

Dengue: prevention and control

Report by the Secretariat

1. At the Sixty-seventh World Health Assembly in May 2014, several Member States raised the public health and economic burdens of dengue in the plenary discussion on the link between climate and health.¹ This report outlines the global threat to public health from dengue, the elements of the global strategy to prevent and control dengue, and essential steps to be taken, including strengthening health systems, ensuring that vector control is sustainable and areas for further research, including the possible introduction of a vaccine.

2. Dengue is a mosquito-borne viral disease of public health significance that has rapidly spread in all regions of WHO in recent years. Dengue virus is transmitted by female mosquitoes mainly of the species *Aedes aegypti* and, to a lesser extent, *A. albopictus*. The disease is widespread throughout the tropics, with local spatial variations in risk influenced strongly by rainfall, temperature and unplanned rapid urbanization.

3. The actual numbers of dengue cases are underreported and many cases are misclassified. One recent estimate indicates 390 million dengue infections per year (95% credible interval 284–528 million), of which 96 million (67–136 million) manifest clinically (with any severity of disease).² Another study, of the prevalence of dengue, estimates that 3900 million people, in 128 countries, are at risk of infection with dengue viruses.³ Member States in three WHO regions regularly report the annual number of cases to the Secretariat; in 2010, nearly 2.4 million cases were so reported. Although the full global burden of the disease is uncertain, the initiation of activities to record all dengue cases partly explains the sharp increase in the number of cases reported in recent years. Other features of the disease include its epidemiological patterns, including hyper-endemicity of multiple dengue virus serotypes in many countries and the alarming impact on both human health and the global and national economies.

4. The distribution of the principal vectors of dengue has continued to silently expand globally; they are now present in more than 150 countries. International trade and movement of goods

¹ Document WHA67/2014/REC/2, verbatim records of the plenary meetings of the Sixty-seventh World Health Assembly.

² Bhatt S, Gething PW, Brady OJ, Messina JP, Farlow AW, Moyes CL et al. The global distribution and burden of dengue. *Nature*;496:504–507.

³ Brady OJ, Gething PW, Bhatt S, Messina JP, Brownstein JS, Hoen AG et al. Refining the global spatial limits of dengue virus transmission by evidence-based consensus. *PLoS Negl Trop Dis*. 2012;6:e1760. doi:10.1371/journal.pntd.0001760.

containing dried mosquito eggs have facilitated the vectors' spread. Both the main vectors transmit not only dengue virus but also other closely related arboviruses such as chikungunya and Zika viruses.

5. The heaviest burden of dengue is in the Asia Pacific countries, where about 1800 million people are at risk of infection. The epidemiology of dengue is rapidly evolving as outbreaks occur with increasing frequency and are expanding to new previously-unaffected geographical areas (from urban to rural areas). Mortality is highest during the initial period of the outbreak or epidemic, and increasing numbers of severe dengue cases overwhelm health facilities. Along with the South-East Asia Region, the Western Pacific Region is currently implementing the Dengue Strategic Plan for the Asia Pacific Region 2008–2015 and the Asia Pacific Strategy for Emerging Diseases 2010.

6. The Western Pacific Region reported cases of dengue in more than 30 countries and territories. Island nations are susceptible to epidemics; during 2013–2014 the presence of dengue virus serotype 3 was recorded in Fiji and in several other islands after 30 years of absence, leading to an increased number of cases in a population particularly susceptible to that serotype. Malaysia and Singapore experienced sustained epidemic activity during the same period. Since late 2013, a few countries in the Pacific have reported concurrent outbreaks of dengue, chikungunya and Zika virus disease. Diagnosis and clinical management remain a challenge and all efforts are focused on vector control with active community involvement. Outbreaks have been reported in China and Japan in 2014.

7. In the European Region, *A. albopictus* has rapidly spread to more than 25 countries, mainly through global trade. The threat of dengue outbreaks now exists in Europe after a lapse of 55 years. Local transmission of the virus was reported for the first time in Croatia and France in 2010; imported cases were detected in several other European countries. A dengue outbreak on the island of Madeira (Portugal) in 2012 resulted in more than 2200 cases and importation of cases into 17 other European countries.

8. Dengue is endemic in the South-East Asia Region, although the incidence varies significantly among countries and within each country. Until 2003, only eight countries in the region had reported dengue cases. In 2004, Bhutan and Timor-Leste reported outbreaks for the first time and Nepal reported its first indigenous case of dengue. By 2009, all the Member States in the Region except the Democratic People's Republic of Korea had reported dengue outbreaks.

9. Dengue is considered an emerging disease in the Eastern Mediterranean Region because laboratory-confirmed cases have been reported for only two decades. Generally, cases have been detected along the coasts of countries bordering the Red Sea. Dengue is emerging as a major public health problem in Pakistan, Saudi Arabia and Yemen, with repeated outbreaks in urban centres and spread of the disease to rural areas (in Pakistan and Yemen). Outbreaks are becoming more frequent in Djibouti, Somalia and Sudan. Oman has reported imported cases.

10. Although the burden of dengue in the African Region is still unknown, outbreaks have been reported from 22 countries. The presence of the disease and the high prevalence of antibodies to dengue viruses in serological surveys suggest that dengue virus infection is endemic in many parts of Africa. Dengue continues to be underreported in Africa owing to a lack of awareness among health care providers, the presence of other febrile illnesses, and insufficient testing and reporting, both of which deficiencies hinder systematic surveillance. Since 2013, dengue outbreaks have been reported in Angola, Mozambique and the United Republic of Tanzania.

11. Transmission of dengue viruses was interrupted in much of the Region of the Americas in the 1970s following the campaign to eradicate *A. aegypti*. As vector surveillance was not sustained, however, mosquitoes thrived and dengue outbreaks recurred in the Caribbean and in Central and South America. These regions are now in a hyperendemic state, with indigenous transmission in almost all countries. A regional initiative that uses an integrated management strategy for prevention offers the most promising approach for control.¹

12. In 2012, after extensive consultations with experts, country programme managers and regions, WHO published a global strategy for the prevention and control of dengue 2012–2020.² Its goal is to reduce the burden of dengue worldwide, with specific objectives to reduce mortality by at least 50% and morbidity by at least 25% by 2020. The strategy relies on five technical elements:

(a) **Diagnosis and case management.** A successful clinical outcome requires efficient and early diagnosis of cases and early response to severe disease. Clinical incidence data are crucial to mobilizing outbreak control measures. Mortality from dengue can be reduced to almost zero by timely implementation of appropriate clinical management that involves early clinical and laboratory diagnosis, appropriate and rapid supportive care (e.g. fluid replacement), training of all staff involved in clinical management of dengue and well-managed triage and management decisions at primary and secondary care levels and reference systems between different levels of care. There is a greater need for better, low-cost rapid diagnostic tools with high sensitivity and specificity to improve diagnosis at the point of care.

(b) **Integrated surveillance and outbreak preparedness.** Surveillance is an essential core intervention of any dengue prevention and control programme because it provides the information necessary for risk assessment and programme guidance, including epidemic response and programme evaluation. The number of dengue cases reported has been increasing, which may be due to increases in either incidence or case reporting. Although both entomological and epidemiological surveillance data have often been collected in countries, there are few instances in which health services integrate and fully utilize such information. Integrated surveillance (epidemiological and entomological) should be sustained during inter-epidemic periods, and include sentinel surveys of representative sites. Dengue surveillance systems should be part of national information systems and be harmonized at all levels. Risk stratification maps developed by Member States can be a useful tool.

(c) **Sustainable vector control.** At present, morbidity attributable to dengue can be reduced only through effective vector-control measures. Preventive vector control interventions indeed reduce transmission of dengue, thereby decreasing the incidence of infection and preventing outbreaks of the disease, but are not at present sustainable. Changes in vector control practices are needed; more effective sustainable control methods must be introduced. Vector control is effective when applied as prevention in between outbreaks or in the early stages of a potential outbreak, but fails to achieve the desired result when it is introduced at later stages. Early detection of a public health threat coupled with a rapid and effective response are therefore important components of effective disease reduction. Some of the vector-control tools and procedures in development are: long-lasting insecticide-treated materials; lethal ovitraps; spatial

¹ 44th Directing Council of PAHO/55th Session of the Regional Committee for the Americas, resolution CD44.R9 Dengue (2003).

² Global strategy for dengue prevention and control 2012–2020. Geneva: World Health Organization; 2012 (document WHO/HTM/NTD/VEM/2012.5).

repellents; genetically modified mosquitoes; and *Wolbachia*-infected *Aedes*. Some of these new tools could play a significant role in sustainable dengue prevention and control strategies.

(d) **Future vaccine implementation.** The availability of a safe, efficacious and cost-effective vaccine will be crucial for dengue prevention. Major progress has been made. Three tetravalent live-attenuated vaccines are under development in phase II and phase III clinical trials, and three other vaccine candidates (based on subunit, DNA and purified inactivated virus platforms) are at earlier stages of clinical development. The most advanced vaccine candidate, a tetravalent live-attenuated chimeric dengue vaccine based on a yellow fever virus backbone, has been evaluated in two phase III clinical trials in Asia and Latin America. WHO welcomes the encouraging results on vaccine safety and efficacy seen in these studies. Once a vaccine is licensed by a functional national regulatory authority, the Strategic Advisory Group of Experts on immunization will advise WHO on the public health utility of the vaccine.

(e) **Basic, operational and implementation research.** Basic, operational and implementation research is needed to support all the objectives of the global strategy. Research should focus on how to enhance the efficacy, cost-effectiveness, sustainability and scaling-up of existing and promising new control methods. New diagnostic tools and means of vector control are needed. Some of the priorities for research include monitoring and management of insecticide resistance, further studies on the integration of vector control and vaccination in mathematical and simulation models and in field studies, supporting innovation not only in the development but delivery of new tools for vector control, more effective use of existing vector control tools and strategies, and basic research into the science of dengue infections.

13. Successful implementation of the global strategy requires five enabling factors: (i) advocacy and resource mobilization; (ii) partnership, coordination and collaboration; (iii) communication to achieve behavioural outcomes; (iv) capacity-building; and (v) monitoring and evaluation. Nationally, these elements require greater collaboration at all levels of government and between sectors. Globally, implementation requires concerted action by Member States, effective global leadership and appropriate engagement of all relevant stakeholders.

14. Local health systems are increasingly responsible for dengue prevention and control. However, they are generally not prepared and lack human and financial resources for the management of dengue outbreaks and cases. The sustainability and continuity of control measures are essential. Dengue prevention and control needs a participatory approach at the local level, and key decision-makers need to forge partnerships with community leaders for better communication and collaboration. National health ministries also need to integrate core components of surveillance, such as entomological data, environmental data and laboratory data, for better decision-making and efficient use of resources. In order to ensure sustained implementation of control programmes at the local level, regulation at national level may be needed to introduce surveillance and control measures as mandatory contributions of local authorities to the national plan.

15. As a result of faster and easier means of transport and frequent travel, the world has become more interconnected. This greater accessibility has largely increased the risk of spreading dengue viruses. Reversing the epidemiological trends of dengue requires unrelenting commitments and obligations from countries, international organizations, partners, and nongovernmental organizations as well as increased human and financial resources. Dengue must be recognized as a public health problem in all countries, and intersectoral activities must be supported and sustained at local and national levels. Cross-border exchange of information among countries is essential to track the emergence of serotypes and enhance preparedness, which must be effectively supported through strong national programmes, sound technical support and resources.

16. The Secretariat will continue to support the implementation of the global strategy and strengthen health systems in order to achieve the goals.

ACTION BY THE EXECUTIVE BOARD

17. The Board is invited to note this report.

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