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Dengue: call for urgent interventions for a rapidly expanding emerging disease

Over the past three decades, dengue fever/dengue hemorrhagic fever has been rapidly expanding in the Eastern Mediterranean Region with outbreaks documented in countries along the coastal lines of the Red Sea and Arabian Sea and in Pakistan. The paper describes the current situation in the Region and proposes specific areas for strengthening of core capacities in the short, medium and long term to reduce the threat of this emerging disease, which threatens national, regional and global health security. The means of prevention and control are well identified and require partnership between different sectors.

A draft resolution is attached for consideration by the Regional Committee.

Contents

Executive summary

Dengue, the most widespread mosquito-borne infection in humans, is an emerging public health problem in countries of the Eastern Mediterranean Region and threatens national, regional and global health security. Since 1998, epidemics of dengue fever and dengue haemorrhagic fever have been reported in the Region with increasing frequency and expanding geographic distribution of both the viruses and mosquito vectors. Outbreaks have been reported from Djibouti, Pakistan, Saudi Arabia, Somalia, Sudan and Yemen. Dengue virus sub-types 1, 2 and 3 have been identified in the Region and have invariably caused outbreaks in these countries. Unplanned urbanization, climate change and population movement are all factors in this growing problem.

In 2009 and the first half of 2010, outbreaks of dengue fever and dengue haemorrhagic fever were reported from Saudi Arabia, Sudan and Yemen. So far outbreaks have been concentrated in the cities and urban areas along the Red Sea and Arabian Sea coasts and Pakistan. Weak surveillance systems for dengue and its vector, lack of reporting and poor preparedness, including inappropriate vector control response, are the main challenges hindering dengue prevention and control in these countries. The magnitude of the public health problem within the Region and the worsening epidemiological trends urgently require intensive coordinated efforts for the prevention (mainly source reduction) and control of the disease in the sub Region. Noting the resistance of *Aedes aegypti* to common insecticides, judicious use and sound management of insecticides is crucial to sustainable control of the disease. This paper identifies specific approaches to reduce the threat of this emerging disease and to strengthen the core capacities required for preparedness planning, detection, characterization, containment and control, especially the role of productive partnerships.

National commitment is a cornerstone to ensuring success and sustainability of any disease surveillance programme. Control of dengue is the collective responsibility of many partners and not only of ministries of health. The global strategy for control of the dengue vector emphasizes functional surveillance, preparedness and selective integrated mosquito control with community and intersectoral participation. A functional surveillance system, with a sentinel component, must be proactive, laboratory-based and provide early warning for impending outbreaks. There is need to emphasize the importance of self-reliant, sustainable, multisectoral community-based interventions in control of dengue, specifically in regard to environmental control, rural development, local administration and mass mobilization, in addition to measures taken by ministries of health. Legislative support is also essential for the success of dengue control programmes. The Regional Office will continue to provide technical support to all Member States.

1. Introduction

Dengue fever and dengue haemorrhagic fever have the ability to cause serious public health impact, to spread rapidly across borders and to threaten national, regional and global health security. As such, they meet the criteria of the International Health Regulations (2005) for diseases that could constitute a public health emergency of international concern. Over the past three decades, there has been a dramatic increase in the incidence and geographical distribution of outbreaks of dengue and dengue haemorrhagic fever around the world. In 1993, the World Health Assembly urged Member States (resolution WHA46.31) to strengthen their national and local programmes for the control of dengue/dengue haemorrhagic fever and to specifically develop and implement cost-effective control strategies for achieving an interruption of transmission of the disease. In response to this resolution, a global strategy for vector control of dengue fever/dengue haemorrhagic fever was developed during a consultation held in Geneva in June 1995. This was further supported by resolution WHA55.17 in 2002.

Dengue fever usually causes a severe benign influenza-like illness. The disease may be incapacitating with severe muscle and joint pain (sometimes popularly termed break-bone fever), and can result in potentially fatal haemorrhagic manifestations (dengue haemorrhagic fever). Occasionally, fatal complications may occur (dengue shock syndrome). The causative agents, dengue viruses, are members of the genus *Flavivirus* and family *flaviviridae*. There are four virus serotypes which are designated as DEN-1, DEN-2, DEN-3 and DEN-4. The incubation period is 4–7 days (range 3–14 days). The disease is characterized by sudden acute onset, biphasic fever of 3–5 days, intense headache, myalgia, arthralgic retro-orbital pain, anorexia, gastrointestinal disturbances and rash. Recovery from infection by one serotype provides lifelong immunity against that virus but confers only partial and transient protection against subsequent infection by the other three viruses.

Dengue viruses of all four serotypes have been associated with epidemics of dengue fever in which there was little or no evidence of dengue haemorrhagic fever. Humans are the main urban reservoir of dengue viruses. Dengue viruses are transmitted from person to person by *Aedes* mosquitoes of the subgenus *Stegomyia*, the most important epidemic vector. All *Aedes* mosquitoes, except *Ae. aegypti*, are generally less efficient epidemic vectors and have their own restricted geographical distribution. However, the role of transovarial transmission in sustaining transmission of the viruses to humans has not yet been delineated. Laboratory tests are essential to confirm diagnosis of dengue infection. The techniques currently available require a relatively high level of technical skill and equipment. Serological tests are simpler and more rapid but have limitations. Although dengue fever rarely causes death, case fatality rates from dengue haemorrhagic fever can exceed 20%. With modern intensive supportive therapy, it can be reduced to less than 1%. The fatality rate for dengue shock syndrome varies by country from 12% to 44%.

This paper provides evidence that dengue/dengue haemorrhagic fever has spread rapidly during the past decade in the Eastern Mediterranean Region and explains why the emergence of these diseases is a growing public health problem. It identifies specific approaches to reduce the threat of this emerging disease and to strengthen the core capacities needed for effective preparedness planning, detection, characterization, containment and control. Recommendations are proposed to foster and further strengthen intersectoral and intrasectoral collaboration between different partners.

2. Situation analysis

2.1 Global situation

Dengue fever is the most prevalent arboviral infection worldwide, with up to 40% (2.5–3 billion people) of the world's population living in endemic regions and at risk of dengue infection. About two thirds of the world's population live in areas infested with dengue vectors, mainly *Ae. aegypti*. It is estimated that 50–80 million dengue infections occur each year, with 500 000 cases of dengue haemorrhagic fever, and at least 12 000–24 000 deaths, mainly among children under 15 years of age. In 2007 alone, there were more than 890 000 reported cases of dengue in the Americas, of which 26 000 cases were dengue haemorrhagic fever. Although up to 80 million persons become infected annually, marked underreporting results in the notification of a much smaller number. Before 1970, only nine countries had experienced epidemic dengue haemorrhagic fever. Now, the disease is endemic in more than 100 countries in the African, Americas, Eastern Mediterranean, South-east Asian and the Western Pacific regions. Historically, DEN-2 is the prevalent serotype found in south-east Asia and may be responsible for conferring immunity against yellow fever. DEN-3 has been found in the Caribbean and DEN-1 has been found in the Pacific islands (Hawaii, Marshall Islands). All four dengue viruses are circulating, sometimes simultaneously, in most of these areas. There is good evidence to indicate that sequential infection increases the risk of developing dengue haemorrhagic fever. In dengue endemic areas, dengue fever seldom occurs among indigenous people.

Although dengue fever/dengue haemorrhagic fever are not new diseases, they can be classified as re-emerging diseases. This is because of the unusual surge in the number of cases in the past three decades. Significant recent dengue outbreaks have occurred in five of the six WHO regions, with the European Region being the only exception. However, cases of imported dengue have been reported in significant numbers in several countries of that region. The geographic distribution of dengue, the frequency of epidemic cycles, and the number of cases of dengue cases have increased sharply and greatly expanded over the past 30 years. The frequency of dengue haemorrhagic fever has begun to increase in countries where only dengue fever occurred previously. Moreover, epidemics of dengue fever/dengue haemorrhagic fever are becoming larger and more frequent. Cases of dengue fever are becoming more severe and more fatal in children below 15 years of age.

The increased incidence of dengue fever has also been attributed to many factors. Climate change has provided a conducive environment for vectors to breed and feed, and has resulted in increased seasonal incidence of vector-borne diseases, such as dengue, malaria and Chikungunya fever, among others. Urbanization and uncontrolled population growth in urban and peri-urban areas has increased the potential for breeding of *Ae. aegypti*. Rapid population growth in urban settings is usually associated with a strain on public services, such as continuous supply of safe drinking-water. As a result, people resort to use of different types of containers and to unsafe water storage practices. The unprecedented increase in air travel has resulted in rapid dispersal of viruses in general, and to wide dissemination and exchange of the different dengue viruses between populations in the world, in particular. Dengue infection is increasingly reported among travellers to tropical countries and is now considered as one of the leading causes of post-travel fever. Travellers may become infected while visiting tropical regions and not show clinical manifestations until returning to their home countries. This results also in introduction of new dengue virus strains and serotypes into areas where the mosquito vectors occur (*1*,*2*).

2.2 Regional situation

Dengue is regarded as an emerging disease in the Eastern Mediterranean Region, laboratory-confirmed cases being first reported officially to WHO only in the past two decades. It is likely

that there were some sporadic cases or small outbreaks of dengue occurring in the Region in the 1980s without being appropriately diagnosed and or reported to WHO. Generally, cases have been detected along the coastal lines of countries facing the Red Sea and Arabian Sea, and in Pakistan. Outbreaks of dengue fever and sporadic cases of dengue haemorrhagic fever have been reported from Yemen (*3*), Oman, Somalia, Sudan, Djibouti (*4*), Saudi Arabia and Pakistan (*5,6,7*).

The current situation of these diseases in countries of the Region can be stratified as follows:

- **group A**: Saudi Arabia, Pakistan and Yemen, where the disease is emerging as a major public health problem, there have been repeated outbreaks in the past two decades in urban centres (and reports that the disease is spreading to rural areas in Pakistan and Yemen) and where the disease is becoming a leading cause of hospitalization and death among children and young adults, and fatal haemorrhagic cases have been reported;
- **group B**: Sudan, Djibouti and Somalia, where small outbreaks of the disease are becoming more frequent, multiple virus serotypes are co-circulating, and it is likely that the disease is expanding geographically within the country;
- **group C**: Oman, where imported cases have been reported but there is no evidence of endemicity or local transmission of the disease;
- **group D**: other countries, where the disease has not yet appeared and inability of the surveillance system to detect ocurrence of the disease in these countries cannot be ruled out.

3. Factors influencing spread of dengue in the Region

Despite the existence of predisposing factors favouring the spread of the dengue fever in the Region, such as presence of the viruses and efficient vectors, intensive urbanization and increase in displaced human population, there are no good data on the occurrence of the disease. Dengue surveillance is difficult to establish and to maintain. This is essentially because it is a complex disease, the symptoms of which are difficult to distinguish from many other common febrile illnesses. Diagnosis of dengue haemorrhagic fever cannot be made by clinical judgment alone. Laboratories play a very important role in dengue surveillance, not only in confirming cases of dengue and dengue haemorrhagic fever but also in monitoring serotypes and strains circulating in the population. The introduction of a new serotype may be an important indicator for future epidemics of dengue haemorrhagic fever and dengue shock syndrome. Competing health priorities, lack of timely laboratory diagnosis and functional epidemiological surveillance, inadequate infection prevention practices at health care facilities and weak vector control programmes can increase the likelihood of prolonged outbreaks. Without timely and appropriate evidence-based interventions, the health and economic impact of dengue and dengue haemorrhagic fever in terms of increased morbidity, mortality, travel and related trade are expected to increase in severity over time and may become very expensive and too complex to control.

Critical impediments and challenges for implementing functional surveillance systems include under-diagnosis, incomplete and delayed reporting, inadequate political commitment and inadequate allocation of funds at the national level. There are insufficient trained health personnel and rapid turnover of those there are. Internal conflict and the presence of large numbers of refugees and internally displaced persons in several countries, together with their limited health services, are also an important factor in the ability of countries to maintain surveillance. The lack of any systematic reports of dengue cases from many countries of the African and Eastern Mediterranean regions is a clear weakness in global surveillance efforts for dengue.

A number of lessons have been learnt from recent outbreaks and these should be considered in the institution of control measures.

- National commitment is a cornerstone for ensuring success and sustainability of the disease surveillance programme.
- Control of dengue is the collective responsibility of many governmental and nongovermmental partners, including the media, and not only of ministries of health, with the coordination of activities of all partners to fill the gaps and avoid duplication of activities especially important in countries in complex emergency situations.
- Control measures must be informed by evidence, while communicable disease surveillance activities need to be integrated at all levels for maximum productiveness and cost-effectiveness.
- Epidemiological surveillance must include both disease (case) and entomological (vector) surveillance.
- Proactive, laboratory-based surveillance systems that can provide early warning of an impending dengue epidemic are needed.
- Sharing of information and experiences and coordination between countries is essential.
- While the eradication of the disease in affected countries has never been reported, the incidence of dengue could be significantly reduced.
- There is need to understand the behavioural risk factors associated with dengue.
- There is no specific treatment for dengue, but appropriate medical care frequently saves the lives of patients with the more serious dengue haemorrhagic fever; the only way to prevent dengue virus transmission is to combat the disease-carrying mosquitoes.
- Re-emergence of outbreaks of dengue may indicate relaxation in the institution of vector control measures in some countries.
- More resources are needed to strengthen surveillance and response, especially in countries in complex emergency situations.

4. Global control strategy

The global strategy for control of dengue and dengue haemorrhagic fever emphasizes: strengthening of active disease surveillance and related health information systems; development of preparedness plans; implementation of selective integrated mosquito control with community and intersectoral participation; strengthening of capacity-building and training in clinical management of dengue haemorrhagic fever/dengue shock syndrome; strengthening of vector control; and promotion of research on vector control. The global strategy also highlights the need for continuous updating and improvement of sustainable national strategies to contain the spread of the disease, including community health education; encouraging health promotion; strengthening research on dengue; and mobilization of external resources for disease prevention as a priority.

5. Establishment of intersectoral coordination at national and regional levels

Outbreaks of dengue fever provide excellent opportunities for integrating field activities, coordinating interventions and implementing gainful collaboration between different partners. The objectives of the national integrated activities for controlling dengue and dengue haemorrhagic fever include, but are not limited to, setting priorities, developing a national strategy, strengthening collaborative (non-competitive) joint activities between different partners and developing detailed plans of action for surveillance, control measures, outbreak and risk communication, among other things. Establishing efficacious and efficient mechanisms for

coordination would result in strengthening surveillance activities and functions, building competent response capacities and ensuring effective use of available health resources. The integrated approach to disease surveillance and response maximizes synergies, takes advantage of new tools, builds on existing resources, permits sharing of experiences and resources, avoids duplication of efforts, reduces workload at lower levels, addresses the needs of programmes and focuses efforts. The expected outcome of integrated disease surveillance would be access to timely, complete, regular and high quality information, prediction and early detection of epidemics, objective assessment of interventions during epidemics, efficient monitoring of intervention programmes, and evidence-based criteria for priority-setting and resource allocation. Transparency is essential to prevent over-reaction and unnecessary control measures. Cross-border activities for surveillance, preparedness and response, including sharing of information, capacities and resources across borders should be facilitated. Information exchange within and among countries is important to avert over-reaction and panic and to ensure appropriate preparedness for a potential threat.

6. Strategic directions

Dengue control programmes aim at reducing morbidity and mortality due to dengue and dengue haemorrhagic fever. In the absence of a safe, effective and economic vaccine against dengue and dengue haemorrhagic fever, vector control is the only method available to prevent and control the disease. Source reduction (elimination of *Ae. aegypti* larval habitats) through community participation is the most promising method for a sustainable, long-term control programme and is the fundamental control strategy. However, full participation of communities will require considerable time, since it is based on behavioural change. The planning of control programmes requires the collection and evaluation of basic epidemiological, entomological and other relevant information to determine which control measures should be combined in an integrated manner for the success of the programme. The information collected should be analysed for the formulation of a sound and feasible control strategy which will best meet the local conditions, needs and resources. National plans should include the following four basic components.

1. Establish effective disease and vector surveillance systems based on reliable laboratory and health information systems.
2. Strengthen partnerships and ensure integrated vector control, with community and intersectoral participation.
3. Establish emergency preparedness capacity to prevent and control outbreaks with appropriate contingency plans for vector control, case management, education and logistics.
4. Strengthen capacity and promote training, health education and research on surveillance, vector control and case management.

Sustainable implementation of such a strategy would require recognition of dengue and dengue haemorrhagic fever as an important health problem in endemic countries in the Region, development of national plans of action with realistic and clear objectives and targets to reduce morbidity from dengue and mortality from dengue haemorrhagic fever, inclusion of dengue/dengue haemorrhagic fever in the list of notifiable diseases and decentralization of vector control activities down to local health services.

1. Surveillance systems

a) Epidemiological surveillance

In many countries in the Region, multiple surveillance systems, including surveillance for dengue, frequently operate in parallel, completely independent of each other. This results in

scattered information on activity of the virus, time of occurrence, location, serotype and disease severity, and low predictive capabilities. There are pooled databases for dengue that collate clinical, laboratory and entomological data from different sources. The overall surveillance function in a country may then become badly disjointed and inefficient, with field workers participating in multiple complicated systems using different surveillance methodologies, terminology, reporting frequencies and forms. Municipalities and the Ministry of Agriculture may not share data on vector control or other activities for prevention and control of dengue on a timely basis with the Ministry of Health. This results in extra costs, duplication of efforts, reduced effectiveness, increased training requirements, as well as overloading and de-motivation of health workers. Despite their limitations, sentinel surveillance networks and in-depth investigations of the diseases under surveillance are quite helpful in identifying risk factors for disease. Syndromic surveillance should be considered as a complement to the fever alert system as this would ensure reporting of any increase in febrile activity in the community and could provide early warning of an impending dengue epidemic.

b) Laboratory surveillance

The role of laboratories in management of outbreaks of dengue fever is often under-estimated; the type of dengue causing an outbreak should always be ascertained and fully characterized. Lack of coordination and integration of surveillance activities will eventually result in the lack of timely information for appropriate public health action. Affected countries need to develop a mechanism to promote establishment of common standard procedures for quality and advanced diagnostics, sharing of critical reagents and resources, capacity-building at the local level, and low cost solutions for diagnostic assays to be used in areas where laboratory capacity is limited.

c) Entomological surveillance

A strong entomological surveillance system is crucial for obtaining data on distribution of vector(s), the extent and types of breeding habitats, intensity and seasonal fluctuations of breeding of mosquitoes. The Regional Committee for the Eastern Mediterranean has already requested Member States (resolution EM/RC52/R.6) to establish a functional vector control unit in the Ministry of Health that would address all vector-borne diseases. They were also requested to ensure that such units are adequately provided with technical, human, financial and infrastructural capacity to be able to plan, implement, monitor and evaluate vector control interventions. Ministries of health need to strengthen these units so that vector control interventions, including timely response to outbreaks of dengue and other vector-borne diseases, is ensured instead of relying on the resources and capacities of the malaria control programmes, which are restrictive. Monitoring and evaluation and research must be an integral component of surveillance, diagnosis, treatment and control programmes; there is need to identify populations at increased risk of the disease. Epidemics also offer unique opportunities to identify risk factors for the disease. Legislative support is essential for the success of dengue control programmes. Municipalities need to revise local legislation to facilitate the necessary prevention measures, with specific provision related to dengue and/or *Ae. aegypti* control, and to evaluate their effectiveness in terms of structural, institutional and administrative changes. The International Health Regulations have a specific provision for the control of *Ae. aegypti* and other disease vectors around international sea/airports.

2. Partnerships

Intersectoral collaboration, effective communication and coordination between the various governmental and nongovernmental partners involved in dengue control programmes are critical to successful programme implementation. There is need to emphasize the importance of self-reliant, sustainable, multisectoral community-based interventions in controlling for *Aedes*

mosquitoes in order to control dengue, specifically those authorities responsible for environmental control, rural development, local administration and mass mobilization, in addition to measures taken by ministries of health. Community participation should be a strategic objective of national plans dealing with environmental control of breeding sites, especially in management of domestic water-holding containers and other important mosquito larval habitats.

Partnerships with policy-makers, media and the community are essential to ensure their commitment to appropriate preparedness and response. In many countries, the jurisdiction for urban metropolitan areas, including management of environment and mosquito breeding sites, usually falls within the municipalities. Academic institutions and public media have important roles to play in studying health behaviours and introducing desirable change. Similarly, research is needed to improve laboratory diagnosis of dengue viruses, case management, *Ae. aegypti* bionomics and control. Social mobilization activities and the mass media, including television, radio, print and cinema, could motivate and encourage community participation in dengue and dengue haemorrhagic fever prevention efforts. Fostering intersectoral collaboration and cooperation involves resource-sharing and policy adjustments among the various ministries and nongovernmental organizations, increasing political commitment, pooling of resources, constitution of intersectoral committees for combined activities, and maximizing the use of mass media for urgent actions by communities, schoolchildren and nongovernmental organizations.

Distribution of roles and responsibilities between different partners should be documented. Such documentation would improve the performance of health and health-related authorities, and promote the sustainability of the surveillance and response systems between partners within and between Member States. The Ministry of Health has a major role to play in the development of guidelines, policy, advocacy for community-based vector control and social mobilization, guidance on allocation of resources, intersectoral collaboration, especially with the school system, and conduct of applied field research to provide the evidence to guide programme activities.

a) Community participation

Community participation entails the creation of opportunities that enable all members of the community and extended society to actively contribute to, influence the development of, and share equitably in the fruits of accrued benefits. The involvement of communities would further extend the coverage of the programme to the whole community by creating community awareness; make the dengue control programme more efficient and cost-effective, with greater coordination of resources, activities and efforts pooled by the community; and enhance sustainability of control programmes by promoting self-reliance among community members and increasing their sense of control over their own health and destiny. Individuals, families, communities and community-based organizations can participate in controlling and reducing sources of *Aedes*. Trained health volunteers could undertake a variety of roles and some specific responsibilities with respect to dengue prevention and control in provision of health education, detecting overlooked breeding sites of the vector at the household level, and conducting household and school inspections.

Communities are more likely to become actively involved in community-based intervention if the Ministry of Health transparently disseminates data on morbidity, mortality and economic losses to families and to the country and explains how the benefits of the programme meet people’s needs and expectations. Also, the provision of knowledge, skills and education materials in regard vector control will empower communities and further increase their involvement. Interaction between ministries of health and the public should generate mutual understanding, trust and

confidence, enthusiasm and motivation. The interaction should not be a one-time affair, but should be a continuing dialogue to achieve sustainability and shared ownership and success.

b) Nongovernmental organizations

Nongovernmental organizations can play an important role in promoting community participation and implementing environmental management for dengue vector control. Community nongovernmental organizations may be informal neighbourhood groups or formal private voluntary organizations, service clubs, religious groups, or environmental and social action groups. Under guidance from the Ministry of Health, nongovernmental organizations can scale up collection of discarded containers (tyres, bottles, tins, etc.), clean drains and culverts, fill depressions, remove abandoned cars and roadside junk, and distribute sand or cement to fill tree holes. The private sector could share in the cost of community-wide public health events aimed at promoting health messages to reduce dengue virus transmission. If not well-planned, industry will exert a strong influence over decisions on resource allocation, mainly towards high cost technology rather than sustainable synergistic social mobilization.

3. Preparedness and response

The principal burden that dengue epidemics create for affected countries is not the number of deaths but the enormous number of hospitalizations and days of illness. Care for an elevated number of dengue cases requires trained physicians and nursing personnel, criteria for triage, beds and supplies, and equipment and training guides for treatment and patient isolation. Isolation refers not only to routine precautions for manipulation of blood and other body fluids but also to the use of insecticide-treated nets to prevent mosquitoes from biting febrile patients and subsequently transmitting infections in the community. Rapid response teams should be ready to be deployed the affected areas. These teams should comprise administrators, epidemiologists, entomologists, clinicians and laboratory specialists, school health officers, health educators and representatives of other related sectors at state and local levels.

4. Health education and research

a) Health education

Health education, a long-term process to achieve human behavioural change, should be given priority in endemic areas and in areas at high risk for dengue haemorrhagic fever. It should be based on formative research to identify what is important to the community and should be implemented at all levels. Health education efforts should be intensified before the periods of dengue transmission as one of the components of social mobilization. The mass media can serve as an ally against outbreaks and play a positive role in the disease control programme or control of outbreaks as long as the appropriate health authorities provide information quickly, correctly and comprehensively. The role of community involvement in health education, source reduction and housing improvement related to vector control should not be underestimated. School health education on all aspects of dengue fever is essential and schoolchildren should be involved in community-based activities to detect and eliminate *Ae. aegypti* breeding places in and around schools, houses and the neighbourhood.

b) Research

WHO will continue to support the development of dengue vaccine and to ensure its efficacy and safe use at low cost. The Regional Office for Eastern Mediterranean will support establishment of a regional centre of excellence for arboviruses. WHO collaborating centres, especially in the Region, can play an important role in strengthening epidemiological, laboratory and entomological surveillance, case management, establishment of early warning systems for outbreaks and management of dengue fever/dengue haemorrhagic fever/dengue shock syndrome

by supporting training activities in countries where dengue is circulating. Reinforcement will be made at the Regional Office in respect of collecting and collating regional epidemiological data, undertaking trend analysis and providing the feedback; developing manuals and guidelines on disease management and control strategies; arranging intercountry workshops for exchange of experience and dissemination of knowledge; developing standard training modules in all disciplines connected with management and control to support national capacity-building; designating additional WHO collaborating centres and strengthening existing centres; standardizing existing rapid diagnostic test kits; and arranging for making an inventory of dengue viruses.

7. Recommendations to Member States

1. Ensure high-level of political commitment so that adequate human and financial resources are made available for the development of an evidence-based national strategy and plan for dengue prevention and outbreak response;
2. Strengthen national health systems so as to improve diagnosis and appropriate case management of dengue and dengue hemorrhagic fever;
3. Establish effective disease and vector surveillance systems based on reliable laboratory and health information systems;
4. Strengthen partnerships and ensure integrated vector control, with community and intersectoral participation.
5. Establish emergency preparedness capacity to prevent and control outbreaks with appropriate contingency plans for vector control, case management, education and logistics.
6. Strengthen capacity and promote training, health education and research on surveillance, vector control and case management.
7. Establish multi-sectoral national dengue committees to foster and support inter-programmatic, interagency, intersectoral and intercountry collaboration for outbreak response and greater community and education involvement in source reduction, early recognition of dengue fever complications at the household level and timely referral of complicated cases;

8. References

1. Gubler DJ. Dengue and dengue haemorrhagic fever in the Americas. *Puerto Rico Health Sciences Journal*, 1987, 6:107–11.
2. Gubler DJ. Dengue and dengue haemorrhagic fever. *Clinical Microbiology Reviews*, 1998, 11:480–96.
3. Jimenez-Lucho VE, Fisher EJ, Saravolatz LD. Dengue with haemorrhagic manifestations: an imported case from the Middle East. *The Journal of Tropical Medicine and Hygiene*, 1984, 33:650–3.
4. Rodier GR et al. Epidemic dengue 2 in the city of Djibouti 1991–1992. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 1996, 90:237–40.
5. Paul RE et al. Expansion of epidemic dengue viral infections to Pakistan. *International Journal of Infectious Diseases*, 1998, 2:197–201.
6. Akram DS, Igarashi A, Takasu T. Dengue virus infection among children with undifferentiated fever in Karachi. *Indian Journal of Pediatrics*, 1988, 65:735–40.
7. Qureshi JA et al. An epidemic of dengue fever in Karachi – associated clinical manifestations. *The Journal of the Pakistan Medical Association*, 1997, 47:178–81.