurrences of diseases are reported. The risk mapping considers various factors, including climate suitability, vector presence and vaccination coverage.

WHO is also working on an integrated global arbovirus reporting system, which will contribute data to the global dashboard. Various data sources are currently available, but they are heterogenous and may differ in reporting criteria. The global dashboard will provide historical data, regional information and maps. The Initiative’s partners include organizations, such as the United States Centers for Disease Control and Prevention (US CDC), the Wellcome Trust, and the Bill and Melinda Gates Foundation, but the most crucial collaborators are the WHO Regional Offices and the Member States.

Despite heavy case-loads, the dengue case-fatality rate (CFR) in most of the Member States remains low as proper clinical management can prevent deaths. In fact, dengue haemorrhagic fever (DHF) is a “predictably treatable” disease. When diagnosed objectively and early, dengue haemorrhagic fever can be managed with judicious application of fluid therapy, with near zero case-fatality rate. The current national guidelines on dengue need review and revision based on the insight clinicians have gathered after gaining years of experience in managing a large number of patients. It can help further reduce the CFR.

In the context of prevention and control, dengue can be considered an environmental disease. The objective of a Dengue Control Programme should focus on keeping the dengue incidence low by adopting an integrated vector management (IVM) approach. Intersectoral collaboration is an important component of dengue control and key stakeholders should be identified and engaged in all steps of dengue control. Innovation- and evidence-based approaches should be harnessed to support vector surveillance and control; a whole-of-government-coordinated approach, working across government ministries, and strong collaborative governance involving government and nongovernment agencies are necessary.

Risk communication and community engagement (RCCE) should be a pillar in vector control programmes; it is important for addressing arboviral diseases, particularly Aedes-transmitted viral diseases (ATVDs), such as dengue. Most of the Member States have made significant efforts to increase knowledge and awareness of these diseases, but sustained behaviour change is still lacking. Therefore, the focus should shift towards modifying behaviours related to effective vector control and health care-seeking practices. Behaviour change and community engagement are ongoing processes and proper planning is crucial. This includes social mobilization and a comprehensive approach to risk communication tightly integrated into everyday vector control activities. Entomological indices, which measure mosquito behaviour, are not adequate for assessing human behaviour changes. Therefore, measures should be adopted for assessing human behaviour.

Social and behaviour change communication (SBCC) is a strategic and systematic framework for positively influencing knowledge, attitudes and social norms to change behaviours, with a focus on specific audience segments. There are myths related to behaviour change. It is necessary to understand that education alone does not guarantee behaviour change. Social norms play a significant role in motivating people. It is important to make information tangible and connect behaviours to values. Furthermore, community engagement and risk communication are resource-intensive, and should be adequately funded and integrated into annual vector control plans.
Research and development (R&D) initiatives for vaccine development for arboviral diseases are a priority need. The chimeric yellow fever virus – DENV tetravalent dengue vaccine (CYD-TDV) (Dengvaxia) from Sanofi Pasteur is the first licensed dengue vaccine; this, however, is not widely used due to the need for pre-vaccination screening. Another vaccine, TAK-003 (Qdenga) from Takeda, administered in two doses at 0– and 3–month intervals, was licensed by the European Medicines Agency (EMA) in December 2022; it is being used for travellers in several European countries. Indonesia is the first dengue-endemic country, where TAK-003 has been introduced but is currently available in the private market only. Currently available evidence shows that TAK-003 offers better protection among seropositive persons against all four serotypes, and against DENV1 and DENV2 among seronegative persons. But it does not protect against virologically confirmed dengue and hospitalization for DENV3 and DENV4 infections with regard to seronegative persons. The WHO global recommendations was released in September 2023 and further in May 2024.1,2

On the other hand, there are currently no licensed chikungunya vaccines. However, there are 11 vaccine candidates against chikungunya in various stages of clinical trials, with seven in Phase I, two in Phase II and two in Phase III. These ongoing trials represent a promising development for potential chikungunya vaccination in the future.

Developing the capacity of Member States, the WHO Regional Office for South-East Asia (WHO-SEARO) organized a very successful training workshop on integrated field entomology, held on 28 November–3 December 2022, with seven modules covering theoretical and practical aspects of entomology and integrated vector management. Some Member States have already rolled out or are planning to roll out similar training programmes at the country level. Such an experience from Nepal was shared with participants.

The key outcomes of the meeting involved the consensus of the Member States for the availability of the Regional Strategic Framework for prevention and control of dengue and other Aedes-transmitted arboviral diseases, and for sharing data to establish the Regional dashboard for arboviral diseases, prioritizing Aedes-transmitted diseases.

1 https://www.who.int/publications/i/item/WER-9847-599-620
2 https://iris.who.int/bitstream/handle/10665/376641/WER9918-eng-fre.pdf
Recommendations

Recommendations to Member States

**Dengue, chikungunya and Zika surveillance, risk assessment, outbreak preparedness and risk communication**

- Contribute to Regional and global standardization of surveillance case definition and adopt the case definition agreed upon.
- Report data regularly to WHO, as per the reporting indicators and frequencies agreed upon.
- Conduct review of surveillance systems, including mapping of existing surveillance initiatives, systems and tools.
- Take a phased approach to strengthening multisource collaborative surveillance, combining various approaches (e.g. notifiable disease surveillance, sentinel surveillance, syndromic surveillance, event-based surveillance), through the national interagency mechanism, guided by national surveillance objectives.
- Develop or strengthen interoperable data management systems that enable real-time data reporting, link existing dengue surveillance systems, and analyse data for risk assessment and prompt decision-making for actions.
- Ensure that risk communication and community engagement plans are developed, implemented and regularly updated to reach the risk population and the general public to facilitate appropriate behaviour changes.
- Continue efforts to strengthen workforce capacities to support surveillance, risk assessment and rapid response.

**Prompt diagnosis and comprehensive case management of dengue, chikungunya and Zika**

- Expand the use of the RDT/NS1 for dengue as per WHO recommendations and strengthen laboratory capacity for dengue serotyping and confirmatory diagnosis of chikungunya and Zika.
- Improve budgeting and planning to ensure uninterrupted supply of diagnostic kits as well as procurement, supply chain and optimal storage, and monitoring of potential overstocking.
- Update arboviral clinical management guidelines and conduct regular training to strengthen health system capacities at all levels with regard to detection and clinical management, targeting medical professionals and nurses, and including the private sector and communities.
- Develop a strategy for early detection of dengue haemorrhagic fever (DHF) and proper case management/referral, including real-time communication among medical professionals.
- Develop a contingency plan for organization of health-care services during epidemics with clear triaging and referral procedures.
Ensure detailed analysis of deaths on a regular basis to identify and address gaps in a timely manner.

**Aedes surveillance, integrated vector management (IVM) and community engagement**

- Strengthen intersectoral convergence, particularly involving local governments and municipality/cooperation for vector control.
- Develop/update operational guidelines and conduct regular cascaded training in vector surveillance, IVM and SBCC to strengthen evidence-based communication targeting (i) policy-makers for advocacy and resource mobilization, and (ii) communities/working class/children for behavioural change.
- Consider use of community alert systems with risk stratification, such as in Singapore.
- Institutionalize dedicated HR and mobilize financial resources for field operation and sustained supply of appropriate vector surveillance/control and laboratory equipment.
- Engage non-entomologists, students, medical colleges, workforce from other sectors (environment), the private sector and civil society organizations (CSOs) for entomological capacity-strengthening.
- Consider introduction of legislative measures to impose penalty and enable access to premises for vector breeding.

**Recommendations for WHO**

- Finalize the Regional Strategic Framework for prevention and control of dengue and other arboviral diseases in the SE Asia Region in consultation with countries and partners.
- Through surveillance guidelines, including reporting protocols and metadatasets, finalize and operationalize the regular reporting mechanism and indicators from countries to WHO, and ensure compatibility with requirements for integration into the global dashboard.
- Develop a global and Regional data dashboard that enables timely synthesis, analysis and visualization of data for country actions, learning from other Regional dashboards and engaging data scientists.
- Develop/adapt standardized tools to support countries in review of surveillance systems, and establish collaborative, comprehensive and integrated disease surveillance and data management system.
- Referring to successful examples from countries (e.g. Thailand, Singapore), develop a step-by-step guide for countries to establish collaborative and comprehensive disease surveillance and conduct training.
- Provide tools and training to enhance data analysis, risk assessment and risk communication capacities in the countries.
- Develop and disseminate a simple leaflet on case management to prevent deaths due to dengue fever (DF) and DHF, particularly targeting peripheral hospitals/PHC, and a booklet for nursing staff.
- Support countries in regular training to strengthen health system capacity at all levels with regard to DF and DHF case management, targeting medical professionals, nurses, the private sector and communities.

- Develop SBCC training toolkit, including evidence-based communication materials and tools targeting different audiences (including policy-makers, communities and schoolchildren).

- Develop an operational guidance on vector surveillance.

- Develop guidance on engineering modification/building design to prevent mosquito breeding.

- Facilitate research and innovation in prevention and control, including novel vaccines, therapeutics, diagnostics and vector control/surveillance through a Regional network.

- Establish a Regional Laboratory Network to facilitate coordination, collaboration and rapid sharing of samples and information for public health decision-making, and support quality assurance mechanism.

- Explore resource mobilization in collaboration with partners.
Introduction

1.1 Meeting organization

Dengue has emerged as the most widespread and rapidly increasing vector-borne disease (VBD) in the world. With dengue endemic in 10 of the 11 Member States, the WHO South-East Asia Region records one of the highest burdens of dengue in the world. There has been an increase in the geospatial distribution, and also the scale and frequency of dengue outbreaks in the Region in the recent past. In particular, five Member States, namely India, Indonesia, Myanmar, Sri Lanka and Thailand, are among the 30 most highly endemic countries in the world. Furthermore, chikungunya and Zika having the potential for outbreaks, with deaths and disability reported in eight and three Member States of the Region respectively.

During the past decade, there has been over three-fold increase, from 0.19 million in 2011 to 0.68 million in 2019, in dengue cases reported in the Region. The reported number of deaths has also increased from 1050 in 2011 to 1684 in 2019, although it is notable that the case-fatality rate (CFR) has reduced to below 0.5% while in the majority of the Member States, it has dropped to around 0.1%, presumably due to the improvement in case management. In 2020, the number of dengue cases and deaths in the Region dropped to 0.26 million and 928 respectively, potentially due to the impact of COVID-19. In 2021–2022 alone, Bangladesh, Nepal, Sri Lanka and Timor-Leste experienced significant dengue outbreaks. During the first six months of 2023, several Member States in the South-East Asia Region as well as in the Region of the Americas showed rapid increase in dengue case reporting, calling for close monitoring and integrated approach to disease outbreak control.

The Regional Technical Advisory Group (RTAG) on dengue and other arboviruses was re-established in 2021. The RTAG meets bi-annually to review the emerging scenario of dengue in the Region, and advise appropriate mechanisms and priorities for prevention and control. In March 2022, the WHO headquarters (WHO HQ) launched the Global Arbovirus Initiative (GLAI) to strengthen the coordination, communication, capacity-building, research, preparedness and response necessary to mitigate the growing risk of epidemics due to arboviral diseases. The RTAG will thus guide Member States on accelerating prevention and control of dengue and other arbovirus diseases under the umbrella of GLAI.

The RTAG last met virtually on 4–6 October 2021 and made a series of recommendations both for Member States and WHO; these include development of standardized training packages and strengthening entomological capacity for surveillance, prevention and clinical management of dengue and other arboviral diseases.
The meeting of programme managers and the Regional Technical Advisory Group on dengue and other arboviruses in the South-East Asia Region was convened in Kathmandu, Nepal, on 14–16 June 2023. The meeting was attended by the Regional Technical Advisory Group members and programme managers, along with other representatives from the Member States and officers from WHO HQ, the Regional Office and the WHO country offices. In addition, several experts from different technical areas participated physically or virtually in the meeting as resource persons. The meeting agenda is in Annexure A while the list of participants can be found in Annexure B.

1.2 Meeting objectives

The general objective of the meeting was to review the progress, and identify the gaps and priority actions for accelerating prevention and control of dengue and other arboviruses in the SE Asia Region under the umbrella of the Global Arbovirus Initiative (GLAI).

The specific objectives of the meeting were to:

• review the situation of dengue and other arboviruses in the endemic countries of the Region and the progress on implementation of the recommendations of the last meeting of the RTAG on dengue in October 2021;

• identify the gaps and priority actions, and make recommendations to WHO and Member States to address the remaining operational and technical challenges; and

• review and provide inputs to the draft Regional Strategic Framework for prevention and control of dengue and other arboviruses in the SE Asia Region.
2.1 Opening remarks

The meeting started with the welcome and opening address delivered by Dr Rajesh Sambhajirao Pandav, WHO Representative to Nepal. He welcomed the participants on behalf of Dr Poonam Khetrapal Singh, WHO Regional Director for South-East Asia, by reading out her opening remarks as she could not attend the meeting owing to prior commitments.

The Regional Director emphasized the importance of *Aedes*-transmitted arboviral diseases that include dengue, chikungunya, Zika and yellow fever as they are having the potential for epidemics, causing deaths and disability. She acknowledged that approximately 1.3 billion people in the Region are at risk of dengue, which is endemic in 10 Member States, while chikungunya and Zika have been reported in eight and three countries respectively. Despite the efforts of the Member States, the number of dengue cases has risen significantly over the years. Dengue cases have increased over three-fold in the Region in the last decade – from 0.19 million cases in 2011 to 0.68 million cases in 2019. Five countries in the Region, namely India, Indonesia, Myanmar, Sri Lanka and Thailand, are among the 30 most highly endemic countries in the world.

The Regional Director also highlighted the factors that drive the uncontrolled spread of dengue and other arboviral diseases. They are climate change, high population density, urbanization, vector adaptability, circulating four virus variants and lack of definitive treatment. She also acknowledged the current efforts to develop new vaccines for dengue and other arboviral diseases. Although case management has reduced the dengue case-fatality rate, outbreaks pose significant risks to vulnerable groups, and strain health-care systems and economies. Therefore, urgent coordinated efforts to halt the increasing burden of dengue while preventing chikungunya and Zika outbreaks, and a strategic approach with comprehensive surveillance, diagnosis, prevention and control are needed.

She also highlighted the priority actions that include the Region establishing collaborative surveillance; strengthening early diagnosis and management of cases; intensifying prevention and control of *Aedes* mosquito breeding; monitoring disease trends and impact; ensuring the availability of a minimum data set for dengue, chikungunya and Zika for regular reporting to WHO; and updating the Regional Strategy guided by the Global Arbovirus Initiative of WHO.

The Regional Director expected that the participants would explore prevention and control efforts in other countries, discuss challenges and seek expert advice from RTAG members while deliberating on the new Regional Strategy, aligning with the Global NTD Roadmap and the Global Arbovirus Initiative.
Dr Roshan Pokhrel, Secretary, Ministry of Health and Population (MoHP), Nepal, thanked WHO for granting the opportunity to organize the RTAG meeting in the country. He pointed out that dengue had been a major public health problem in Nepal in the recent past; a huge outbreak was recorded in 2022 with more than 54 000 cases. Issues related to surveillance, involvement and commitment from local-level governance for surveillance and interventions are being experienced. The meeting recommendations were expected to help in formulating the way forward. Dr Pokhrel wished the participants fruitful deliberations.

The meeting objectives were presented by Dr Aya Yajima, Regional Adviser, CDS/NTD, WHO-SEARO. This was followed by the self-introduction of the RTAG members, programme managers and their teams, distinguished experts and WHO teams from the Country Offices, the Regional Office and HQ.

Subsequently, the technical sessions – focused on global, Regional and country updates, dengue surveillance and laboratory, dengue case management, *Aedes* mosquito prevention and control, risk communication and community engagement (RCCE), and new tools, research and development – were held over three days. A dedicated session involved group work to prepare a draft Regional Strategic Framework for prevention and control of dengue and other arboviral diseases.

**2.2 Global and Regional updates and progress on recommendations**

**Global situation of dengue and other arboviral diseases: Dr Diana Rojas Alvarez, Technical Officer, WHO HQ/WHE**

Globally, the incidence of dengue and other arboviral diseases has been showing an increasing trend over the past decade. Although there is a cyclical trend in dengue incidence with epidemic years and interepidemic years, more epidemic years than interepidemic years have been observed in recent times. In 2019, the highest number of dengue cases was reported globally (5 037 403). Although a lower number of cases was reported in 2020 (2 904 920) and 2021 (1 465 348), with movement restrictions during the COVID-19 pandemic, a comparatively higher number of cases was reported in 2022 (3 503 550). In 2023, outbreaks in many Regions were being experienced. Since large proportions of dengue cases are asymptomatic, each year, only a small fraction of all cases is actually being reported. A similar trend was noticed in the number of deaths due to dengue, with 2760 deaths in 2022, and 1450 and 1094 deaths in 2020 and 2021 respectively. In 2019, 5819 deaths were reported. However, the case-fatality rate often remains below 0.1% since good clinical practice can prevent many of the dengue deaths.

The Region-wise details of the dengue situation in recent years were also shared, which showed that all Regions had been reporting dengue cases, with outbreaks in many Regions. In the Eastern Mediterranean Region, outbreaks were reported in Pakistan (in 2017 and 2019), Yemen (in 2019) and several other countries. In the African Region, at a time when malaria cases are declining, non-malaria cases, mainly arboviral diseases such as dengue and chikungunya, are increasing. In 2020, 220 897 dengue cases were reported in the African Region. The Framework for the Integrated Control, Elimination and Eradication of Tropical and Vector-Borne Diseases has been developed for the African Region, which is very much aligned with the Global Arbovirus Initiative.

In Europe, dengue and chikungunya transmission is seasonal. Since 2007, focal outbreaks in Italy, France, Croatia, Portugal and several other countries have been reported. Over the past five years,
almost every year, cases are being reported in the European Region. In the Region of the Americas, in countries where arbovirus diseases were not previously reported, especially in the southern parts of the continent, dengue and chikungunya outbreaks are being reported; this can be attributed to climate change. In the first half of 2023, the Region of the Americas has reported 2,015,389 dengue cases. In the dengue-endemic areas, outbreaks are occurring earlier than previously experienced.

Zika is mainly an asymptomatic disease; however, its transmission has been reported in 89 countries. The first Zika outbreak activity occurred in the Pacific Region between 2007 and 2013. In 2015, Zika virus emerged in Brazil and rapidly spread in the Americas, causing a large outbreak in the Region that led to the declaration of a public health emergency of international concern (PHEIC). To date, most of the reported cases are from the Americas.

In 2019, a limited autochthonous cluster was reported in France. In 2022, Zika outbreak was reported in Kerala, India. In 2023, several imported cases to Europe from endemic transmission areas (Thailand, Maldives) were also reported. In the Region of the Americas, 8,763 cases have been reported in the first half of 2023. Autochthonous Zika virus transmission has been reported in all WHO Regions with the presence of the *Ae. aegypti* and/or *Ae. albopictus* species. For better detection, laboratory surveillance is advisable in special population groups, such as pregnant women.

In Cambodia (2021), Paraguay (2023), Argentina (2023) and several other countries, large chikungunya outbreaks had been reported in recent years. In the Region of the Americas, since 2023, 213,656 cases with 280 deaths have been reported. Unlike in the past, increased severity of the disease can now be observed. For example, in the outbreak in Paraguay in 2023, neurological complications and neonatal chikungunya were associated with high mortality and the reported case-load overwhelmed the health system.

Other arboviruses circulating in different Regions include JEV in the SE Asia Region; RRV, MVEV, JEV, TBEV in the Western Pacific Region; RVFV, YF, CCHFV, WNV, ONNV in the African Region; CCHFV, RVFV, WNV, TOSV in the Eastern Mediterranean Region; CCHFV, WNV, TOSV, USUV, TBEV in the European Region; and WNV, MAYV, OROV, EEV, SLEV, POWV in the Region of the Americas.

The way forward includes: Regional and country implementation of the arbovirus initiative to integrally address arboviral diseases; capacity-building at the Regional level to capture Member State data on arboviruses, including Zika and chikungunya; capacity-building in the diagnostics domain; improved tools for surveillance; improved case management; more sustainable tools for vector control and prevention [including but not limited to the introduction of *Wolbachia*-infected *Aedes* mosquitoes (population replacement/population suppression methods), sterile insect technique, spatial repellents]; vaccines as a preventive measure; and innovations in health systems and integration of programmes. The WHO publication, *Global Framework for the response to malaria in urban areas* (2022), may provide technical guidance to tackle dengue as well.

**The Regional situation of dengue and other arboviral diseases and progress on the recommendations of the virtual RTAG in 2021 – a summary: Dr Sudath Samaraweera, Consultant, CDS/NTD**

The presentation started with the circulating arboviruses, viz. dengue virus (DENV), chikungunya virus (CHIKV), Zika virus (ZIKV) and Japanese encephalitis virus (JEV) in the SE Asia Region. Most countries have reported dengue [except Democratic People's Republic of Korea (DPR Korea)], chikungunya
There were major dengue outbreaks in most of the countries of the Region in 2019 with 684,465 cases and 1708 deaths. A declining trend was noted in the number of reported cases (275,786) and deaths (974) in 2020. As per the recently reported data, incidence of dengue has increased, relative to the previous year, in many countries. The CFR has been reported to be relatively high in Timor-Leste (1.03%), followed by Indonesia (0.96%), while in other countries, the CFR has been noted to be less than 1%. The CFR has, however, shown an increasing trend in Bangladesh, Indonesia, Maldives and Nepal in recent year, compared with the previous year.

All countries have established arbovirus disease surveillance. While in Bangladesh, Indonesia, Nepal, Sri Lanka and Timor-Leste, ongoing reporting is noted, in rest of the countries (except Maldives), weekly reporting is ensured. In Maldives, daily reporting is conducted, which is followed in India too during outbreaks. In Bhutan, severe dengue and DHF are reported as immediately notifiable diseases. Most SE Asia Region countries primarily follow passive type of surveillance, except for Indonesia, Maldives and Timor-Leste, where a combination of active and passive surveillance is followed. In Indonesia, surveillance is integrated with other programmes. Vector surveillance is also carried out.

Larval/pupal surveillance is conducted in all countries except in Nepal. Adult surveillance and mosquito species identification are also conducted in many countries except in Indonesia, Maldives and Nepal. Vector control is mostly carried out using adulticides and larvicides (except in Nepal). Such interventions as insect growth regulator (IGR) (in Bangladesh, Bhutan, India, Sri Lanka), source reduction/source management/ search and destroy (in Bangladesh, Bhutan, India, Sri Lanka, Maldives) are also in place. A few countries have also introduced or piloted Wolbachia/sterile insect technique (SIT) (Sri Lanka, Indonesia) and larvivorous fish (India).

The presentation also highlighted the access to in-country expertise (either within the Ministry of Health and/or through another national agency/academic institution or the private sector). As regards other aspects, all countries have clinical management guidelines. However, constraints include relatively few countries having separate areas for close monitoring of dengue patients at hospitals; poor intersectoral collaboration, planning for social mobilization/sustainable community engagement; limited human resource for outbreak control at the periphery and use of surveillance data in cluster management; and inadequate research on novel vector control methods.

The presentation also informed the participants about the progress on recommendations of the meeting held in 2021 by Member States. With regard to epidemiology and clinical case management, vector surveillance and IVM, many countries showed implementation progress. Progress seemed to be relatively slow with regard to advocacy and behaviour change, health impact assessment, sensitization of urban local authorities and public health engineering.

Progress regarding recommendations for WHO includes:

- arboviral surveillance and response capacity survey with the outcomes being compiled into a report to summarize the dengue situation and progress on strengthening arboviral surveillance and response capacity in countries;
training in dengue laboratory diagnosis carried out by the National Institute of Virology (NIV), Pune (WHO Collaborating Centre), as part of the WHO-SEARO-ICMR Research Platform, conducted in Timor-Leste;

WHO-SEARO-supported clinical case management training in Timor-Leste and Nepal;

Regional integrated field entomology training workshop on vector-borne diseases (VBDs) of public health importance in the WHO South-East Asia Region, conducted at the ICMR-Vector Control Research Centre, Pondicherry, India (WHO Collaborating Centre for IVM) from 28 November to 3 December 2022; training package being developed;

similar integrated field entomology training also conducted in Nepal;

in-person training in entomological surveillance and insecticide resistance management, and virtual training in WHO toolkit for burden estimation of dengue and other arboviral diseases conducted in Sri Lanka;

test kits to monitor insecticide resistance in Aedes vectors and onsite training in insecticide resistance monitoring provided to Sri Lanka;

joint programme review of vector-borne diseases, including dengue, malaria, kala-azar and lymphatic filariasis, conducted in Nepal in June 2023; and

facility for validation of rapid diagnostic kits made available on request at the WHO Collaborating Centre in Singapore.

Actions are to be taken regarding collaboration with selected tertiary centres or hospitals experienced in management of dengue patients in Member States for possible designation as WHO collaborating centres to support capacity-building in this aspect throughout the Region; dissemination of guidelines and standardized kits to Member States to monitor insecticide resistance in Aedes vectors (except in Sri Lanka); organization of cross-border meetings for dengue and other arboviral diseases at the Regional level at regular intervals to facilitate inter-country information-sharing and collaboration; providing training and technical support to Member States for implementation of Wolbachia and other novel interventions; and facilitation of independent evaluation of dengue control programmes of Member States through the Joint Monitoring Mission by involving multidisciplinary experts across three levels of WHO (except in Nepal).

Salient discussion points

WHO-SEARO updated data, as available from countries. Data-sharing with WHO from the countries varies. Efforts should be made by countries and WHO-SEARO to facilitate real-time data-sharing for prompt decision-making and actions.

In Nepal, no entomological surveillance was implemented in 2020. In 2022, such surveillance was implemented and data were updated.

India has an IVM strategy and training of trainers (ToT); trainings in IVM have been initiated. National guidelines for outbreak preparedness and response exist, drawing on the WHO technical guidance.

Each country should adapt and regulate/approve tools and technologies appropriate for country context. Wolbachia, sourced only from Australia, is costly. Hence, many countries have so far refrained from pursuing the idea of introducing them. Besides, there is the issue of community acceptance for mosquito release.
2.3 Country updates on the situation and programmatic progress

Bangladesh

Dengue has been a major public health concern in recent years. The outbreak in 2019 reported 101,354 cases and 179 deaths. Although the situation remained under control in 2020 and 2021, another upsurge was recorded in 2022 with 62,382 cases and 281 deaths. The incidence per 100,000 population was 61 and 36 in 2019 and 2022 respectively; the case-fatality rate was also high, recorded at 0.49% and 0.45% in these years respectively. In 2023, the country reported 3021 cases and 22 deaths (until 10 June 2023), with the maximum number of cases and deaths reported in Dhaka city.

The seasonality pattern showed increase in cases from July–August onwards with variation in peak months. In 2021, the peak was noted in August–September while in 2022, the peak was reached in October with a declining trend from November onwards. As regards the dengue serotypes, DENV3 has been the predominant serotype circulating in the country. No chikungunya cases have been reported since the first chikungunya outbreak in 2017 with two million reported cases. After 2020, there have been no reported cases of JE. Likewise, no Zika cases have also been reported following a lone case in 2016.

Dengue surveillance includes disease surveillance [information on admitted dengue patients is received online daily at MIS (central database of the Directorate General of Health Services) from 53 hospitals of Dhaka city (both government and private hospitals), 64 districts and 495 upazilas]; serological surveillance regarding circulating dengue virus serotypes by the Institute of Epidemiology and Disease Control (IEDCR); and entomological surveillance – pre-monsoon, monsoon and post-monsoon. Laboratory surveillance has not been established yet. Surveillance data are used for hotspot identification and vector control. However, there is shortage of trained workforce; facility-based surveillance is yet to be optimal.

The country follows the WHO guidelines for case classification. Case management is being strengthened progressively with service availability at medical college hospitals, district hospitals and Upazila Health Complex (UHC) hospitals as well as private hospitals and clinics with the presence of well-trained clinicians; organized facilities; uninterrupted logistic supply; regular updating of guidelines, SOPs; and regular continuing medical education (CME) and training programmes. However, resource constraints and delays in interventions remain as challenges.

The strengths of Aedes vector surveillance include IVM approach, Infectious Diseases (Prevention, Control and Eradication) Act 2018, and multisectoral collaboration and coordination [collaboration with CDC (DGHS), MIS, IEDCR of MoHFW; other ministries; WHO, technical experts/universities)]. As regards risk communication and community engagement, the CDC, along with Lifestyle and Health Education Promotion (L&HEP), Ministry of Local Governance, Rural Development and Co-operatives (MoLGRD), conducts regular programmes for RCCE and media is considered an important stakeholder. Capacity in disease surveillance is being improved with updating formats, training/motivation, reaching out to community clinics, development of mobile-based application for aiding clinicians in fluid management, with MoLGRD and relevant organizations, and media engagement and social mobilization.

The Strategic Plan for Dengue Control is incorporated into the existing Dengue Control Programme and regularly assessed, and measures are taken. Challenges include rapid urbanization requiring further strengthening of multisectoral IVM; extensive breeding sites and barriers to source reduction; limited laboratory facility and novel sustainable tools for vector control; and limited
community engagement, population movement and implementation of the Internal Health Regulations (2005) IHR (2005), besides climate change. For the next three years, an independent Aedes-Borne Disease Control Programme under the DGHS is proposed, besides providing technical and financial support to establish an entomology laboratory, strengthening multisectoral collaboration and cooperation, and research for system strengthening. WHO support is expected for capacity-building for dengue surveillance, case management, IVM, risk communication and community engagement, and establishment of a research laboratory.

**Bhutan**

Dengue is a public health concern in Bhutan. In 2022, the positivity rate was 5.4% with 460 cases detected by NS1. Besides, 108 and 87 cases were tested positive by IgM and IgG respectively. In 2023, the positivity rate was 1.62% (by week 22). The incidence per 100,000 population has shown a decline after the outbreak in 2019 (88.4). However, the incidence was high in 2022 (8.6), relative to 2021 (0.1). No deaths have been reported since 2020.

The presentation also talked about dengue vector distribution. Zika was not reported in Bhutan and only one case of chikungunya was reported in 2023. A few cases of JE had been reported until 2022. Dengue is a notifiable disease and must be notified to the Royal Centre for Disease Control (RCDC) through the National Early Warning, Alert and Response System (NEWARS) and the Vector-borne Disease Control Programme (VDCP). Case-based vector surveillance is conducted for the positive cases (NS1 and IgM positives).

The RCDC shares monthly epidemiology report through email. A rapid response team (RRT) is formed at hospitals for immediate response. Overall strengths of the Dengue Control Programme are: designated programme for dengue prevention and control with a surveillance system in place, including decentralized vector surveillance, availability of guidelines (although dengue surveillance guidelines/SoPs are not available yet) and improved patient care [patients with warning signs and all special populations (Group B), patients with severe dengue (Group C) are admitted at the hospital for management]. A high dependency unit (HDU) is established at one of the hospitals in the dengue-endemic district (Chukha, Phuentsholing General Hospital).

Contingency and triaging plans are in place in the event of an outbreak. Health workers in malaria risk areas are trained in dengue case management. Two rounds of indoor residual spraying (IRS), conducted in the urban areas for malaria, have co-effectiveness for dengue; in addition, larviciding and container management are also carried out. The Health Promotion Division is responsible, in collaboration with the programmes under MoH, for carrying out RCCE. Public messages are mainly disseminated in the form of infographics, audio, posters, leaflets and door-to-door awareness activities. Dengue task forces were formed in four high-risk towns. Research study on dengue serotype was initiated by the RCDC.

The gaps and challenges are: home-based management for Group A patients, who are poorly literate; data discrepancies, space and human resource constraints [shortage of doctors (1:150) and other clinical staff members (nurses, laboratory technicians and pharmacists during outbreaks); yet to be optimal reporting system for vector surveillance; development activities contributing to increased breeding sites and expansion of vectors; pyrethroid resistance in *Aedes aegypti*; and funding [which is mostly donor-driven (WHO support)]. Besides, there are limitations regarding availability of reliable data on dengue and no technical partners for R&D.
India

In India, dengue remains one of the major public health concerns. Following the outbreak in 2019, with incidence per 100,000 population recorded at 14.84, the dengue situation was brought under control in 2020, when the incidence decreased to 3.19. However, increased incidence was noted in 2021 (13.73 per 100,000 population). In 2023, the number of reported dengue cases was 13,297 (until May). The CFR, nevertheless, had remained low in the range of 0.1–0.2 through 2019 to 2022. All four serotypes had been noted (DENV1, DENV2, DENV3 and DENV4). Both genders and all age groups are affected.

The most affected areas include Andhra Pradesh, Delhi, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal. Chikungunya cases have also been showing an increasing trend in recent years. In 2022, 0.15 million cases were reported, compared with 0.12 million cases in 2021. In 2023 (until May), 35,474 cases had been reported. Following the first two Zika cases in 2016, a large number of Zika cases were reported in 2018 (290). While the country did not report any Zika cases in 2019–2020, 242 cases were reported in 2021. In 2022, the reported number of cases declined substantially (17). In 2023, only two cases were reported (until May). JE cases, however, continue to be reported every year, although during the COVID-19 years (2020–2021), the number of cases showed a slightly declining trend. In 2022, the number of cases again increased to 1109. In 2023 (until May), 127 cases had already been reported.

Strengths of dengue control are notifiable diseases; organized programme for prevention and control; network of 805 sentinel surveillance hospitals for free diagnosis and disease surveillance; 17 apex referral laboratories with advanced diagnostic facilities; laboratory surveillance through a network of 805 laboratories at sentinel surveillance hospitals across the country, which are linked with apex referral laboratories; 114 entomological zones for vector surveillance; availability of national guidelines for prevention and control, clinical management, IVM, community involvement, and schools and hospitals; and close monitoring through reports from states.

Epidemiological data are compiled and analysed at national, state and district levels at regular frequency. The gaps and challenges are real-time monitoring; suboptimal entomological infrastructure; early warning signal based on meteorological data and lack of proactive measures for vector control; incomplete/delayed reporting from private health facilities; and commercially available rapid diagnostic kits with variable sensitivity and specificity.

Case management has improved over the years with facilities available in both public-sector and private-sector health facilities. The CFR has remained at <0.2% since 2015. Regular trainings in case management are organized at national and state levels. However, comorbidity with lifestyle diseases, high-risk age groups, and co-circulation of arboviruses and other pathogens pose challenges.

Aedes vector surveillance covers both larval and adult stages. However, numerous natural Aedes breeding habitats and cryptic indoor breeding sites remain as challenges.

As regards the plan for the next three years, several initiatives have been envisaged, including the development of the Strategic Framework, covering roadmap, dissemination of updated national guidelines on clinical management of dengue and chikungunya, formation of the inter-ministerial committee and multidisciplinary task force for programme guidance and review of newer tools and technologies, and advocacy. A programme for dengue control with dedicated HR and provision of
adequate budget is to be proposed. Coordination with the Integrated Disease Surveillance Programme (IDSP) and WHO for incorporating dengue into the Integrated Health Information Platform (IHIP) for real-time reporting and expanding the laboratory network are planned, in addition to strengthening the Central Entomological Laboratory and reviving the entomological zones. Deploying artificial intelligence (AI) for entomological monitoring for evidence-based decision-making is also being discussed.


WHO support is expected for newer vector control tools, capacity-building for doctors for case management and that for entomologists for IVM, use of EWARS tools based on the results of pilots, and vector control need assessment, besides technical support for the development of policy/guidelines and IEC materials, including printing and review of arbovirus programme.

**Salient discussion points**

- All Member countries need capacity-building for dengue fever and DHF (case management, prevention, surveillance, risk communication).
- In Bangladesh, only admitted dengue cases are reported in the database. However, this provides a fair picture of the disease situation.
- In Bhutan, volunteers, named as “prime movers”, have been introduced as an innovative initiative for dengue surveillance at the community level and community engagement. They are easily recognizable by their bright orange outfit. In Bhutan, all samples are sent to the Central Laboratory for confirmation. However, issues related to timely transportation of samples pose a challenge. Hence, cases are somewhat underreported.
- In India, EWARS at the National Centre for Disease Control (NCDC), in collaboration with the Meteorological Department, was operational with WHO Tropical Disease Research (TDR) support. Estimation of the burden of disease was attempted drawing on such a source. India has IDSP and other systems with separate datasets. The forthcoming IHIP envisages capturing data from all sources. In India, a case-control study identified severe abdominal pain and extreme weakness as determinants. In India, village committees exist. There should be risk communication on VBDs.

**Indonesia**

In Indonesia, the trend of dengue during the period of 2012–2023 showed a decline until 2018, after the outbreak in 2016, when 204 172 cases were reported. In 2022 again, an upsurge was noted with 143 266 reported cases and an increase of 49%, compared with the number of cases reported in 2020 (73 511). In 2022, the incidence per 100 000 population was high – 52.12. A similar trend is noted in reported deaths. In 2022, the number of reported deaths was 1237 and the CFR stood at 0.86%.
The National Strategic Plan for Dengue Control Programme 2021–2025 has six strategies. They include 1) enhancing effective, safe and continuous vector management; 2) improving access and quality of dengue case management; 3) strengthening comprehensive dengue surveillance and responsive outbreak management; 4) increasing sustainable community engagement; 5) strengthening government commitment, policy and programme management, and partnership; and 6) improving assessment, invention, innovation and research as the basis of evidence-based policy and programme management. National guidelines for dengue, chikungunya and Zika prevention and control have been developed.

According to a SWOT analysis, the strengths of overall programme management and governance include the availability of the Dengue Control Programme both at central (MoH) and peripheral levels (PHOs and DHOs). Yet, the programme has still not become a high priority at the subnational level. Besides, there is limited intersectoral coordination and collaboration. For strengthening surveillance, outbreak responses and management, the Arbovirus Information System (SIARVI) is available; risk factor sentinel was established (dengue sentinel) along with development of early detection and reporting system.

There are delays in hospital alert system, underreporting of data in early detection system and bottlenecks in dengue sentinel reporting that affect outbreak responses. The absence and/or undefined role of the Dengue Surveillance Officer at hospitals also poses a challenge. While guidelines on case management are available, weaknesses of case management include compliance issues with regard to national guidelines among health-care workers; lack of trained laboratory officers to support dengue diagnosis in primary health care (PHC) facilities; limited logistic supply for laboratory confirmation at PHC facilities; weak RDT need estimation; and yet to be optimal external quality microscopic examination.

Entomologist capacity is strong at the national level. In order to strengthen vector control and surveillance, the national guideline for source reduction through the One House One Dengue Cadre (G1R1J) has been designed. A Vector Control Information System (SILANTOR) is available and fully functional. However, there is a lack of entomologists at the subnational level, apart from weak evaluation of vector management interventions, especially G1R1J, and difficulties in programme implementation and M&E. Several opportunities are being discussed to address the weaknesses and challenges.

The plan for the next few years includes high-level advocacy mission; mid-term programme review; review of national arboviruses guidelines and updates that are to be in line with WHO guidelines; capacity-building workshops on chikungunya and Zika virus; strengthening the Regional Referral Laboratory capacity, including external quality assurance (EQA) for the National Referral Laboratory; Wolbachia impact assessment in five cities; community behaviour change and communication evaluation; and assessing the effectiveness of community-based vector control approach (with an innovative approach of One House One Larvae Cadre). WHO is expected to support the country in these endeavours.

Maldives

As in some countries in the SE Asia Region, Maldives witnessed dengue outbreaks in 2018 and 2019, recording 3403 and 5008 cases respectively. Although a remarkable decline was noted in
the following years, another upsurge was recorded in 2022 with 2647 cases. The incidence per 100,000 population was 45.69 in 2022. The CFR, however, has remained low so far (0.089% in 2022). The weekly status of dengue was shared, besides the age and gender disaggregation. Both genders and young children and adolescents as well as adults are affected. The country has been reporting only a few chikungunya cases in recent years following the 2019 outbreak when 1470 cases were recorded. No Zika has been reported since 2019.

As regards the strengths of surveillance, an excellent health system and dedicated teams at central and atoll-level public health units are in place. Daily data collection and reporting are making use of virtual platforms, such as Google Sheets and Google Forms. However, high turnover of expatriate doctors and limited staff capacity, and multitasking lead to poor data quality; delays in sample transport, reporting and case follow-ups are challenges too. Case management is being strengthened. The guideline was revised in 2021. Clinical management sessions for clinical and public health staff are organized regularly. In addition, uninterrupted supply of NS1 kits to all health facilities has facilitated timely testing. Sample transportation to regional referral laboratories remains difficult in terms of reaching out to a courier who makes door-to-door delivery. Besides, there are few technical experts at the central level.

Aedes vector surveillance and vector control are carried out in collaboration with local councils and women’s development committees (WDCs). Home visits are continued by community health workers (CHWs) and 187 health facilities, including 20 administrative hospitals, collect and compile the reports. However, there is a lack of entomological capacities. Weekly larval surveillance reports from health facilities need to be strengthened and digitalized. Lack of new tools is also impeding Aedes control. There is policy-level commitment and community outreach, including digitized awareness, is being enhanced. The challenges include lack of technical staff and crowded living conditions of migrant workers.

In the next three years, the country envisages establishment of a digitalized data management system to strengthen the existing surveillance system; development of a comprehensive national vector control policy and plan; publication of vector control regulation; strengthening councils for effective control measures; capacity-building programmes for regional/atoll level; and continuation of the Wolbachia project. WHO is expected to continue the technical support to all areas for control and management of vector and vector-borne diseases. This includes support for serotyping of dengue cases at regional referral laboratories; Triplex PCR reagents for uninterrupted testing for dengue, chikungunya and Zika; operational-level research; developing a national vector control policy and plan; accelerating the Wolbachia project; advocacy of the project to policy level; and new tools for control of Aedes.

Nepal

Dengue is a major public health problem in Nepal. In 2019, 17,992 cases were reported. The incidence per 100,000 population was high; it was recorded at 60.37 that year. In the following two years, dengue cases remained below 600 while a huge outbreak troubled the country in 2022 with 54,784 reported cases. The incidence per 100,000 population was very high (184.57), indicating the urgent need for strengthening the Dengue Control Programme. In 2022, the number of deaths was also relatively high – it stood at 88 even though the CFR was 0.16%. While both genders were affected, the percentage of dengue cases among men was slightly higher – 53%. The age group, 15–49 years, was the most affected, most probably due to their higher exposure to mosquito bites. Furthermore,
the details of the peak months as well as the province-wise details were mentioned. In 2022, Bagmati Province and Kathmandu district reported the majority of the cases. All four dengue virus serotypes have been reported in Nepal in different time periods.

The country has not reported chikungunya cases since 2020. However, the country continues to report some JE cases every year. In 2022, there were 22 JE cases.

Overall strengths are political commitment for dengue prevention and control as one of the 30-point directives issued by the Prime Minister to government secretaries; establishment of the NTD Steering Committee and the National Dengue Task Force; recent budgetary policy strongly emphasizing dengue prevention and control; development of national guidelines and SOPs; and serotyping of circulating virus, death review, analysis of 2022 upsurge and entomology survey in three districts. An Action Plan had also been developed for 2023 with an activity calendar. The weaknesses include the suboptimal operation and functional status of surveillance system (coverage, data quality, timeliness in reporting); limited engagement of non-health sectors (existing governance mechanisms, such as steering committees, do not include non-health sectors); limited risk communication and community engagement efforts at sub-national levels; and insufficient entomological capacity.

Dengue surveillance includes case reporting through the Early Warning and Reporting System (EWARS) (118 sentinel sites under EWARS and immediate reporting of one confirmed case of dengue); manual reporting of line list from high-case reporting districts (through email, photo snap); and monthly aggregate reporting through HMIS (DHIS2-based). Daily situation report (SITREP) is prepared for timely planning and response. Line listing is available for 94% of the reported cases. However, data quality in terms of timeliness and completeness is an issue. Immediate reporting is not implemented effectively as well. Many large hospitals are yet to enrol in EWARS. In addition, there is no syndromic surveillance for febrile illness, fever and rash.

Dengue case management is being improved with service provider trainings in the updated case management guidelines; fever clinics at some hospitals; involvement of private-sector hospitals; and coordination with the Nepal Red Cross Society for blood management. Delayed diagnosis and referral, and inadequate triage implementation are considered gaps. Dengue vector surveillance has been accorded higher priority in the recent policy and plan. New Guidelines for Integrated Vector Surveillance are in place and more than 80 health workers/entomologists have been trained in integrated field entomology (covering all provinces). The provincial governments (Gandaki, Bagmati, Sudurpaschim) have initiated recruitment of entomologists. However, most of the positions for entomologists remain vacant and entomological laboratories are needed for virus detection.

Regular vector surveillance is yet to be implemented for all seasons. SOPs for dengue vector control have been developed and endorsed. Ownership and commitment from local-level elected representatives are improving. Yet, community engagement for “search and destroy” activities, particularly in urban areas, remains suboptimal. Limited multisectoral engagement (especially of non-health sectors) and absence of enforcement of public health bylaws (the Public Health Act is not explicit in this regard) remain as challenges as well. As regards risk communication and community engagement, high-level engagement is noteworthy. There is also a dedicated Ministry of Health and Population (MoHP) Centre for Information and Communication (NHEICC). However, misinformation through media needs to be tackled; irregular risk communication interventions and community engagement need improvement.
The country has a Strategic Plan/Action Plan for Dengue Control in addition to the Clinical Management Guideline, the Surveillance Guideline/SoP, the Aedes Surveillance Guidelines/SoP and the Aedes Control Guidelines/SoP. For the next three years, the following interventions have been envisaged – strengthening dengue detection and case management at the basic health facilities level; reducing pressure on referral hospitals; increasing entomological capacity at subnational levels; implementation of integrated vector surveillance and entomological laboratories and facilities for viral detection; and intersectoral coordination and multisectoral engagement. A robust and long-term plan for risk communication and community engagement will be developed as well.

WHO is expected to support regular vector surveillance on selected sentinel sites, entomological laboratory setting and training for health workers, strengthening of virus isolation from mosquitoes and clinical case management training for clinicians, and provide technical support to update the National Dengue Prevention Control and Management Guideline.

**Salient discussion points**

- Countries have different surveillance and information systems. Data synthesis and triangulation pose challenges. This needs to be assessed and resolved in terms of linkages and harmonization. There is a need for IT solution for supporting data cleaning.
- Cases should be confirmed with NS1 before entering these into EWARS/other information systems.
- WHO should support capacity-building for entomological surveillance, vector control, case management and external quality assessment.
- Indonesia – CFR is high. Assessment of mortality (death audit) should be attempted for identifying determinants and mitigation.
- Maldives – age- and gender-disaggregated data are important.
- Nepal – disaggregated data show that the majority are in the productive age group. Therefore, workplace guidelines for prevention and control of dengue are needed.
- There are several brands of RDT present. Quality assurance should be supported by WHO. Nepal also has multiple information systems for dengue, including EWARS. Data cleaning and harmonization across various information sources is conducted manually, which is quite cumbersome.

**Sri Lanka**

Dengue remains a public health problem in the country. Outbreaks are being reported periodically. Even in the past, the number of cases was substantial. In 2017, the country reported 186,101 cases, followed by a drastic decline in reported cases in 2018 (51,659). The number of cases more or less doubled in 2019 (105,049) and in 2022 (76,689) when compared with the number of cases reported in the preceding years (51,659 in 2018 and 35,924 in 2021). In 2023 (until June), the number of dengue cases stood at 39,795. The presentation highlighted that the incidence per 100,000 population has been quite high even in non-epidemic years. In 2022, the incidence was estimated at 345.74. The CFR, however, remained relatively quite low and had even been declining over the years. The peaks of dengue cases after rainfall were underscored. The most affected ones are the
working population (62.4%), followed by school-going children (25.4%). DENV2 and DENV3 are the main circulating serotypes.

Overall assessment of strengths shows the highest level of political commitment for dengue control; availability of a special programme dedicated to dengue control; availability of technical experts from central to district level; adequate HR for surveillance and disease control; availability of infrastructure for implementation of public health activities; trained staff and guideline-driven clinical management system; availability of island-wide HDUs and logistics in base hospitals and above; and availability of real-time disease surveillance system. The weaknesses are inadequate use of GIS systems for case investigations and entomological surveillance; disease forecasting and prediction modelling not widely utilized; inadequate viral surveillance in humans and vectors; poor adherence of general practitioners to the established clinical guidelines; and poor solid waste management by local governments.

The integrated disease surveillance system is available to receive timely notifications to take necessary control actions. The online real-time database, DenSys, is up and running, and will be upgraded to enhance its capacity. However, there are delays in case investigation due to resource constraints; improvement in cluster identification through disease surveillance for outbreak control is needed. Strengths in case management include availability of consultants, medical officers, nursing officers and paramedical staff with regular training in management; availability and widespread use of dengue clinical management guidelines for adults, adolescents, children and pregnant mothers; and availability of HDUs and logistics islandwide at base hospitals and above. In some instances, however, deviation from guidelines in prescribing non-steroidal anti-inflammatory drugs (NSAIDs) is observed, besides delays in admission and unavailability of essential diagnostic facilities in some middle-level institutions (Base Hospital type B), which need attention.

A streamlined vector surveillance system has been established with technical guidance of several levels (National Dengue Control Unit, Provincial Directorates of Health Services, Regional Directorates of Health Services and Medical Officers of Health) and the reporting system is optimized with semi-digitized methods. An enhanced online surveillance data reporting system is under way for timely optimization of vector control data. Yet, challenges remain in terms of inadequate human resources for field activities in certain high-risk districts, poor laboratory facilities, and inadequate field and laboratory equipment, transport facilities and infrastructure facilities. A streamlined system is available to execute, regulate and monitor vector control activities right from the national level to the subregional levels. The NDCU is continuously engaged in policy revision in vector control, according to the updated knowledge and information. However, inadequate HR for field activities in certain high-risk districts and infrastructure facilities and frequent breakdowns of fogging machines are to be addressed.

A separate pillar is established in order to conduct and execute risk communication activities in all provinces across the country. Risk prediction models and scenario-based risk predictions are utilized. A focal point at the NDCU is established for risk communication and collaborations with the Health Promotion Bureau. Continuous scenario-based training is carried out for all relevant public health staff. There is also a major focus on community empowerment and health promotional activities at the grass-roots level. Unavailability of skilful and dedicated HR to engage in risk communication is a challenge. Risk communication needs to be expanded to the educational curricula.
Continuous international collaborations in research on new approaches in vector control are being emphasized. Yet, financial constraint and inadequate capacities at the regional level pose difficulties. The country has developed necessary plans and guidelines, viz. the Strategic Plan/Action Plan for Dengue Control, the Dengue Surveillance Guideline/SoP, the Aedes Surveillance Guidelines/SoP, the Aedes Control Guidelines/SoP, the Guideline on Management of Dengue Fever and Dengue Haemorrhagic Fever for adults, adolescents, children and pregnant mothers, and the Handbook for field mosquito control activities.

For the next three years, the country envisages improved risk forecast and predictions by the NDCU in collaboration with the Meteorology Department, the Disaster Management Centre, the National Building Research Organization; upgrading the disease surveillance system to strengthen detail case investigations; establishing a comprehensive operating centre for outbreak management; web-based real-time entomological surveillance system replacing the paper-based system; and a Centre of Excellence (WHO Collaborating Centre) for clinical management, in addition to scaling up Wolbachia and sterile insect technique (SIT) to cover larger geographical areas.

WHO is expected to provide technical support for capacity development in modelling and forecasting for dengue, and establishment of a WHO Collaborating Centre for clinical management. In addition, technical and financial assistance for rolling out Wolbachia and SIT in vector control as well as developing risk communication strategy and capacity development in risk communication are expected.

**Thailand**

Thailand has three major mosquito-borne diseases, including dengue, chikungunya and Zika. Compared with other arboviruses, dengue fever affects most of the patients. As noted in most SE Asia Region countries, an outbreak was reported with 131,157 dengue cases in 2019. In 2020 and 2021, a declining trend was noted with only 10,617 cases in 2021, particularly during severe COVID-19 situation. However, another outbreak was reported in 2022 with 46,755 cases. Dengue epidemic shows a cycle of every two years; however, dengue cases are reported throughout the year. Each year, at least 40,000 cases are reported while in an outbreak year, it may be more than 100,000 cases. During 2014–2023, the CFR was between 0.06 and 0.13. Since 2017, it has been found that significantly, more adults have died than children because most of the adults and the elderly suffer from chronic diseases. People tend to buy medicines themselves over the counter and arrive at the hospital late. The country has DENV1 predominance almost every year. But in 2022, DENV3 increased 5–16 times, compared with the previous five years.

In 2023 (until June), 19,503 cases had already been reported. In 2023, it was expected that there would be more dengue cases than in 2022, with the continuation of an outbreak from the previous year. In addition, there was a change in the dengue virus type, with a marked increase in DENV3, compared with five years ago. Therefore, most people may not have immunity. It was predicted that approximately 93,394 cases would be reported throughout the year, if the disease control measures were not implemented according to standards, the number of cases would be as high as 140,091 and there would be an increased chance of higher deaths.

Dengue situation analysis uses information from the surveillance system comprising passive and event-based surveillance. There is a situation awareness team (SAT), responsible for daily event-based surveillance, verification, follow-up and coordination (at national, regional and provincial levels). SAT
covers disaster, disease outbreak, injury and accident. Risk communication is carried out according to guidelines. The Division of Vector-Borne Diseases (DVBD) prepares the information and supports health promotion tools in consultation with experts (surveillance, prevention and control). Priorities for action for dengue and other arbovirus disease management are as follows:

- for surveillance: analysing situation and risk assessment in order to prioritize the risk area as well as plan for outbreak preparedness and response;
- for prevention and control: eliminating mosquito larvae in all settings throughout the year; conducting case investigation and disease control within 28 days; and activating the Emergency Operation Centre (EOC) for outbreak control;
- for case management: increasing the capacity for diagnosis; strengthening the training courses for health-care providers using the National Treatment Guidelines (optimal therapy); setting up dengue corners and dengue wards at hospitals and health facilities; and
- for risk communication: preventing mosquito-bite, generating awareness about symptoms that require immediate medical attention and about using drugs with steroids and NSAIDs.

Suspected, confirmed dengue cases are reported within three hours after diagnosis. Action for control is taken within three hours too (investigation; adult control by spraying insecticide and larval control by identifying and managing breeding places). Furthermore, within one day, adult vector control is undertaken with spraying insecticide, larval control of breeding places and health education. Health education through network works well as “Ing-ma” campaign. Collaboration activities between Takeda and the Department of Disease Control envisage integration of cooperation on information and empirical evidence, communication to people, and encouraging education for medical professionals and village health volunteers.

The government and the private sector work together to stop dengue fever and a memorandum of understanding (MoU) has been signed to prevent and control dengue and other arboviruses. There are 11 partners of the Dengue-Zero initiative. The goals are to reduce dengue morbidity rate by 25% from the five-year median, curb DHF death rate to less than 0.05% and restrict the larval house index to less than 5%. Thailand also participated in such significant events as ASEAN Dengue Day. Activities covered exhibitions and discussions, and awards were presented.

Education tools for Aedes-borne diseases have also been designed in a variety of options such as e-learning and online game, covering basic knowledge of diseases and vectors, and how to control breeding places. A Vector Control Unit (VCU) has been set up within the Communicable Disease Control Unit (CDCU) per district for control measures during an epidemic situation, following the Communicable Disease Act 2017. Moreover, the presentation highlighted the ICT Revolution for Epidemic Mission. Innovative approaches are being rolled out to support surveillance system, for instance, applications/software using technology for vector surveillance and outbreak alert. These include TanRabad (software for dengue vector surveillance and dengue situation analysis), Aor Sor Mor Online (an application for dengue vector surveillance for village health volunteers) and Rootan (an application for general public alert).

**Timor-Leste**

Dengue is reported from Timor-Leste, but the numbers are minimal. In 2022, the country reported the highest number of cases (5658) so far. The incidence per 100 000 population was high (39.5).
In 2023 (until May), 1188 cases had already been reported. The CFR was noted to be 1% in 2022. Most cases are registered in the capital, Dili. The most affected age group reported was between 5 and 14 years in 2023. Cases were reported throughout the year in 2022, although the highest number of cases was reported during the period stretching from January to March. In 2023, the highest number of reported cases was noted in the month of March. No chikungunya and Zika cases have been reported in the country so far. In 2019, 23 JE cases were reported.

The overall assessment of the Dengue Control Programme noted the following strengths: availability of guidelines to strengthen the ability and preparedness to address the epidemic; development of the Integrated Vector-Borne Disease Control (IVBDC) Strategy; timeliness of notification with intensified case-based surveillance (immediate notification of cases within 24 hours, investigation of cases and entomology surveys within five days, and response within 10 days); positioning community health inspectors at the Dili Municipality for dengue surveillance and source reduction (supported by WHO); social mobilization in community (community education programmes, door-to-door health education, interpersonal communication and greater health staff-community engagement) and advocacy with spreading awareness through all available local communication media; and cross-border collaboration with notification on unusual/outbreak situation and detection of imported cases in their territories, especially in border areas. The presentation also informed participants about a new communication strategy developed for 2021–2023 to maintain awareness among local leaders, health-care service providers and community members about malaria prevention and control; sustain high level of long-lasting insecticidal nets (LLIN) ownership and use among the target populations; ensure immediate consultation of patients with fever and history of travel to endemic areas or previous history of malaria; and increase political commitment and ownership on the part of the local administrative/health leaders of the Malaria Programme.

Major weaknesses include a fragmented Dengue Control Programme and absence of any donor-/government-committed funding. Other weaknesses and gaps that have been identified involve data transmission (manual reporting and data collecting methods); laboratory surveillance (RDT and NS1); available facilities [intensive care units (ICUs) for severe cases and laboratory services for diagnostic testing]; lack of HR (both supervisors and field staff); health-care providers lacking the skills and knowledge to improve the quality of care for dengue patients; inadequate entomological capacities; inadequate community sensitization regarding common breeding sites and their preventive measures; and lack of budget for the Dengue Control Programme. Furthermore, passive surveillance is followed at most facilities.

The country has developed the National Dengue Clinical Management Guideline 2022, the National Strategic Plan for Integrated Vector-Borne Diseases 2021–2030, and the Social and Behaviour Change Communication Strategy for Prevention of Re-establishment of Malaria Transmission in Timor-Leste. For the coming three years, establishing the IVBDC unit and implementation of the IVBDC strategy, building capacities of all doctors at public and private hospitals for following the Dengue Clinical Management Guidelines and fostering advocacy for increasing funding allocation to support the programme activities have been envisaged.

WHO support is expected for nationwide dengue clinical management training; entomological surveillance and breeding site mapping, besides strengthening laboratory technical guidance for laboratory diagnosis of dengue, SOP for RDT, dengue-serotyping capacity (collaboration with WHO CC – National Institute of Virology in Pune, India) and reagent support; and launching a “zero-dengue death initiative” by capacity-building, and improving care facilities and tertiary referral centres.
In addition, technical guidance is needed for introduction of *Wolbachia* to the Dengue Control Programme.

**Salient discussion points**

- Risk maps should be developed. Consider inclusion of comorbidities (e.g. NCDs) as risk factors. Data disaggregation may be considered accordingly.
- There is lack of strategy for risk communication. Information technology should be used for risk communication, e.g. use of social media and mobile messaging.
- Sri Lanka: The majority of the affected persons are in the productive age group. This group does not seek early treatment in view of economic pursuits.
- Thailand has developed online apps for dengue surveillance. Risk assessment is being carried out. Real-time data are available. An MoU exists with the Meteorological Department. One of the innovative apps is used by trained VHWs, whereby larval survey data from households are entered. The apps are still evolving.
- India is also establishing information system in collaboration with the Meteorological Department. Trainings were carried out. This was a time-limited activity.

**Overall discussion on common challenges and good practices regarding dengue and other arboviral disease surveillance in the countries of the Region**

**Salient discussion points**

- Common challenges:
  - epidemiological transmission varying within and across countries;
  - documentation of data regarding the serotypes;
  - asymptomatic cases and their contribution to the burden of disease;
  - clinical determinants of severe dengue and comorbidities;
  - optimal programme implementation with political, executive will, especially at the subnational level;
  - optimal utilization of existing tools;
  - non-standardization of case definition;
  - lack of communication on the ground through skilled manpower (in Delhi, involvement of youths, university scholars, security guards and sanitation workers have yielded results in terms of reduction in dengue cases and mosquitogenic conditions);
  - lack of involvement of private-sector hospitals and medical colleges;
  - lack of community engagement;
  - no guidelines for *Aedes* surveillance; and
  - Difficulty to understand the difference between DF and DHF; achievement of zero mortality (if diagnosed early, disease can be managed well, even with regard to cases with comorbidities).
The areas of critical needs:

- understanding the role of/contribution from asymptomatic cases from public health perspectives;
- evidence-based case management;
- updating of WHO guidelines on dengue control by WHO HQ (including but not limited to integrated vector surveillance, clinical management); and
- WHO Epidemiological Bulletin on dengue situation updates that has been initiated by the World Health Organization’s Health Emergencies Programme (WHE) with information on five countries but needs to include other countries as well.

### 2.4 Dengue surveillance and laboratory

**Surveillance and rapid risk assessment for dengue and other arboviruses – overview and options: Dr Masaya Kato, Programme Area Manager, WHE/HIM**

The risk of emergence and re-emergence of arboviruses with pandemic potential has increased as a global public health threat and will continue to rise in the years to come. The presentation shared information about countries and territories with current or previous transmission of dengue, chikungunya, Zika and yellow fever, followed by the details of the key public health events in the SE Asia Region during 2015–2023 (specific arbovirus events and natural disasters which can increase the risk of arboviral events). The geographical range of arboviruses keeps expanding due to increased human movement, urbanization, climate change, environmental adaptation of the mosquito vectors and uncontrolled expansion of mosquito vector populations. The information needs pertain to understanding the number of cases and deaths, and disease trends, cases with neurological complications, outbreak situation, any shift in serotype of dengue, health system capacities as well as vector situation and environmental factors.

The *Aedes*-borne surveillance objectives are to monitor morbidity and severity, provide early warning, assess serotypes, detect birth defects/Guillain-Barré syndrome (GBS), assess health-care system situation (e.g. bed occupancy), examine entomological parameters, and assess weather, temperature and rainfall. The surveillance approaches include indicator-based surveillance (notifiable disease surveillance, sentinel surveillance, syndromic surveillance) and event-based surveillance (media, health-care/laboratory services, communities). Arboviruses are notifiable in most countries in the SE Asia Region. However, variations are observed across countries in terms of case definition (some countries report only confirmed cases vs confirmed/suspected cases, only hospitalized cases vs including ambulatory cases, passive vs active surveillance, weekly reporting vs daily reporting).

Syndromic approach allows timely reporting and sentinel surveillance allows higher-quality data and potentials to include enhanced components such as testing for CHIKV and ZIKV, serotyping, genomic analysis and sentinel population (pregnant women, persons with higher risk of infection). Sentinel surveillance is implemented in Bhutan, Nepal, Sri Lanka and Thailand. Event-based surveillance (EBS) allows rapid capture of information regarding health events that may represent a potential risk to public health. EBS is increasingly playing a critical role in early warning function. Triage (by EBS team) and verification (by local rapid response team) of signals are essential as well.
The arbovirus surveillance approaches are also variable in terms of frequency and type. It was pointed out that multisource collaborative surveillance has advantages since no single system is expected to meet all surveillance objectives and the relative importance of surveillance approaches varies over the emergency cycle (pre-event, alert, event and transition phases). It is the systematic strengthening of capacity and collaboration among diverse stakeholders, both within and beyond the health sector, with the ultimate goal of enhancing public health intelligence and improving evidence for decision-making. It allows for triangulation of multiple sources of information for risk assessment and decision-making. It builds intentional collaboration across four dimensions (diseases and threats, sectors, emergency cycles, geographical levels), connecting surveillance stakeholders across systems, platforms, tools, networks and skill sets. It also increases the coverage and quality of surveillance.

The presentation also shared the steps for rapid risk assessment of acute public health events and factors to be assessed for risk assessment for arbovirus events (viz. hazard, exposure and context) and risk characterization (including the process of assigning a level of risk to the assessment and creating a risk matrix combining estimates of the likelihood and the consequences). Further, EWAR in emergencies combines information from indicator-based surveillance (IBS) and EBS to guide alert and response activities.

Expected considerations include clarification of surveillance objectives; optimizing surveillance systems to meet surveillance objectives; standardizing case definitions and surveillance approaches; hospital-based vs inclusion of outpatient settings; minimum data set for reporting; digitalization of surveillance information systems; roles and methods for risk assessment; collaboration to improve synthesis of multiple sources of information across systems and sectors; surveillance of GBS and birth defects; dissemination/communication of data; and utility of data on travel-related cases [information-sharing via IHR(2005)].

**Orientation on existing dengue diagnostic tools, and existing laboratory network and capacity in the Region:** Dr Dhamari Naidoo, Public Health Laboratory Scientist, WHE/IHM

The presentation described the baseline survey conducted by WHO to get an overview of country capacities for arboviral disease surveillance (epidemiological and entomological) and control in Member States in 2021. Post COVID-19 response, the SE Asia Region has increased PCR and sequencing testing capacity by expanding national laboratory networks and connectivity with private and academic sectors. The lessons learnt are: scalability of testing (inclusion of the private sector); sequencing capacity for rapid pathogen and variant identification (national networks/consortiums); testing outside the health-care system (health-care worker screenings, mass gatherings, self-testing); rapid sharing of information with public domains (upgraded data management systems, infrastructure); workforce for surge (increased hiring, repurposed HR); adaptability of testing strategies (multiple test platforms, wastewater surveillance); quality testing (national QC for expansion); and optimization for efficiency and effectiveness (centralized supply chain management, placement of diagnostic tools across the health system).

The factors that have driven the success of preparedness and readiness are pandemic influenza preparedness, global disease surveillance programmes, bilateral partnerships and national efforts. Furthermore, it was shared that a SE Asia Region roadmap had been developed for diagnostic preparedness, integrated laboratory networking and genomic surveillance (2023–2027). This roadmap
focuses on health emergency preparedness, response and resilience (HEPR) and has consolidated the lessons learnt from the COVID-19 response, provides strategic technical guidance to Member States and aligns with resolution WHA76.5 resolution on strengthening diagnostic capacity in the Region (Regional Reference Laboratory Network, Regional Diagnostic Innovation Platform, genomics consortium, diagnostic task force). The technical aspects emphasize strengthening national leadership, governance and multisectoral collaboration; ensuring adequate investment to build and modernize laboratory networks, building agile and resilient laboratory systems with an all-hazards approach; promoting research and development of and access to new and innovative technologies; maintaining and sustaining readiness for public health emergencies; and establishing a trust architecture for rapid information and sample-sharing, access to tools and resources to enable and strengthen pathogen surveillance and sequencing systems.

The details of the Regional Network of Laboratories (decision-making body for oversight of implementation of workplans); the diagnostic task force (providing technical advice to WHO, responsible for establishing regional diagnostic priorities, establishing linkages to the R&D ecosystem and development partners and donors); and the Working Groups for development of workplans were explained. The opportunities to improve arbovirus laboratory surveillance involve enhancing access to testing and training as well as procurement and pricing; supporting genomic surveillance for arboviruses, and the validation and implementation of new technologies; leveraging the expertise for virus isolation and neutralization; and contributing to the SE Asia Region Diagnostic Reference Laboratory Network.

Observation and opportunities for dengue laboratory strengthening in countries: Dr Gajanan Sapkal, NIV, Pune

The presentation started with highlighting the worldwide estimated distribution of dengue in the next 30 years due to climatic and population change and phylogeny analysis of 922 complete genomic evolution of all DENV serotypes reported from January 2000 to October 2020, based on their origin. It was mentioned that the dengue disease burden challenged WHO South-East Asia Region with significant health and economic loss. With the abundance of Ae. aegypti vector mosquitoes in the Region and favourable geographical conditions, dengue is an apparent threat to the population in SE Asia Region countries and globally. The presentation also included different diagnostic tools for detection of dengue timeline, namely direct methods such as virus isolation, genome detection and antigen detection, and indirect methods such as serology (IgM, IgG), and antibody detection as well as febrile, critical and recovery phases, in addition to timelines for viral detection. Laboratory-based surveillance is critical because of overlapping clinical symptoms with other flaviviruses and chikungunya, which makes differential diagnosis difficult without laboratory confirmation.

India has witnessed several public health threats due to the emerging/re-emerging viral infections: MERS-CoV, Ebola, Zika and yellow fever, to name a few. There is acute shortage of laboratory diagnostic facilities to combat such impending viral threats. The quality of laboratory diagnosis has a huge impact on patient care, treatment, and prevention and control of the disease. Hence, there is an urgent need for strengthening the laboratory capacity for dengue infections. Considering this fact, the Indian Council of Medical Research (ICMR)-National Institute of Virology (NIV) has begun dengue laboratory strengthening in countries in terms of the Viral Research and Diagnostic Laboratory (VRDL) Network capacity-building in India under the Department of Health Research (DHR)/ICMR scheme on “Establishing a network of laboratories for managing epidemics and natural calamities”.

Meeting of programme managers and the Regional Technical Advisory Group on dengue and other arboviruses in the SEAR
Besides two apex laboratories, VRDLs exist at regional (10), state (25) and medical college (102) levels. The scope of VRDLs includes testing all viruses of public health importance, excluding high-risk viruses (Nipah, SARS, KFD, etc.), polio and HIV. Samples are received from two sources: routine samples from the hospital (outpatient and inpatient departments) concerned and outbreak samples (IDSP and state health authorities). Data are entered offline/online for time, place, person and other epidemiological details for the following syndromes: i) encephalitis/ meningitis; ii) diarrhoea; iii) respiratory fever of unknown origin; iv) fever with rash; v) jaundice; vi) haemorrhagic fever; vii) conjunctivitis; and viii) others. Continuous interactions are held with health authorities, including the National Centre for Vector-Borne Disease Control (NCVBDC) regarding unusual occurrence of viral diseases (sporadic cases/outbreaks), and information is collated from local newspapers and electronic media.

The NIV is the Resource Centre for Virus Research and Diagnostic Laboratory (RCVRDL) for human resource development and VRDL capacity-building; external quality assurance of dengue, chikungunya and Japanese encephalitis virus infection; and scientific and technical support. Its role also extends to the supply of reagents and test kits; serotype-specific detection of circulating dengue virus; Zika virus surveillance; preparedness for yellow fever in addition to supporting laboratory capacity-building efforts in SE Asia Region countries. In addition, other studies have been conducted on dengue using the laboratory capacity gained at the VRDL Network in the country. Going forward, preparedness for “newly emerging pathogens” is envisaged with a focus on such core elements as “predict, identify, respond and prevent”.

Salient discussion points

- NIV, India, in collaboration with WHO-SEARO, conducted trainings in Timor-Leste. WHO-SEARO will continue to provide technical support to countries.
- Multiple surveillance systems, which are often under different programmes, different sectors/stakeholders, which are not linked/coordinated with each other:
  - Dengue surveillance should be collaborative towards convergence of data from all sources – related to tests, cases, deaths, travel history, etc.
  - Thailand has rolled out epidemiological surveillance as well as entomological surveillance, even with the involvement of village health volunteers contributing to the latter.
  - Lessons learnt from the COVID-19 pandemic with regard to multistakeholder and partner coordination should be considered.
  - Data quality remains important.
- WHO should provide step-by-step guide for countries.
- The WHO Global Risk Monitoring Framework, among others, should be referred to for guidance.
- Guidance from social science and communication disciplines should be sought.
- Serotyping should be more emphasized at the point of care while molecular diagnosis should be considered when proper laboratory facilities are available. Capacities for isolation and neutralization should be built too.
- Development of vaccines, therapeutics and diagnostics should be emphasized by countries as well as partners, including WHO.
In Nepal, shortage of dengue test kits is a huge challenge. Guidance on whether all cases should be tested, especially in an outbreak situation, needed:

- Ideally, each suspected case should be tested and the right of the patient for testing should be supported. Accordingly, logistics should be arranged.

- In an outbreak situation, clinical diagnosis may also be followed in exceptional, challenging circumstances. However, all high-risk groups, pregnant women, children and patients with comorbidities should be tested.

- While testing each suspected case may not be required in an outbreak situation and clinical diagnosis may be followed, the right of the patient for testing should be supported.

- Good-quality RDTs are now available. Hence, each case should be tested. During the COVID-19 pandemic too, a huge number of tests was possible in countries.

- The forthcoming WHO global and Regional initiatives should include guidance on testing and case management, among others.

Strategy for biomarkers for high-risk patients should be developed. Surrogate biomarkers should be identified too. This needs to be included in the Regional initiative.

Chikungunya diagnosis is available at limited facilities in India. During an outbreak, not every case is tested, only clinical diagnosis is carried out.

- Chikungunya diagnosis is also available; hence, testing should be carried out.

- Two consortia, one each on dengue and chikungunya, exist in India.

The vision for the arboviral disease data dashboard of GLAI: Dr Diana Rojas Alvarez, Technical Officer, WHO HQ/WHE

One of the priority actions under the Global Arbovirus Initiative is to create a global dashboard that allows everybody to access the most updated data. The main aim is to make this dashboard useful for the local level where data can be interpreted in various ways for informed decisions. Finally, such a global arboviral dashboard will help everyone to be prepared for the next pandemic. Therefore, the initiative is a pandemic plan to address mosquito-borne viruses.

Currently, almost 4 billion people across the globe are at risk of arboviral diseases and this number is growing over time. The spread is in different regions of the world. Therefore, it is necessary that the global initiative covers all arboviral diseases, especially Aedes (Stegomyia)-transmitted diseases, i.e. dengue, chikungunya, Zika and yellow fever. Integration of different components of disease control, such as surveillance, prevention and control measures, entomology, environmental surveillance, clinical management, risk communication and risk management, is also necessary for better results.

The Global Arbovirus Initiative has six pillars. They are: 1) monitor risk and anticipate; 2) reduce local epidemic risk; 3) strengthen vector control; 4) prevent and prepare for pandemic; 5) enhance innovations and new approaches; and 6) build a coalition of new partners.

The presentation was focused on pillar 1: monitor risk and anticipate. This pillar has two priority actions. They are: 1) develop a global risk monitoring framework for arboviruses using the One Health approach, and 2) forecast and model potential epidemic and pandemic scenarios for arboviruses. The One Health approach integrates environmental surveillance, human surveillance
and animal surveillance into a full view of the risk from different diseases. Since the main reservoir of these arboviral diseases is humans, there will be no surveillance in animals, but vector surveillance has an important role to play, similar to that of animal surveillance in the One Health approach. When the global risk monitoring framework is available, modelling with these surveillance data, forecasting epidemic and endemic scenarios, is possible. This is a step-by-step approach to be started with ensuring the availability of data.

Currently, WHO is working with different modelling groups, including the London School of Hygiene and Tropical Medicine (LSHTM), for the development of a comprehensive risk mapping of arboviral diseases. The LSHTM conducted a systematic review to identify the main drivers of transmission of arboviruses and implemented the risk mapping using the ecological niche model.

The global risk map has no high resolution due to limited data. Although several risk mappings for dengue are available, these are limited for chikungunya and Zika. With the declaration of the Zika outbreak as a public health emergency of international concern, Zika risk mapping gained some interest, but all risk mapping available belonged to the pre-COVID-19 period.

Updating risk maps is necessary since the virus has been isolated in new places and the disease reported in new Regions. The risk maps for Zika were last updated in 2016 and those for chikungunya in 2015. Since the last update, there have been 707 new occurrence points of Zika transmission and 531 points for chikungunya. The risk mapping includes temperature suitability, precipitation, vegetation index and presence or absence of *Ae. albopictus/Ae. aegypti* in different Regions; for yellow fever, it includes presence of non-human primates and yellow fever vaccination coverage. Urbanization and GDP are also included in the risk mapping.

In parallel, WHO is working on an inventory of data sources and systems across the WHO Regions. The Organization will be developing an integrated global arbovirus reporting system to capture and transmit arbovirus-related data from the national to the Regional and then to the global level. The global arbovirus dashboard will be designed and operationalized to be hosted by WHO HQ. However, the global dashboard will depend on how the Member States feed data into the Regional dashboards from where the global dashboard will be fed into.

Data sources currently available include dengue data reported to a master file administered by the Department of Control of Neglected Tropical Diseases (NTDs); reporting of cases under the Infectious Hazard Management (IHM) Unit (e.g.. Zika transmission); event-based surveillance in emergencies; the European Centre for Disease Prevention and Control (ECDC); Chikungunya, Dengue, Zika World Views, Institute for Health Metrics and Evaluation – Global Burden of Diseases (GBD); DHIS2 across multiple Regions; and EWARS for fragile countries/territories. These are heterogeneous data sources with Regional disparities in the data available and also with disparities in what is being reporting; for example, case definitions may vary. The global arbovirus dashboard will provide historical data, regional information, maps, etc. If more detailed country data are required, Regional dashboards may need to be explored. New tools will be available to analyse data and generate reports with least effort.

The next steps will be determining the data system/dashboard requirements, data collection requirements (field/mobile collection) (number of data elements), the minimum list of variables to start with, and collection of data from the MoH level to begin with (computer-based). These topics had been further discussed at the Global Arbovirus Technical Advisory Group (TAG) meeting, held in Accra, Ghana, in June 2023. Results of the global risk mapping were discussed and some of the SE Asia Region countries may help validate these risk mappings. The Global Arbovirus TAG also discussed
how to use arborviruses as a case study in the One Health approach for prevention and control of epidemic-prone diseases.

The partners in this initiative include US CDC, Pasteur Institute, FIND, National Environment Agency (NEA), German Agency for International Cooperation (GIZ), Wellcome Trust, IHME, UNICEF, London School of Hygiene and Tropical Medicine, Drugs for Neglected Diseases Initiative (DNDi), The Rockefeller Foundation and Bill and Melinda Gates Foundation. But the most important partners will be all WHO Regional Offices and Member States.

**Arboviral diseases in the Americas – strategies and dashboard: Ms Thais H dos Santos, Regional Adviser, Surveillance and Control of Arboviral Diseases, PAHO/WHO**

**Strategy and epidemiological situation**

Since the Pan American Health Organization (PAHO) was created in 1902, 17 different resolutions have been passed as strategies for control of dengue and other arboviral diseases. After the introduction of Zika and chikungunya in the Region, in 2016, a new resolution was passed, including these diseases, apart from dengue. This is just a formalization of commitment from countries to collaborate on the issues related to arboviruses, implement an integrated management strategy for arboviruses and share data.

When case reporting since 2008 is considered, dengue cases have been dominating over all these years. In 2013, chikungunya first appeared in the Region and Zika in 2015. In the year 2023, up to the EPI Week 21, 1.99 million suspected dengue cases had been reported in the Region with cumulative incidence of 203 per 100 000 population. Furthermore, 39% of cases were laboratory-confirmed. Out of all, 0.13% (2555) belonged to the severe dengue category; 733 deaths were also reported. The case-fatality rate was 0.037% and remained below the Regional target of below 0.05%.

CHKV case reporting has gradually declined since 2014, but in 2023, some countries were experiencing large outbreaks. The highest level of Zika case reporting was seen in 2016; this made WHO declare it as a PHEIC. Since then, notification has largely declined. One of the reasons for low case reporting may be attributed to the fact that some countries are not reporting Zika cases.

**Collaborative surveillance and the Arbovirus Information Platform**

The Arbovirus Information Platform facilitates collection, transformation, analysis and publication of data on arboviral diseases. This has information on 35 countries and 18 territories in the Americas. Although data on dengue, chikungunya and Zika are available, more complete data on dengue are available, compared with that on other diseases. This system consists of epidemiological, laboratory and entomological data.

When the Regional dashboard is established, initial collaboration will be with the countries that offer greater probability of success in reporting instead of with the countries that have the greatest need for such a dashboard. This is because the developing dashboard needs to be tested first for its success and then it is convenient to expand to other countries. Data to the system are received from countries in different formats, such as in Microsoft Word and Excel files, Microsoft Access databases, text files and PDF files. Multiple data points received in different formats are transformed and entered into the database. In addition, a person assigned from the Regional Office regularly visits relevant websites of the ministries of health to capture published data and enter them into the database.
manually or through macros that are being developed. This ensures less work for contributing countries, thereby ensuring their higher participation. Analysis has been conducted through Tableau software, but it is now shifting to Power BI. The dashboard has two main products – they are public arboviral report and private virtual collaboration space (VCS).

The private virtual collaboration space is data-rich but has limited access, only to the national counterparts and the focal point at WHO HQ. This is a closed space where data can be shared transparently, building up trust among stakeholders. The space is flexible and dynamic, and the structure and content can be easily modified based on the needs of users.

The public facing ARBO portal ensured a very static reporting of case counts in PDF format until 2014. This was transformed into the Health Information Platform for the Americas (PLISA) – an interactive data portal based on Tableau that enabled more customizable analysis. It generates an automated Epidemiological Bulletin with dengue, chikungunya and Zika data and has more than 2 million views. The template was developed as collaborative work with programmers; codes are written into where changes are necessary, based on the weekly data.

**The opportunity**

This dashboard modernizes and automates the surveillance processes that are still manual and obsolete in some countries. It has the provision to use all available collected surveillance data (epidemiological, clinical, laboratory and entomological data) for a better understanding of the transmission dynamics and apply them to prevention and control measures most effectively; strengthen capacities to improve data quality, analysis, integration and decision-making in prevention and control within national and subnational technical teams; and provide continuity and sustainability to new modalities of technical cooperation.

**PAHO arbovirus team and budget**

The process started with two advisers and 50% full time equivalent (FTE) of a computer scientist. In most of the years, the annual budget was around US$ 120,000 and in 2020, it was US$ 327,000. With the expansion of the system with inclusion of more data and activities, more funds could be raised and the budget in 2022 touched US$ 2 million so that more human resources could be made available. The 2022 staff included one additional computer scientist and two technical officers.

**Salient discussion points**

- Uniform case definition across Member States is important for reporting on a common platform and comparison of data. For example, in 2009, dengue case classification regarding severity was introduced by WHO HQ. But some countries in the Region are still using the case classification as dengue fever, dengue haemorrhagic fever and dengue shock syndrome.

- In the PAHO Region, despite all efforts made, there was only a little impact on the transmission of dengue. But with the introduction of the new case definition, the proportion of severe dengue and the case-fatality rate have drastically declined.

- Yellow fever is not included in PLISA since there is no Aedes-borne yellow fever in the Americas.
Initially, the Global Arbovirus Initiative was focusing on Aedes-transmitted arboviruses only. However, when the Region is adapting GLAI, they are free to add other relevant arboviral diseases.

Granularity of data reporting will depend on to which level the Member countries are prepared to report and share country data on the Regional dashboard.

Member States may have different mechanisms of approval for publishing and sharing data. Sometimes, reluctance to display data in the public domain can be observed. In PAHO, beyond passing resolutions, initially publishing data in the dashboard, in collaboration with the countries willing to share data, has made an impact since it has convinced other countries of how useful the availability of data is in a such a platform, where data can be analysed and used for decision-making.

The next step of the database development should be focusing on the subnational-level analysis of data, with least support from the higher level, for local staff to make informed decisions on impending outbreaks and control measures.

**Proposed standard indicators, reporting mechanism and Regional dashboard in the SE Asia Region: Dr Sudath Samaraweera, Consultant, CDS/NTD**

The requirement of a Regional dashboard for arbovirus diseases had been highlighted during this meeting. In this regard, Aedes-transmitted arboviruses will be prioritized and to begin with, dengue fever will be in focus. In order to develop and operationalize the South-East Asia Regional dashboard, inspired by the experiences of the Region of the Americas PLISA dashboard, the Member countries in the Region need to agree on a minimum set of data against a “wish list” or the best data set, if available. It is also suggested that at the beginning, it is appropriate to not focus on entomology data but to consider its inclusion at a later stage of the development.

The suggested minimum set of indicators and other modes of data presentation are:

- incidence of dengue fever;
- dengue case-fatality rate;
- proportion of severe disease;
- proportion of laboratory-confirmed dengue cases;
- age-wise breakdown of reported dengue cases; and
- gender-wise breakdown of reported dengue cases.

To ensure the availability of the above-mentioned indicator details, the data elements required are:

- number of suspected dengue cases;
- number of confirmed dengue cases;
- number of cases with severe disease;
- number of deaths due to dengue;
- number of dengue cases by pre-determined age groups;
- number of dengue cases by gender; and
- mid-year population of the Member States.

The feasible frequency of data reporting also needs to be determined. It may vary from daily reporting to weekly, bi-weekly, monthly, quarterly or annual reporting. However, for a meaningful analysis to understand the disease dynamics and to forecast outbreaks, reporting of cases at least at a weekly interval is suggested.

In addition to the national level of data reporting, reporting of cases at the subnational level by Member States is also suggested. Development of an annual report with more details is also suggested. It is observed that some Member States are already reporting similar data in their Annual Health Report of the Department/Ministry of Health. Availability of a Regional Annual Report on arboviral diseases will be a useful repository for future references.

**Salient discussion points**

- When the Global Arbovirus Initiative was developed, it was decided that the initiative should be focusing on diseases transmitted by *Ae. aegypti* and *Ae. albopictus*. There are many other *Aedes* mosquitoes that transmit different arboviruses, but these cannot be in focus at this moment under the current Initiative. Therefore, the classification, *Aedes* (Stegomyia), is chosen in GLAI to avoid confusion. However, Member States and Regions can use classification of *Ae. aegypti* and *Ae. Albopictus*, if they prefer to do so.
- If the Region seeks to adapt all six pillars of the Global Arbovirus Initiative, it is important to identify all indicators that will be reflecting the six pillars.
- Data reporting should not be unidirectional, viz. limited by reporting from Member States to the Regional Office but should be incorporating feedback from the Regional Office to the Member States.
- Sometimes, there can be errors in data reporting. Therefore, a provision to reconcile data at a later stage should be available. However, to avoid any data manipulation, this must be executed with administrative authorization and supervision.
- Daily reporting of cases during an outbreak situation and weekly reporting in other instances are suggested.
- Consensus on reporting of severity of cases should be reached. It is necessary to decide whether case reporting will be as dengue fever and dengue haemorrhagic fever or mild, moderate and severe dengue cases.
- Proportion of hospitalization will not be a valid indicator since clinical practices may vary widely. Use of such case classification as DF/DHF or mild/moderate/severe cases will provide more valid information on the proportion of severe cases.
- Since comorbidities play a significant role in dengue deaths, it is advisable to also collect and analyse data on comorbidities related to dengue deaths.
- Consider reporting the number of cases tested for dengue and the proportion of cases that tested positive.
- In addition to reporting laboratory-confirmed dengue cases, it is important to expand laboratory testing and report confirmed chikungunya and Zika cases as well.
Reporting of circulating dengue serotypes is also important.

Consider reporting gender equity and social inclusion with the support of experts in the area.

Development of aggregated entomological data at the national level and then reporting these to the Regional level will be challenging. Entomological data will be more useful at the subnational level of Member States.

In the order of preference of entomological data, Container Index, House Index, Breteau Index and Pupal Index are recommended.

Dengue Early Warning and Response System (EWARS) experience, lessons learnt and opportunities in Thailand: Ms Rawadee Kumlert, Public Health Technical Officer, Senior Professional Level, Division of Vector-Borne Diseases, Ministry of Public Health

In Thailand, this system was started in 2022 with collection of data from 15 stations in nine provinces of Thailand. Data are received through an online platform called Thingcontrol and stored in a cloud storage. Collected data include humidity, temperature and rainfall figures. Once these data are received, these are fed into EWARS. In addition to the environmental data, case data are also fed into EWARS.

Based on the data fed, weekly reports are generated. If the outbreak probability is higher than the alarm threshold, the system generates alarm signals. This prompts outbreak response at the local level. Detection of outbreak status with reporting current data and comparing it with retrospective data was demonstrated.

In the pilot project, data from 12 stations were collected through focus groups and personal investigations. For follow-up and evaluation, five weather stations near the Eastern Economic Corridor (EEC) have been identified.

In this pilot project, the problems and solutions are identified. There are plans to evaluate the effectiveness and the possibility of scaling up the project. It is encouraging to note that communities in some subdistricts, who are motivated by the results of EWARS, have taken initiatives to create their own vector control projects.

For data-sharing, an MoU has been signed between the Department of Disease Control and the Meteorology Department. This will link 128 weather stations in 77 provinces to automatically provide climate data (humidity, rainfall and temperature) to EWARS. The future plan involves establishment of a fully automated EWARS in Thailand.

Salient discussion points

Several countries shared their experience and future plans. These include:

- India is piloting EWARS in six states. The National Centre for Disease Control (NCDC) and the Ministry of Environment, Forest and Climate Change, in collaboration with the Meteorology Department, are carrying out this project.

- Bangladesh has implemented EWARS in the population settlements of displaced persons of Myanmarese origin. Through this system, disease outbreaks such as cholera, dengue and scabies are monitored and timely mitigation measures taken.
- Nepal has implemented climate-sensitive disease surveillance through EWARS.
- Timor-Leste has not implemented EWARS yet. Since climate data are beyond the Ministry of Health, it will be exploring the possibility of collaborative implementation after discussion with higher-level government authorities.
- Sri Lanka’s National Dengue Control Unit is closely working with the Meteorology Department and the Disaster Management Centre, obtaining climate data. However, EWARS has not been implemented. With the experiences shared by Thailand, there are plans to explore the possibilities for a similar project in Sri Lanka in future.

WHO published *Early warning alert and response (EWAR) in emergencies: an operational guide* in early 2023. EWARS has different scope and definitions. For example, EWARS in such countries as Bangladesh, Indonesia and Nepal primarily focuses on epidemiological data, mainly through indicator-based and event-based surveillance. However, Thailand and Singapore have tried to incorporate additional indicator data, such as vectors, serotype, climate and environmental parameters. For designing an early warning system for arboviral diseases in future, this is an important direction to decide on what type of information to incorporate for early warning alert. The country experiences should be utilized in the future development of EWARS.

2.5 Dengue case management

**Country experience in reducing dengue morbidity and mortality – case study from Sri Lanka: Dr Lakkumar Fernando, Consultant Paediatrician and Head of the Centre for Clinical Management of Dengue and Dengue Haemorrhagic Fever at Negombo, Sri Lanka**

Dr Lakkumar Fernando presented “the case management learning curve on dengue”, which he has gone through while getting involved in dengue clinical management, from bedside practice to guideline development, over the past 156 months, aiming at zero dengue mortality.

In Sri Lanka, clinically, dengue-like illness has been reported since the beginning of the 20th century. In 1962, the first serologically confirmed dengue case was reported. From 1969 to 1989, dengue fever was established as endemic in the country but with occasional dengue haemorrhagic fever cases. In 1989, the first major epidemic with 203 cases and 20 deaths (CFR 9.8%) was reported. Since then, DHF has also been endemic in Sri Lanka. Thailand experienced a similar situation in 1958 when 2100 cases and 300 deaths (CFR 13%) were reported in Bangkok. At that time, the condition was named as Thai haemorrhagic fever. However, in 1989, when 74,391 cases were reported in Thailand, there were only 290 deaths. The low CFR (0.39%) was attributed to better case management with experience gained over time.

The dengue CFR in Sri Lanka has shown an almost 100–200-fold reduction from 1989 (9.8%) to 2021 (CFR 0.06%). The CFR reported in 2009, 2012 and 2018 stood at 1%, 0.4% and 0.11% respectively. This is a great achievement when the increased proportion of DHF cases (who are at a higher risk of death) over the years is also taken into consideration. For example, in 2009, of all dengue patients, only 6% were DHF cases while by 2019, this proportion had increased to 20%. In Sri Lanka, more adults die, compared with children. Earlier, there was confusion on patient management and the platelet count was considered an indicator for the progress monitoring.
In Sri Lanka, over the years, there has been a transformation in clinical management of dengue. Earlier, dengue diagnosis was solely clinical and there was confusion about how to identify severe dengue cases. Dengue with overt bleeding was considered dengue haemorrhagic fever. Much of the attention was paid to the platelet count. Platelet and plasma transfusion with the advice to consume large amounts of fluids was the main line of treatment.

In the current context, while diagnosis is still based on clinical grounds, more accurate diagnosis is ensured with the support of serological evidence. Differentiating between dengue fever and dengue haemorrhagic fever is clearer and more accurate. Since the majority of the dengue deaths occur among patients with dengue haemorrhagic fever, better management of DHF cases has brought down deaths dramatically. The fluid therapy of DHF is not blind but appropriate, whether it is fluid or blood. The need for platelet transfusion is now extremely rare.

**Key milestones in Sri Lanka’s dengue success story**

1. **Adopting the WHO-SEARO classification:** Adopting the WHO-SEARO classification for clinical management of DF is largely self-limiting. DHF is largely “predictably treatable”. In the natural course of dengue fever, there are febrile, critical and convalescent phases. DHF is the leaking syndrome wherein there is a transient plasma leakage through the capillary walls only into the pleural and peritoneal cavities for a period of not more than 48 hours. The volume of fluid loss in the intravascular compartment can lead to shock and organ hypoperfusion. DHF in some patients is mild (Grade I or II) while in other patients, this may develop into a severe form – dengue shock syndrome (DSS) (Grade III and IV). Over 95% of dengue deaths occur among the DHF group. Therefore, it is suggested that the CFR for DF and DHF be calculated separately. In the Sri Lankan Guidelines in 2005, there were errors in the fluid management plan. The training in Thailand, received by clinicians in 2007, was a turning point. It was understood that DHF is not badly managed DF and they can be considered two clinical entities. However, DSS or DHF Grade II and IV are often badly managed Grade I and II DHF. Sri Lanka has developed new guidelines based on these principles.

2. **Early diagnosis of dengue:** Suspecting and diagnosing dengue early is important, based on proactive surveillance mechanism. The best timing for the NS-1 antigen test is 18–20 hours after the onset of fever. The test sensitivity is as high as 95% but with time, the sensitivity declines, not because the test has gone awry but due to the natural course of the disease. Carrying out full blood count (FBC) early is also necessary to avoid complications and deaths. Waiting until Day 3 to carry out FBC is not advisable. The most important follow-up test is also FBC.

3. **Improving on early differentiation of DF and DHF using packed cell volume (PCV):** The use of microhaematocrit centrifuge for bedside/point-of-care capillary haematocrit to assess the degree of plasma leaking and to decide on appropriate fluid response is also an important milestone in dengue management.

4. **Improving on early differentiation of DF and DHF even earlier and managing DHF in a better way by using limited ultrasound scan (USS):** The natural plasma leaking in dengue is selective and occurs only in the pleural and peritoneal cavities. Fluid accumulation elsewhere suggests fluid overload. Gradual accumulation of fluid in these spaces, shown in limited USS conducted serially in suspected cases, is the most objective way to prove...
continued leaking. This can be carried out by any Medical Officer after minimum training. If platelet count is dropping towards or beyond 100,000 or when there is a sharp drop in the platelet count, USS should be carried out and thereafter, a series of ultrasound scans should be followed.

(5) Preventing shock and re-shock by monitoring key parameters in DHF patients: It is not just the platelet count estimation that will help. Pulse pressure, blood pressure, heart rate and urine output (UOP) should be monitored. Maintaining a pulse pressure of 30 for all ages is important.

(6) Using judicious fluid regimen to maintain key parameters: Main causes of death from DHF are prolonged shock, fluid overload and massive bleeding. They can be avoided by delicate fluid balance.

(7) Measuring the fluid and duration of leaking: This is useful since the leaking period is time-limited and appropriate fluid management will minimize complications. It is worth noting that fluid overload is a major cause of dengue deaths.

DHF is a “predictably treatable” disease. When diagnosed objectively and early, dengue haemorrhagic fever can be managed with judicious application of fluid therapy with near-zero case-fatality rate. The current national guidelines on dengue need review and revision, based on the insight clinicians have gained after years of experience in managing a large number of patients. It can help further reduce the CFR. It is justifiable to conclude that dengue is changing, with new virulent viruses, genetic and ethnic factors, multiple infections, etc. playing a role. The disease has also changed the way patients are managed.

Key messages

- Any fever can be dengue.
- Carry out NS-1 antigen test on Day 1–2 (18–24 hours from onset of fever).
- Serial USS is needed to diagnose leaking.
- Bedside microhaematocrit is needed to monitor leaking.
- Keep pulse pressure above 30 mmHg.
- Maintain UOP at 0.5–1 ml/kg/hour (and >0.7 ml most of the time).
- Intervene if UOP is not above 0.5–0.7 ml/kg/hour.
- Keep counting the fluid while managing DHF to avoid prolonged shock and fluid overload.
- When consecutive platelet counts are naturally rising, leaking is over.
- Leaking can occur as early as Day 2 or as late as Day 7.
- The duration of leaking may be as short as six hours or as long as 48 hours.

Salient discussion points

- WHO HQ is updating the clinical guidelines for dengue fever, chikungunya and Zika. A total of 20 experts, representing all Regions and ensuring geographical and gender balance, are on the panel and reviewing the guidelines to identify key questions that need to be addressed.
The health system should be organized and have a contingency plan for dengue management. Clinicians should be trained at different levels – for example, at commencement of employment, regular in-service training, etc.

For clinical management, standard case definition should be identified. Patients who are not suffering from dengue haemorrhagic fever but have severe co-morbidities should be properly categorized and managed.

The proportion of DHF among all dengue patients may vary from country to country and place to place, depending on for how long dengue virus has been circulating in the area.

Admission of dengue patients may be decided depending on several factors, including the platelet count (if below 100 000/ mm³, low urine output, living alone, it takes a long time to travel to the hospital, etc.). If case-load is less, all patients may be able to get admitted for initial monitoring, but if there is high turnover, triage may be necessary.

Nurses can play a major role in managing dengue patients, especially in monitoring and fluid management.

Drug development for preventing vasculopathy will be useful to address leaking.

USS can detect early leaking before it can be detected by X-ray.

Tachycardia in dengue patients may be due to bleeding, hypovolemia or hypocalcemia. If the reason is hypocalcemia, it should be treated since tachycardia may lead to hypoperfusion.

### 2.6 Aedes mosquito prevention and control

**Good practices and lessons learnt with regard to Aedes mosquito prevention and control applicability in resource-poor settings – dengue prevention and control in Singapore: Dr Tan Cheong Huat, Director, Vector Control and Biology Division, Environmental Health Institute, National Environment Agency, Singapore**

Singapore considers dengue an environmental disease. It is managed by both the Ministry of Health and the National Environment Agency (NEA) under the Ministry of Sustainability and Environment. The Ministry of Health looks after the clinical aspect of the disease while the NEA looks after environmental management targeting Aedes mosquito-related factors. Virus surveillance and characterization, and case investigation, integrating human, virus and vector, are shared by the two agencies.

The objective of the NEA’s dengue control framework is to keep dengue incidence low by adopting an integrated vector management approach. This has four integrated lines of operation to keep mosquito population low and plan response during an outbreak. These include surveillance, sustainable prevention and control, outbreak management, and public communications and advocacy. The year-round surveillance is targeted at dengue patients, virus, vector and ecological parameters. Sustainable prevention and control includes risk-stratified inspections, scheduled inspections countrywide and intersectoral collaboration activities with other governmental and private-sector stakeholders.

During outbreaks, intensified source reduction, adult mosquito eradication using chemical methods and enhanced community and stakeholder engagement are activated. Public communication and advocacy involves national-level initiatives and stakeholders’ specific engagement with constantly reminding the public about the menace of dengue and how to prevent and control the disease while
sharing information on areas where high mosquito population is reported. This response framework is supported by legal enforcements to impose penalties, if mosquito breeding places are maintained, and also by research and capacity-building.

One of the cost-effective innovations of the NEA is the gravitrap for adult mosquito surveillance and control. Gravitrap is used as a surveillance tool to assess adult mosquito population and guide resource prioritization where the risk is high. It also acts as a control tool since gravitrap catches adult female mosquito seeking places for laying eggs. A study shows that the incidence of dengue has decreased by 30% in areas where gravitraps are used when compared with areas where these are not deployed.

Intersectoral collaboration is an important component since dengue control is everybody’s responsibility. It is critical to identify all key stakeholders and ensure that they play their part in control of dengue transmission in view of the infrastructure design and maintenance, environmental sanitation, people’s behaviour, use of technology in dengue prevention, and close collaboration with other ministries, town councils, community associations, research and academic organizations, and private agencies. For this purpose, an Inter-Agency Dengue Task Force has been established to resolve cross-agency issues; share best practices; ensure a coordinated approach in dengue control; place the ownership on individual agencies to put in place a vector control scheme within their sectors/premises; and drive upstream measures via building designs (for example, changing bamboo holders for cloth drying in high-rise apartments and installing anti-mosquito valves in gully drains).

Public communication and advocacy measures are taken to raise awareness of dengue prevention and control. Communication messaging and call for action in different languages are placed on various platforms such as newspapers, digital displays, bus stops, buses and Mass Rapid Transit (MRT) stations. People are asked to stop dengue with BLOCK (B=break up hardened soil in flowerpots, L=lift and empty flowerpot plates, O=overturn pails and wipe their rims, C=change water in vases, K= keep roof gutters clear and apply insecticide, if necessary). To prevent dengue, especially if living in dengue cluster, SAW (S=spray insecticide in dark corners around the house, A=apply insect repellent regularly and W=wear long-sleeve tops and long pants) is advocated for protection against dengue. A dengue community alert system has been developed with three alert levels (red, yellow and green), based on the number of cases and status. Colour-coded alert banners will be deployed in dengue cluster areas to inform residents and facilitate targeted outreach activities in cluster areas.

In 2022, the NEA developed purple-coloured banners that are deployed selectively in areas with persistently high mosquito population, identified with gravitrap data. Information on areas with higher *Ae. aegypti* mosquito population is shared with the public to heighten public awareness and vigilance through the mobile app, myENV. This facilitates pre-emptive targeted action by key stakeholders, community partners and residents, galvanizing the community into action. Advocacy is promoted by engaging pools of diverse key opinion leaders/influencers and other multipliers, who can generate “talkability” of dengue among their specific audiences, and making them voices of the NEA. The pools include popular actors and dengue survivors.

In summary, innovation- and evidence-based approaches should be harnessed to support vector surveillance and control; a whole-of-government coordinated approach (working across government ministries) and strong collaborative governance (collaboration between government and nongovernment agencies) are needed, along with delivering public messaging that is impactful, transparent and consistent, to effectively raise awareness, drive action and promote advocacy.
**Salient discussion points:**

- Modification of building designs is an innovative and sustainable approach for curbing dengue breeding places. This is achieved through law enforcement as well as through advocacy. For example, by legislation, roof gutters are not allowed. The Inter-Agency Dengue Task Force meetings are used as a forum to share information on problematic areas – for example, sharing information on how laundry bamboo poles facilitate mosquito breeding slowly but steadily has encouraged relevant stakeholders to change the design as well as incorporate newer designs into newly built apartments.

- Law enforcements support vector control in several other aspects as well. For example, there is a fine for repeated defaulters (if mosquito breeding sites are repeatedly found in the follow-up inspection of houses), especially if there are dengue clusters. If houses are persistently kept closed and there is no response to notifications, officials are allowed to break open the doors to enter such houses. With regard to construction sites, the fine is heavy. If construction sites are messy, the Director General of Environmental Protection can issue stop order until all breeding sites are cleared. If other government agencies are responsible for maintaining breeding sites, such institutions are fined.

**Regional training workshop on integrated field entomology:**

Dr Aya Yajima, Regional Adviser, Neglected Tropical Diseases, Department of Communicable Disease Control, WHO-SEARO

Knowledge of entomology is essential to determine the most effective vector control techniques and strategy. However, the overall lack of entomologists and resultant entomological capacity throughout the Region continues to be a persistent challenge for control and elimination of many VBDs. Strengthening entomological capacity in countries in a cost-effective and sustainable manner is, therefore, of critical importance for overall VBD control.

The objectives of the training were to serve as a training of trainers (ToT); build capacity for both entomologists and non-entomologists involved in VBD programmes at all levels in basic field epidemiology; and develop and implement an integrated vector management (IVM) strategy to cover all major VBDs in each area, based on the analysis of local epidemiological, entomological and political/institutional setting for rational use of resources. The training modules were developed based on the adaptation of the WHO handbook for integrated vector management and WHO core structure for training curricula on integrated vector management, which was published about 10 years ago.

This was a six-day training. Participants from most of the countries in the Region attended the training. Entomologists as well as non-entomologists, such as public health officers, laboratory technicians and vector-borne disease control officers, also attended the training. It included theoretical components as well as practical sessions. The training was held at the Vector Control Research Centre, Pondicherry, which is a WHO Collaborating Centre for lymphatic filariasis and integrated vector management.

Training Module I was an introduction to vectors of human diseases in the South-East Asia Region (vector identification, life-cycle, biology and ecology).

Training Module 2 involved the theoretical aspect of vector sampling and control methods with field work related to selection of suitable sites for vector collection, adult and larval sampling techniques, and demonstration of vector control tools.
Training Module 3 focused on the concept of IVM. This included teaching formulation and implementation of a tailor-made programme, group work by countries and individual exercises to develop country-specific IVM plans. For this exercise, the participants were informed in advance about bringing their country data on vector surveillance by provinces or states. During the training, participants analysed their data to identify what the most suitable vector control methodologies for each vector species would be, what was the ecosystem these species were living with, what the evidence of human contact was, and what constituted the seasonality patterns, biting time, biting location, biting preferences and resting place, by disease and the vector. Then, countries could identify the IVM plan for relevant diseases and vectors. This helped participants decide on which vector control measures they should use for different vector species, among other things.

Modules 4 to 7 covered the areas of organization and management of IVM, policy and institutional framework, advocacy and communication, and monitoring and evaluation respectively.

This was a very interactive training session and all participants enjoyed it. Following the workshop, which was held from 28 November to 3 December 2022, a WhatsApp group was created for active contribution and sharing information on follow-up activities, such as conducting training in participants’ countries at national and subnational levels.

Among the follow-up activities of the programme, one would be continued active communication among training participants in the WhatsApp group. These would also include sharing updates on national- and subnational-level IVM activities/trainings. For example, India is conducting state-level training while Nepal is planning refresher field epidemiology training. Furthermore, in collaboration with the ICMR-VCRC, an integrated field entomology training package (composed of refined PowerPoint presentation modules, resources and Facilitator’s Guide) is currently in development at WHO-SEARO. Annual training workshops are planned at the Regional level. On the request of Member States, national- and subnational-level training workshops will be supported.

**Country experience in rolling out integrated field entomology training – progress, challenges and future plans: Professor Murari Lal Das, Entomologist**

Vector-borne diseases, such as malaria, kala-azar, dengue, lymphatic filariasis and scrub typhus, are prevalent in Nepal. In 2022, 481 malaria, 274 kala-azar, 52,557 dengue, 3,161 scrub typhus, 66 Japanese encephalitis and a cumulative number of lymphatic filariasis (31,029) cases were reported in Nepal. Most of these vector-borne diseases have been targeted for elimination.

In July 2022, a seven-day integrated entomology training for 23 participants (entomologists, vector control officers, vector control inspectors, public health inspectors, senior malaria inspectors, malaria inspection officers, medical laboratory technical officers, medical laboratory technicians, laboratory technical officers, laboratory technical inspectors) was held. A seven-day refresher training in malaria entomology was held in December 2022 for 15 health workers, including entomologists, public health inspectors, health assistants and senior auxiliary health workers; it integrated entomology of other vector-borne diseases as well.

Demonstrating the progress of integrated vector surveillance training, the personnel trained participated as team members in dengue vector surveillance in Dang district in 2022. In the same year, in Kanchanpur district of Sudurpraschim Province, where indigenous malaria cases were reported, other vector mosquitoes, such as of *Culex* species, were also collected and reported during malaria surveillance.
However, there are several practical challenges to implementing integrated vector management in Nepal. For example, up till now, none of the integrated vector surveillance/integrated vector control teams has been formed at any level – central, provincial, district or local. Non-availability of adequate entomological survey equipment/materials at different levels also impacts conducting vector surveillance and control activities. Issues related to effective human resource management are also observed. For example, persons with MSc in Entomology from ICMR-VCRC, Pondicherry, pursued under government scholarships, are assigned to other posts in different departments. On the other hand, persons who will never engage in entomological survey are being nominated for training by provinces/districts (bias in selection of trainees).

In conclusion, the Epidemiology and Disease Control Division (EDCD) should take the lead to get feedback from trainers in order to form a team of competent entomological HR in each province to conduct integrated entomological surveillance, whenever/wherever it is needed. Development of a human resources plan and filling up vacancies quickly are needed to support elimination of VBDs and further facilitate prevention of re-establishment of eliminated VBDs. Entomology teams with the necessary surveillance and response skills should be strategically placed in at-risk districts and provinces. Each team should be provided with at least the minimum number of materials and equipment needed for integrated entomological surveillance.

**Salient discussion points**

- Development of training modules for entomological surveillance will be useful too. The two pillars, vector control and entomology surveillance training, can be combined and a uniformity in training programmes, conducted at different levels, should be ensured.
- Training of non-entomologists in vector surveillance and control as well is a timely decision.
- When ToTs are conducted, it is necessary to ensure that the chain of training is cascaded down within each country.
- One of the capacity-building exercises will be integrating field entomology training into the three-month field epidemiology training programmes (FETPs).
- It is useful to develop a mechanism to ensure that at least the minimum facilities will be provided to trainees to translate the knowledge gained into action. WHO developing the minimum list of equipment will be useful.
- In India, the manual on IVM was updated in 2022. Hands-on training for 95 entomologists (from national, regional, state and zonal levels) in three batches was organized. Municipal corporations in India have their own entomologists. Where there were no entomologists, district VBD consultants with biology background were trained. This was a five-day training, including two-day theoretical training, one-day laboratory and one-day field training. Pre- and post-tests were included. They were also trained in how to conduct insecticide resistance monitoring and use of vector control equipment.
- With the support of WHO-SEARO, Thailand has conducted the first phase of IVM training in May 2023. More than 85 persons were trained in online and offline modes. Training covered lymphatic filariasis, leishmaniasis and emerging diseases. This training will be further expanded. The target is to train more than 200 personnel.
2.7 Risk communication and community engagement

**RCCE: Key for arboviral disease control: Dr Linda S Lloyd, Consultant, Behaviour Change and Communication**

In most countries in the South-East Asia Region, a great deal of work has been carried out for increasing the knowledge and awareness of dengue and other *Aedes*-transmitted viral diseases (ATVDs). But sustained behaviour changes are lacking. Therefore, more focus on behaviour than on knowledge is currently needed. When focusing on the behaviour that is need for an effective and efficient vector control or health-seeking, any existing knowledge gap can be identified and addressed too.

Behaviour change and community engagement are not events but processes. A process is a long-term exercise; events are part of a process. Planning for education, community engagement and communication activities is about planning a process. Such a process consists of events like social mobilization. Without planning for this process, a behaviour change will not be achieved. Risk communication and community engagement activities should be part of a broader process tightly linked to everyday vector control programming. Since entomological indices measure mosquito behaviour instead of human behaviour, they are not the correct indices to measure human behaviour. Sometimes, there may even be conflicts with expected behaviour. Behaviour does not change just because the knowledge level is improved and engagement will not continue just because people have participated in activities before. Therefore, it is critical to focus on and measure human behaviour change but not changes in knowledge or mosquito indices (mosquito behaviour).

Social and behaviour change communication (SBCC) is a very pragmatic and flexible framework. It is strategic, systematic and targeted. SBCC refers to the use of communication to change behaviour, including service utilization, by positively influencing knowledge, attitude and social norms. SBCC coordinates messaging across a variety of communication channels to reach multiple levels of society (audience segmentation). If SBCC is not guided by a plan/document, there will not be a planned process. SBCC should be targeted at audience groups, such as high-risk population groups.

There are three types of communication. Social/health communication is planned, along with systematic use of communication strategies to inform, influence and motivate individual and community decisions that enhance health and quality of life, including disease prevention, health promotion, health-care policy and health-care services. For example, routine communication prior to ATVD transmission season, aimed at behaviour, may include general reminders, such as “before the rains start, to eliminate items that are no longer in use in the household, school yards, businesses to prevent water accumulation” or “allow vector control staff to enter the premises and inspect for mosquito breeding sites”; these emphasize that it is neither a punishment nor a negative visit, it just aims to engage with the public to ensure that their environment is safe.

Risk communication is a two-way exchange of information and opinion between the programme/Ministry of Health, and its internal and external target audiences. When a programme communicates about the risk of a disease and its transmission, it is risk communication. There may be passive resistance to the messages delivered. Therefore, it is necessary to negotiate for behaviour. When one communicates about a risk, people may not believe the risk. Even if they believe they may not care for it. Therefore, negotiating for knowledge of and agreement on what may be carried out to recognize the risk and mitigate it is necessary. People also should be informed about what exactly they should do.
The two-way information exchange consists of what the types of risk for different groups are, levels of exposure and ways to manage the risks. For example, the Ministry of Health informs the public that the number of dengue/other ATVD cases is increasing above normal levels and an outbreak is either under way or imminent. Risk reduction behaviour may include intensifying breeding site control in domestic and public areas and leaving windows and doors to houses and businesses open for fogging to reduce adult mosquito populations.

Risk communication during a crisis is a combination of the urgency of disaster communication with communication of specific risks and benefits of specific actions. For example, during a dengue outbreak with confirmed deaths due to severe dengue, the Ministry of Health may inform the public that anyone who thinks he/she has dengue and one or more of the dengue warning signs should visit the local clinic or the hospital immediately. During such crisis situations, even vector control staff can be mobilized for communication activities. It will be a tremendous opportunity to combine the clinical and vector control components.

Risk communication for ATVDs may need a combination of those communications, depending on the disease pattern over time that may contain outbreaks/one or more peaks, interepidemic periods, etc. During the interepidemic phase, social and risk communication must take place while at the beginning of the outbreak, risk communication is the priority. During the control phase of the outbreak, risk and crisis communication is necessary. During the recovery phase of the outbreak, risk and social communication is needed and after the outbreak, during evaluation of the incident, social communication may be useful.

Despite public awareness, people continue to not follow the recommended behaviour. Surveys have shown that people often know what to do and what not to do, but they are unable to translate this knowledge into action. Therefore, communication efforts need to focus on the whys and the hows, not just the what. The issue is not with the messaging. Even if the messages are well placed, mosquito control may be at the very bottom of people’s priority list. There may be many competing issues, higher priorities and greater risks that people face on a daily basis even during an outbreak.

Instead of a long list of containers (breeding sites), a more focused prioritized list should be available for behaviours that will have the most impact. For example, it is advisable to pick three most productive breeding sites out of a long list and focus on these. People may also feel that vector control is a responsibility of the government and not their’s. For example, people may not pay attention to advice on keeping their households clean if there are productive mosquito breeding sites in the surrounding area, irrespective of whether they breed Aedes mosquitoes or not.

There are some myths regarding behaviour change as well. One is that education does change behaviour. In fact, education alone does not change behaviour. To change behaviour, it is necessary to make information tangible to an individual or it should satisfy an identified need. It is necessary to personalize information for each specific group (audience segmentation). Available data, for example, data on most productive breeding sites, can be used to target behaviour and messages for geographical areas, individuals, etc. Social interaction is more effective than provision of information. New modalities such as social media can be utilized effectively and should not be forgotten when planning social interactions.

Another myth is that the attitude needs to be changed to change the behaviour. Research indicates that while changing the attitude can be important, changes in attitude has a limited effect
on behaviour. Connecting behaviours to values that are important to groups or audiences, and not to attitudes, has more benefits in behaviour change.

Believing that people know what motivates them is also a myth. In fact, social norms are the big motivators. When people see someone doing something, it increases the likelihood that others too will follow him or her. How many other people are showing a particular kind of behaviour can really change an individual’s behaviour. Behaviour change strategies need to make it easier to practise the desired behaviour and highlight the positive practices that people are already following.

Effective communication can increase programme visibility. It highlights programme accomplishment and efforts of programme partners. Effective communication also shares data and information in real time to stimulate and sustain Ministry of Health engagement actions involving partner organizations and communities. It provides rapid and precise feedback to individuals, families and communities to recognize positive efforts and offers suggestions for improving prevention and control behaviour. Good communication also encourages and stimulates people to identify themselves as part of the public health efforts to control ATVDs.

The positive aspect with regard to the Member States of the Region is that every country has data to varying degrees that are adequate enough to be used to identify and promote ATVD-specific mosquito control and health-seeking behaviour. Entomological data should be used to stratify neighbourhoods and identify the most productive breeding sites to target specific integrated vector control actions/messages. The staff is experienced in vector control, health promotion, communication and epidemiology. They should be engaged effectively. Already there are published guidelines for integrated prevention and control of dengue, including SBCC guidelines. Being creative will bring many positive results in terms of behaviour change for effective ATVD control.

Community engagement and risk communication are time- and resource-intensive. Implementation of SBCC strategies with funding within the annual vector control plans is key to sustaining these processes.

Some of the recommended reference documents on this subject are: Planning social mobilization and communication for dengue fever prevention and control: a step-by-step guide (the speaker is co-author), WHO Participants Handbook for effective communications and FHI/USAID demand reduction guidebook on social and behaviour change communication.

**Salient discussion points:**

* SBCC is very pragmatic. Depending on the resources available, countries will have to be very specific and should prioritize their audience segments. For example, if the Ministry of Health has close working relationship with the Ministry of Education, schoolchildren can be prioritized as a segment, specially to control mosquito breeding on school premises. Partners should be actively engaged in initiatives. Furthermore, look for other agencies who work with water. For example, municipalities manage water and infrastructure. Depending on the mandate of the municipalities, plan activities that are feasible and reasonable to carry out with these partners in a year. Likewise, every year, activities can be planned and implemented in partnership with these agencies. In an outbreak situation, it may be necessary to stratify by risk and prioritize those who are affected the most. Depending on the ecology of these diseases, seasonality and situation, the partnership may change.
Social media can be used effectively. If decided to be used, it should be deployed properly. There should be a dedicated person or persons who will be promptly responding to posts appearing on such platforms. People who actively use social media and possess the know-how to effectively handle these social media platforms should be engaged. It is advisable to hire people in the same age group as those who are using the targeted social media platform. Different age groups may have different preferences on different social media platforms and the nature of posts may also vary for those target groups. Understanding these dynamics is important for targeted interventions.

Measurement of effectiveness of SBCC activities will be difficult. For many reasons, there are no behavioural indicators. One approach will be observing whether people are having the expected behaviour. Quick observational assessment of specific behaviours may be possible. One approach will be identifying some qualitative indicators to measure whether people are engaging in expected behaviours. Looking at questions appearing on social media platforms is another approach. If people are really engaging in the matter, the questions will be more detailed. The way in which people are answering these questions on social media before the administrator (you) responds to them can also be used as a qualitative indicator.

Legal measures to control behaviour should be used very carefully because use of laws can be negative. People may get penalized and marginalized by penalties. However, it has a place, especially when dealing with large businesses and specific sectors such as the construction industry and maybe when dealing with other ministries in the government.

2.8 Word Café

For the World Café exercise, the participants were equally divided into three groups and one leader for each group was nominated. Each group was assigned one of the three questions mentioned below and each was given 20 minutes to answer the question with bullet points and write on a flipchart. After 20 minutes, group members were rotated twice to other groups at 20-minute intervals with the group leader remaining in the original group. Then the rotating team was given the opportunity to go through the answers submitted by the previous team/s and to add to those, if anything was missing. In this manner, all participants were provided with the opportunity to answer all three questions. The responses from all groups are as follows:

**Question 1: What are the priority actions in the Region to operationalize and strengthen dengue, chikungunya and Zika surveillance, risk assessment, outbreak preparedness and risk communication in countries?**

- Ensure standardized case definition.
- Develop tools for surveillance system review that can be adapted by different programmes.
- Conduct surveillance system review in each country.
- Map different systems (one country may have more than one surveillance system – different surveillance systems for different diseases).
- Decide on indicators to be used for monitoring and visualizing data.
- Ensure integrated data management with interoperability.
- Should move closer to real-time surveillance.
- Identify and target high-risk areas/populations.
- Consider screening of migrants from endemic areas.
- EWARS is to inform early warning, integrating epidemiological data with climatic data, ecological data and vector data.
- Develop algorithms for risk mapping, combined with some prediction modelling.
- Use the One Health approach in disease prevention and control.
- Identify the importance of syndromic surveillance.
- Link laboratories to the surveillance system.
- Strengthen serotyping.
- Conduct special studies for post-treatment syndromes.
- Cross-cutting issues include:
  - capacity-building through different types of approaches, e.g. e-learning, in-service training, field assignments; and
  - guidance for surveillance, risk assessment and risk communication.
- Ensure communication with the public about risk levels.
- Establish rapid response teams for outbreaks.
- Develop a contingency plan for outbreaks.
- Strengthen logistics and supply management.
- Ensure effective advocacy measures – how to mobilize funding amidst limited resources.

Question 2: What are the priority actions in the Region to operationalize and strengthen prompt diagnosis and comprehensive case management in countries?

These include:

- diagnostic algorithm with how to check all arboviruses, not limiting to dengue;
- having more point-of-care testing conducted jointly with operational research – sampling, testing, depending on whether it is an interepidemic period or an epidemic period;
- testing strategies that should be depending on disease epidemiology and guaranteeing communication of findings on time;
- uninterrupted supply of different test kits with high sensitivity and specificity, and having quality assurance;
- guaranteeing transportation and storage of test kits, assuring that they are available when and where they are needed;
- capacity-building for laboratories;
- developing the infrastructure and equipment at laboratories;
- ensuring the availability of the referral system with a network of laboratories, including centres of excellence and national referral laboratories;
- expansion of serotyping;
- use of laboratory data for hotspot mapping conducted jointly with epidemiological data;
- timely reporting and data-sharing for decision-making;
- ensuring cross-border collaboration;
- exchange of information between countries as well as within the countries;
- cross-border exchange of data;
- ensuring the availability of standardized case definition;
- developing and using detailed case reporting forms;
- training and education of doctors on case reporting;
- developing strategies for early detection of outbreaks;
- ensuring the availability of a contingency plan for outbreaks;
- establishment of dengue wards, especially during outbreaks;
- development of guidelines for triage and clinical management;
- ensuring the availability of guidelines for hospital management and ambulatory care;
- ensuring the availability of guidelines on fluid management and availability of fluids;
- planning and budgeting in advance;
- ensuring the availability of funds;
- fixed prices in the private sector;
- prevention of hospital-acquired infections;
- arranging long-term follow-up of patients, especially for chikungunya and Zika;
- ensuring the availability of skilled manpower – primary care doctors, nurses from different specialities;
- planning capacity-building – training during interepidemic period;
- community awareness about available treatment facilities;
- communication with patients and families about symptoms, warning signs to reach health facilities, preventing deaths and severe disease;
- use of appropriate communication for different patient categories;
- ensuring a multisectoral approach for disease prevention and control;
- detailed analysis of deaths – main gaps identified, analysed and policies developed;
- developing an action plan for governance; and
- research and development for clinical management, vaccines and diagnostics.
Question 3: What are the priorities in the Region to operationalize and strengthen vector surveillance, integrated vector management and community engagement in countries?

- Conduct vector control need assessment, if the country has not carried it out.
- Identify the gaps in current vector control resource and capacity.
- Ensure that the SBCC Strategic Plan (costed) is part of the Vector Control Strategic Plan.
- Develop/update operational guidelines for entomological surveillance, IVM and SBCC.
- Develop training modules and conduct capacity-building.
- Train more entomologists in entomology and risk communication.
- Engage students, medical colleges and the private sector in vector surveillance and vector control.
- Conduct SBCC training and identify communication experts or partners, such as UNICEF, NGOs, which are heavily engaged in or have expertise in risk communication, to be part of the training.
- Ensure that the communication plan targets both the community and decision-makers (to make them aware of the importance of vector control and to mobilize resources).
- Identify appropriate vector control tools and equipment for each area.
- Develop guidelines and monitor insecticide resistance.
- Ensure an effective, comprehensive data management system for vector control.
- For vector control data management, develop and update a dashboard (similar to Thailand).
- Map vector density and breeding sites.
- Develop risk mapping using GIS.
- Entomology data should be closely linked with epidemiological data.
- Ensure evidence-based communication capacity development for decision-makers.
- WHO is to develop a series of materials as guidance for evidence-based decision-making for different audiences.
- Link human and vector laboratory in terms of data-sharing.
- Enforce legislation for penalty (similar to Singapore) and also access to private properties.
- Develop guidance on engineering modification in building designs to be carried out by public works departments.
- Research to develop new tools and techniques, and to update guidelines (e.g. use of fogging in adult vector management, Wolbachia in mosquito control).
- Ensure Xeno-monitoring that will enable triggering risk communication and vector control just before outbreaks.
- Develop intersectoral collaboration, including city corporations/municipalities, for vector control.
- Ensure cross-border notification of diseases.
- Ensure pool procurement of vector control tools.
- WHO is to facilitate technology transfer (e.g. Wolbachia-infected mosquitoes).
- Facilitate R&D partnership in the form of a dengue research forum both at the Regional level and the country level for wider information-sharing among programme managers and researchers.
- Initiate vector surveillance at points of entry.

2.9 New tools, research and development

**Novel techniques in Aedes mosquito control:** Dr Qingxia Zhong, Technical Officer, Veterinary Public Health, Vector Control and Environment Unit (VVE), Global Neglected Tropical Disease Programme (WHO Headquarters/NTD)

Currently, the full potential of vector control is not utilized for control of dengue and other arboviral diseases. The available conventional tools are not sustainable. The evidence base for their effectiveness is weak. Use of insecticide has severe limitations as insecticide resistance is a growing problem while the arsenal of insecticide for public health use is very limited. In vector control efforts, climate change, water stress, urbanization and population displacement are some of the key challenges that are being experienced globally.

Effective, locally adapted, sustainable vector control is the strategy for achieving the goal of reducing the burden and threat of vector-borne diseases that affect humans. This strategy is built on four pillars of action: 1) strengthen intersectoral and intrasectoral action; 2) engage and mobilize communities; 3) enhance vector surveillance, monitoring and evaluation; and 4) scale up and integrate tools and approaches. Enhancing vector control capacity and capability, and increasing basic and applied research and innovation are the foundation of these pillars of action. The country leadership; advocacy, resource mobilization and partner coordination; and regulatory, policy and normative support are the enabling factors of the whole process.

This presentation is focused on one of the two foundations, i.e. increasing basic and applied research and innovation.

There are two pathways WHO follows for incorporation of new vector control interventions to be listed as pre-qualified product and issuing of new policy recommendations. They are the pre-qualification pathway and the new intervention pathway. When a new product or an intervention is submitted for evaluation, the Pre-submission Coordination Committee (PCC) decides on the pathway to be followed based on existing policy recommendations. When policy recommendations already exist, usually, it follows the pre-qualification pathway. If there are no existing policy recommendations, in addition to the pre-qualification, the new intervention pathway is also needed to be followed.

In the pre-qualification pathway, initially, review of quality (chemistry and manufacturing), safety (exposure) and entomological efficacy are assessed as pre-qualification assessment. Based on the submitted dossier and inspection of product sites, the decision for pre-qualification will be taken. In the new intervention assessment pathway, initially, there will be the planning phase during which initial meetings will be held, and requirements and milestones established for the evaluation. The Vector Control Advisory Group (VCAG) will be assessing intervention trial design and evaluating trial results, and then based on the results, it will advise on the public health value of the intervention.
Based on the recommendations of the VCAG, the relevant departments will be developing new policy recommendations. In addition, these interventions may need to follow the pre-qualification pathway as well. As the final outcome of both pathways, WHO will be listing them as new products and will be issuing new policy recommendations.

Targeting dengue and other *Aedes*-transmitted arboviral diseases, several new vector control tools are under investigation. One randomized control trial (RCT) on transfluthrin passive emanator as a spatial repellent has been recently completed. Trial on targeted IRS as another spatial repellent technique is ongoing. Trials on AGO trap and Trap-N-kill® trap, as a combined adulticidal and larvicidal trap, autodissemination mosquito trap (in2Trap®) as autodissemination device method, sterile insect technique and sterile insect technique combined with incompatible insect technique (IIT) as sterilization of male mosquitoes are also ongoing. One RCT with incompatible insect technique (sterilization of male mosquitoes) and another RCT, *Wolbachia* wMel (reduction of pathogen transmission induced by *Wolbachia*), have been recently completed.

In the use of spatial repellents to prevent human–vector contact, devices that release chemicals into the air are used to prevent mosquitoes from biting humans within a given space. They can be placed inside or around houses. No need of high doses of chemicals is an advantage. The intervention – a transfluthrin-based passive emanator – is now under evaluation. Trial results in Iquitos, Peru, has shown a 33% reduction in risk from dengue. The second trial is ongoing in Sri Lanka.

For the use of *Wolbachia*-infected mosquitoes, there are two strategies: suppression strategy (incompatible insect technique) and replacement strategy. The goal of the suppression strategy is to reduce the mosquito population to a level that inhibits disease transmission. In this intervention, only *Wolbachia*-infected male mosquitoes are released to the environment. Mating of these mosquitoes with wild female mosquitoes will result in production of unhatched eggs due to cytoplasmic incompatibility. This reduces the *Aedes* population. Only the trial carried out in Puerto Rico produced inconclusive evidence. Epidemiological trial combined with sterile insect technique (SIT) has shown reduction in dengue incidence by 71%–88% in targeted areas. Combined SIT/IIT RCT is ongoing.

The goal of the replacement strategy is to establish a dominant *Wolbachia-Aedes* population that is resistant to infection. In this approach, both *Wolbachia*-infected male and female mosquitoes are released to the environment. Mating of *Wolbachia*-infected mosquitoes with wild female mosquitoes will ultimately result in *Wolbachia*-infected mosquito population in the environment that is resistant to the dengue virus infection. A total of five trials have been assessed by the VCAG. Results have demonstrated a 77% reduction in virologically confirmed dengue case incidence over a 27-month period. The target product profile (TPP) has been drafted. A systematic review and WHO recommendations are currently in development.

The sterile insect technique has been widely used in agriculture with successful results. In this technique, irradiation is used to induce sterility in mosquitoes. Multiple trials are ongoing and one epidemiological trial is being initiated. In this technique, mass rearing of mosquitoes is necessary. Then, the male mosquitoes (or male pupae) are irradiated and sterilized male mosquitoes are released to the environment. When these sterile male mosquitoes mate with wild female mosquitoes, there is no generation of offspring.

In integrated vector management, instead of using different vector surveillance and control measures for different vectors that transmit different diseases, several vectors or diseases are addressed
in an integrated manner at the same time with a multisectoral approach. Multisectoral collaboration is a key factor in successful integrated vector management. Each sector has a specific role to play. For example, interventions to prevent creation of vector-breeding habitats in the agriculture sector are necessary while housing and urban planning should focus on “vector-free” planning and design. Removal of vector-breeding habitats is a role of the environmental sanitation sector. Construction industries need measures to be taken to prevent creation of vector-breeding habitats on their sites. The education sector can play a key role in advocacy, sensitization and vector control.

For an effective and sustainable multisectoral collaboration, stress on co-benefits and aligning interventions by different sectors are necessary. Establishment of an interministerial steering committee and strengthening the existing mechanism for collaboration should be a priority action. Coordination among different sectors at all levels should be ensured. The ownership of the interventions by stakeholders of relevant sectors and honouring co-leadership are also necessary for sustainable multisectoral collaboration.

As guidance, WHO has published “Multisectoral approach to the prevention and control of vector-borne diseases – a conceptual framework”.

Community engagement is also a key requirement in integrated vector management. It is necessary to identify locally adapted products and control strategies. Through advocacy, consultation and feedback, and volunteerism, community ownership of interventions should be promoted. Enhancing the inclusiveness and adopting a human rights approach in all interventions are also primary requirements.

Progress on public health use, research and development of the dengue and chikungunya vaccine: Professor Annelies Wilder-Smith, WHO Focal Point for COVID-19, dengue, chikungunya, Zika and yellow fever vaccines

Summary

CYD-TDV vaccine (Dengvaxia), produced by Sanofi Pasteur, is the first licensed dengue vaccine, but it is not much in public use due to the need for pre-vaccination screening. TAK-003 vaccine (Qdenga), produced by Takeda, was licensed by the European Medicines Agency (EMA) in December 2022. It is in use for travellers in several European countries. Indonesia is the first dengue-endemic country in which TAK-003 has been introduced but is available in the private market only. Therefore, none of the dengue vaccines is in public health use yet. No chikungunya vaccines are licensed yet, therefore, not in public use. However, 11 vaccine candidates against chikungunya are in clinical trials (seven in Phase I, two in Phase II and two in Phase III).

Dengue vaccines

There are three dengue vaccine candidates, all are tetravalent, live attenuated and chimerized. They are CYD-TDV, TAK-003 and TV003 (developed by NIH, Butantan and Merck). They are different from each other, going by the backbone used and the extent of chimerization. The backbone of the CYD-TDV is the yellow fever virus while in the TAK-003 vaccine, the full genome of DENV2 is used, with DENV2 as the backbone for the other three serotypes of the virus. In TV003, three out of four serotypes of the viruses are full genomic and for DENV2, DENV4 has been used as the backbone.
In terms of dengue proteins, TV003 has the highest number, followed by TAK-003, and the lowest number is in Dengvaxia, which has basically no dengue non-structural proteins.

Dengvaxia, first licensed in 2015, is administered in three doses at intervals of 0, 6 and 12 months. The post-hoc analysis of Phase III clinical trial population by the baseline seropositivity showed that there is a major reduction in cumulative incidence among the baseline seropositive vaccine recipients, in comparison with the placebo recipients. Among the baseline seronegative vaccine recipients, there is only very little protection for up to 30 months and thereafter, the cumulative incidence crosses over the seronegative vaccinated, in comparison with the seronegative placebo recipients. This means the incidence of infection is higher among the vaccinated than among the placebo recipients. This shows that the vaccine performance of Dengvaxia is highly serostatus-driven.

Among seropositives, the vaccine efficacy of CYD-TDV is 72%–80% against dengue of any severity and more than 90% against severe dengue. However, it increases the risk of severe dengue in seronegative persons with a relative risk of 2–3. In endemic countries, although the population-level benefit is high, seronegative subpopulations, who can be identified, are at a higher risk of severe disease, if they are exposed to dengue infection after the vaccination. Therefore, a pre-vaccination screening strategy is recommended by WHO wherein only dengue seropositive persons are vaccinated. This is costly and poses programmatic challenges. Therefore, due to this “test and vaccinate” policy, the vaccine uptake is low.

The TV003 vaccine is developed as a single-dose vaccine. It is still under trials and the five-year follow-up observation data are not published and available yet. The licence rights of the vaccine are only in Brazil and will not be available for use in other countries sooner.

The TAK-003 vaccine has been trialled in eight endemic countries in Asia and PAHO Regions, licensed by the EMA in December 2022. As of June 2023, it was under evaluation by the FDA. The vaccine is administered in two doses at 0- and 3-month intervals.

Assessment of percentage of subjects with detectable viremia by culture after a single dose of the vaccine in flavivirus-naïve subjects shows that CYD-TDV is a mainly DENV4-predominant vaccine while the TAK-003 is DENV2-predominant. Assessments shows that unlike in CYD-TDV, the vaccine efficacy (VE) of TAK-003 is not serostatus-driven. However, this trial has been carried out during a period when DENV2 has been the predominantly circulating virus serotype. The overall vaccine efficacy of TAK-003, measured by the outcome of virologically confirmed dengue, is 61.2% (56.0%, 65.8%). The VE in seropositives and that in seronegatives are 64.2% (58.4%, 69.2%) and 53.5% (41.6%–62.9%) respectively. When the VE by the serotypes is assessed, the efficacy against DENV2 is the highest, regardless of serostatus. However, there is lack of vaccine efficacy when seronegatives are exposed to DENV3 or DENV4.

When the VE is measured by hospitalization as the outcome measure, the overall VE is 84.1% (77.8, 88.6%). Among seropositories and seronegatives, the same measure amounts to 85.9% (78.7, 90.7%) and 79.3% (63.5, 88.2%) respectively. The VEs for DENV1 and DENV2 are high, but for DENV3 and DENV4, there is no efficacy. Those results are inconclusive due to few numbers of end points. The key take-home message for TAK-003 is that for seropositive persons, it protects against virologically confirmed dengue, hospitalization and severe dengue for all four serotypes; for seronegative persons, it protects against virologically confirmed dengue and hospitalization for DENV1 and DENV2. It does not protect against virologically confirmed dengue and hospitalization for DENV3 and DENV4. The
WHO global recommendations (Strategic Advisory Group of Experts on Immunization) was released in September 2023\(^1\). The FDA is currently assessing the vaccine. The EMA has already approved the use of the vaccine without pre-vaccination screening for persons, aged four years and above, with no upper age limit.

**Chikungunya vaccines**

Chikungunya vaccines developed on different platforms, such as the adenovirus vector-based, mRNA, inactivated virus, virus-like particles and live attenuated, are under trials. The live attenuated vaccine (VLA1553), developed by Valneva and Butantan, will be the first vaccine to be approved, having met its primary endpoints in the Phase III trial with the evaluation of the final dose in over 4000 adult recipients. This is not a measure of clinical efficacy but is based on immune correlates. It has confirmed its robust immunogenicity with an overall seroconversion rate of 98% on Day 29 and 96% seroprotection rate on Day 180. The vaccine is further being evaluated in adolescent and paediatric populations.

### 2.10 Regional Strategic Framework for prevention and control of dengue and other arboviral diseases

**The Regional Strategic Framework for prevention and control of dengue and other arboviral diseases in the SE Asia Region – the proposed outline, targets and key components: presentation and group work**

Dr Sudath Samaraweera, Consultant, CDS/NTD, presented the vision, goal, targets, key indicators, strategic aim and interventions, supporting areas, and key milestones of the proposed Regional Strategic Framework for prevention and control of dengue and other Aedes-borne arboviral diseases. Thereafter, the participants were divided into three groups as Group 1: Surveillance, Group 2: Diagnosis and case management, and Group 3: Entomology. Based on their expertise, the RTAG members and WHO staff members were assigned to the respective groups. Country participants were requested to choose the appropriate group based on their expertise. Each group was assigned one Strategic Area and one Supporting Area, and was asked to review those, along with the other components of the proposed Strategic Plan, such as vision, goal and targets. After the group work, each group was given the opportunity to present their recommendations. Based on these recommendations, the relevant sections of the Strategic Plan will be updated and further consulted with Member States.
## Annex 1

### Meeting agenda

#### Day 1: Wednesday 14 June 2023 (Kathmandu time – GMT +5.45 hours)

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<td><strong>08:30–09:00</strong></td>
<td>Opening remarks</td>
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<td></td>
<td>Welcome remarks</td>
<td>Dr Roshan Pokharel, Secretary, Ministry of Health and Population, Nepal</td>
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<td></td>
<td>Meeting objectives</td>
<td>Dr Aya Yajima, Regional Adviser, CDS/NTD</td>
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<td>Introduction of the participants</td>
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<td>Dr Aya Yajima</td>
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<td>Administrative announcements</td>
<td>Ms Tanushri Mitra, Executive Assistant, CDS/NTD</td>
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<td><strong>09:00–09:15</strong></td>
<td>Global situation of dengue and other arboviral diseases</td>
<td>Dr Diana Rojas Alvarez, Technical Officer, WHO HQ/WHE</td>
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<tr>
<td><strong>09:15–09:30</strong></td>
<td>Regional situation of dengue and other arboviral diseases and progress on recommendations of the virtual RTAG in 2021 – a summary</td>
<td>Dr Sudath Samaraweera, Consultant, CDS/NTD</td>
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<td><strong>09:30–09:45</strong></td>
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#### Agenda 2: Country updates on the situation and programmatic progress

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<td>DGHS Bangladesh, MoH Bhutan, NCVBDC India, The Chair</td>
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<td><strong>11:15–12:15</strong></td>
<td>Indonesia, Maldives, Nepal</td>
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<td><strong>14:15–14:45</strong></td>
<td>Discussion on common challenges and good practices in dengue and other arboviral disease surveillance</td>
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### Agenda 3: Dengue surveillance and laboratory

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<td>14:45–15:00</td>
<td>Surveillance and rapid risk assessment for dengue and other arboviruses – overview and options</td>
<td>Dr Masaya Kato, Programme Area Manager, WHE/HIM</td>
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<td>15:00–15:30</td>
<td>Discussion</td>
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### Arboviral disease diagnostic and laboratory capacity in the Region

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<tr>
<td>15:45–16:00</td>
<td>Orientation on existing dengue diagnostic tools, and existing laboratory network and capacity in the Region</td>
<td>Dr Dhamari Naidoo, Public Health Laboratory Scientist, WHE/IHM</td>
</tr>
<tr>
<td>16:00–16:15</td>
<td>Observation and opportunities for dengue laboratory strengthening in countries</td>
<td>Dr Gajanan Sapkal, NIV, Pune</td>
</tr>
<tr>
<td>16:15–16:45</td>
<td>Discussion on priority and next steps for dengue laboratory strengthening</td>
<td>The Chair</td>
</tr>
</tbody>
</table>

### Day 2: Thursday 15 June 2023 (Kathmandu time – GMT +5.45 hours)

#### Agenda 3: Dengue surveillance and laboratory (continued)

Development of the Regional arboviral diseases data reporting mechanism and dashboard under the Global Arbovirus Initiative (GLAI)

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00–09:15</td>
<td>Vision for the arboviral disease data dashboard of GLAI</td>
<td>Dr Diana Rojas Alvarez</td>
</tr>
<tr>
<td>09:15–09:30</td>
<td>Health Information Platform for the Americas (PLISA) of PAHO as an example of Regional data dashboard</td>
<td>Ms Thais Dos Santos PAHO</td>
</tr>
<tr>
<td>09:30–10:00</td>
<td>Discussion</td>
<td>The Chair</td>
</tr>
<tr>
<td>10:00–10:15</td>
<td>Proposed standard indicators, reporting mechanism and Regional dashboard in the South-East Asia Region</td>
<td>Dr Sudath Samaraweera</td>
</tr>
<tr>
<td>10:15–10:45</td>
<td>Discussion on the agreed indicators and reporting mechanism</td>
<td>The Chair</td>
</tr>
<tr>
<td>11:00–11:15</td>
<td>Dengue Early Warning and Response System (EWARS) experience, lessons learnt and opportunities</td>
<td>MoPH, Thailand</td>
</tr>
<tr>
<td>11:15–11:30</td>
<td>Discussion on the adoption of EWARS</td>
<td>The Chair</td>
</tr>
</tbody>
</table>

#### Agenda 4: Dengue case management

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30–11:50</td>
<td>Country experience in reducing dengue morbidity and mortality: case study from Sri Lanka</td>
<td>Dr Lakkumar Fernando, Sri Lanka</td>
</tr>
<tr>
<td>11:50–12:15</td>
<td>Discussion on priority and next steps for dengue case management strengthening</td>
<td>The Chair</td>
</tr>
</tbody>
</table>

#### Agenda 5: Aedes mosquito prevention and control

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:25–13:35</td>
<td>Public work measures for Aedes mosquito prevention and control in resource-poor settings</td>
<td>Dr Ashwani Kumar, ICMR-VCRC</td>
</tr>
<tr>
<td>13:35–13:50</td>
<td>Multisectoral approach for vector control – experience in Bangladesh</td>
<td>DGHS, Bangladesh</td>
</tr>
<tr>
<td>13:50–14:15</td>
<td>Discussion</td>
<td>The Chair</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
<td>Presenter/Speaker</td>
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<tr>
<td>14:15–14:30</td>
<td>Regional training workshop on integrated field entomology (WHO-SEARO)</td>
<td>Dr Aya Yajima</td>
</tr>
<tr>
<td>14:30–14:45</td>
<td>Country experiences in rolling out the IVM approach in Nepal</td>
<td>Professor Murari Lal Das</td>
</tr>
<tr>
<td>14:45–15:15</td>
<td>Discussion</td>
<td>The Chair</td>
</tr>
</tbody>
</table>

**Agenda 6: Risk communication and community engagement**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:30–15:45</td>
<td>Risk communication and community engagement as key tools in arboviral disease control</td>
<td>Dr Linda Lloyd, PAHO Consultant</td>
</tr>
<tr>
<td>15:45–16:00</td>
<td>Discussion</td>
<td>The Chair</td>
</tr>
<tr>
<td>16:00–17:15</td>
<td>World Café on dengue surveillance/laboratory, case management, vector control and community engagement/ communication</td>
<td>Dr Aya Yajima</td>
</tr>
</tbody>
</table>

**Day 3: Friday 16 June 2023 (Kathmandu time – GMT +5.45 hours)**

**Agenda 7: New tools, research and development**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter/Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00–09:15</td>
<td>Novel techniques in <em>Aedes</em> mosquito control</td>
<td>Dr Raman Velayudhan and Dr Qingxia Zhong, WHO HQ/NTD</td>
</tr>
<tr>
<td>09:15–09:30</td>
<td>Progress on the public health use, research and development of the dengue and chikungunya vaccine</td>
<td>Dr Annelies Wilder-Smith, WHO HQ/IVB</td>
</tr>
<tr>
<td>09:30–10:00</td>
<td>Discussion</td>
<td>The Chair</td>
</tr>
</tbody>
</table>

**Agenda 8: Regional Strategic Framework for prevention and control of dengue and other arboviral diseases**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter/Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00–10:30</td>
<td>Regional Strategic Framework for prevention and control of dengue and other arboviral diseases in the SE Asia Region – the proposed outline, targets and key components</td>
<td>Dr Aya Yajima and Dr Sudath Samaraweera</td>
</tr>
<tr>
<td>10:45–11:45</td>
<td>Discussion on the proposed outline and targets</td>
<td>The Chair</td>
</tr>
<tr>
<td>11:45–13:00</td>
<td>Breakout group discussion on three key areas of the Regional Strategic Framework</td>
<td></td>
</tr>
<tr>
<td>14:00–14:45</td>
<td>Breakout group discussion continues</td>
<td></td>
</tr>
<tr>
<td>14:45–15:30</td>
<td>Group presentation (3 Groups)</td>
<td></td>
</tr>
<tr>
<td>15:30–16:15</td>
<td>Plenary discussion and next steps</td>
<td>Dr Aya Yajima</td>
</tr>
</tbody>
</table>

**Agenda 9: Closing session**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter/Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:35–16:55</td>
<td>Recommendations</td>
<td>The Rapporteur</td>
</tr>
<tr>
<td>16:55 –17:00</td>
<td>Closing remarks</td>
<td>Dr Rajesh Sambhajirao Randav</td>
</tr>
</tbody>
</table>
### Annex 2

**List of participants**

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Meeting of programme managers and the Regional Technical Advisory Group on dengue and other arboviruses in the SEAR

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Meeting of programme managers and the Regional Technical Advisory Group on dengue and other arboviruses in the SEAR

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Meeting of programme managers and the Regional Technical Advisory Group on dengue and other arboviruses in the South-East Asia Region

Kathmandu, Nepal, 14–16 June 2023