WHO-EM/CSR/041/E

Report on the

Subregional meeting on dengue fever in the Red Sea rim

Cairo, Egypt
20–22 July 2011

World Health Organization
Regional Office for the Eastern Mediterranean

Document WHO-EM/CSR/041/E/02.12/96

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1. INTRODUCTION

Dengue, the most widespread mosquito-borne infection in human beings, is an emerging public health problem in countries of the Eastern Mediterranean Region. The burden of dengue fever and dengue haemorrhagic fever in countries of the Region is not well known. Moreover, the disease is poorly understood by most medical practitioners in affected countries. Except for Saudi Arabia, the affected countries do not have dengue control programmes. The disease is often forgotten or neglected between outbreaks. These outbreaks are often detected and responded to late. Routine epidemiological, laboratory and entomological surveillance for dengue are absent. Vector control for dengue relies heavily on the malaria control programme thus creating heavy burden on the resources of this programme. As a result little attention is focused on dengue. There is an urgent need to focus attention on this disease.

It is against this backdrop that the World Health Organization (WHO) Regional Office for the Eastern Mediterranean held a subregional meeting on dengue fever for Red Sea rim countries in Cairo, Egypt on 20–22 July 2011. The meeting was attended by policy- and decision-makers from countries of the Red Sea basin as well as representatives from the U.S. Naval Medical Research Unit No. 3 in Cairo, Tan Tock Seng Hospital in Singapore, the Singapore Environmental Health Institute, the London School of Tropical Medicine and Hygiene and WHO staff from headquarters and the Regional Office.

The objectives of the meeting were to:

- review and discuss the dengue situation in affected countries of the Region
- analyse the burden of the disease and identify priority areas for intervention
- recommend regional strategic directions on the control of dengue for countries
- develop a draft regional guidance for control of dengue in the Region.

Dr Jaouad Mahjour, Director, Communicable Disease Control opened the meeting and delivered opening remarks from Dr Hussein A Gezairy, WHO Regional Director for the Eastern Mediterranean. In his message, Dr Gezairy noted that this was the first time the Region had held a meeting on dengue fever. He stressed that there was an urgent need to strengthen core capacities required for effective preparedness, planning, detecting and controlling dengue fever and dengue haemorrhagic fever, which threatened national, regional and global health security. The WHO Regional Office was committed to working with all affected Member States to contain and interrupt the spread of dengue fever/dengue haemorrhagic fever in the Region. He concluded by expressing hope that the meeting would identify a way forward in confronting dengue and chikugunya in the future and stressed the need for a joint approach in order to make a significant impact.

Dr Hassan El Bushra, Regional Adviser, Surveillance, Forecasting and Response, WHO Regional Office for the Eastern Mediterranean, informed participants that the meeting would focus on identifying ways of minimizing the burden of dengue on the community through control and containment of the spread of dengue. Thus the purpose of the subregional meeting was to bring together all endemic countries facing recurrent dengue outbreaks and those that

were under the threat of spread of dengue to work together and agree on common strategies for cooperation in the control and containment of dengue. Expected results were recommendations for affordable dengue disease prevention and control in the Region; an outline strategy for regional cooperation in dengue containment and control in the countries in the Red Sea rim and other affected countries; and priority research needs in the Region.

2. MAGNITUDE OF DENGUE/SEVERE DENGUE AND CHIKUNGUNYA

Chairman: Dr Ziad Memish, Saudi Arabia

2.1 Dengue fever/dengue haemorrhagic fever and chikungunya: global overview

Dr Raman Velayudhan, WHO headquarters

Dengue is the most rapidly spreading mosquito-borne viral disease. Secondary infection with a different serotype of dengue increases the risk of more severe disease. Demographic changes, modern transportation, changes in public health policy, need for political commitment and intersectoral collaboration, climate change and scarcity of water resources were identified as drivers for the rapid global increase in dengue. In the hottest seasons, the vector is able to breed as long as there are uncovered water sources suitable for its habitat. The dengue vector differs from the malaria vector, as the *Aedes* mosquito cannot fly beyond 500 metres. Some recent major dengue fever/dengue haemorrhagic fever outbreaks were predominated by serotype 2 which is observed to alternate with sero-type 3 in a somehow a cyclical manner.

The average number of dengue cases reported to WHO per year has increased from less than 1000 cases per year in 1950 to more than 2 million cases in 2010. Most of the reported dengue cases (and deaths) are from the WHO Western Pacific, South-East Asia and Americas regions, and not from Eastern Mediterranean Region. These reports have also reflected expansion and increase in dengue fever in more countries in South-East Asia. 2010 has witnessed generalized reporting from all WHO regions. Globally, dengue fever is a grossly under-reported disease. However, up to 3.0 billion people live under threat of dengue with 50 million new infections and 24 000 deaths reported annually in over 100 countries. In comparison with malaria, dengue fever is on rise especially if the two diseases are weighed against the variables of population at risk, number of endemic countries, number of reported infections/year and severity of cases.

In terms of the economic burden of dengue fever, studies in several countries estimate the overall cost to be US$ 440 million to handle 500 000 reported cases. In addition, an overall cost of a dengue case can be as much as US$ 828 and hospitalized cases can cost US$ 1500. Added to this is the huge burden heaved on the health sector during outbreaks. Dengue illness in the Americas was estimated to cost $2.1 billion per year on average (in 2010), with a range of US$ 1–4 billion in sensitivity analyses and substantial year to year variation.

Recent maps of the spread chikungunya do show vast coverage of most of Africa and South-East Asia and parts of Europe. Recent outbreaks were reported from these areas. In addition, confirmed cross-border importations of cases of chikungunya were recorded. A

single mutation in chikungunya virus affects vector specificity and increases epidemic potential. Due to the widespread distribution of *Aedes albopictus*, this mutation increases the potential for chikungunya to permanently extend its range into Europe and the Americas. Chikungunya usually affects the productive young age group. “Three-strike” strategies are considered with regard to chikungunya measure: strike back (i.e. early detection); strike fast (i.e. source reduction); and strike hard (i.e. mass campaigns).

The challenges identified and addressed in this presentation were: urban/rural migration; land use changes and impact on mosquito ecology; monitoring continental spread; implementation of the International Health Regulation (2005) to monitor vectors in airports and sea ports; climate change; and outbreaks and intersectoral collaboration. Advocacy and awareness are needed to work out these public health problems. In ASEAN countries, 15 June is assigned as “Dengue Day”. This may be replicated at the global level.

2.2 Dengue fever/dengue haemorrhagic fever and chikungunya: regional overview

Dr Hassan El Bushra, WHO Regional Office for the Eastern Mediterranean

Dengue fever is a notifiable disease as per the International Health Regulation (2005). A dramatic global increase in the incidence and geographical distribution is observed (9 countries in 1970 versus >100 countries today). All four virus serotypes are capable of causing epidemics of dengue fever/dengue haemorrhagic fever. Potential risk factors include increased urbanization, uncontrolled population growth in urban and peri-urban areas, unprecedented increase in travel by air and climate change, increasing the extent and intensity of breeding.

In the Eastern Mediterranean Region, dengue fever was first reported in the last two decades in Somalia (1982), Sudan (1986), Oman (1990), Djibouti (1991), Pakistan (1993), Saudi Arabia (1993) and Yemen (1994). The main challenges identified are the non-specific symptoms of dengue fever, laboratory diagnosis/confirming/sero-typing, under-diagnosis, incomplete and delayed reporting and shortage and rapid turnover of trained health personnel. Currently affected countries in the Region are divided into three categories. Category A countries, which include Pakistan, Saudi Arabia and Yemen, are countries where dengue disease is emerging as a major public health problem, characterized by repeated outbreaks in the past two decades in urban settings, and dengue is becoming a leading cause of hospitalization/death in children and young adults. Fatal haemorrhagic cases have been reported. There is little or no evidence that the disease is spreading to rural areas. Category B includes countries (Djibouti, Somalia and Sudan) where small outbreaks of the disease are becoming more frequent; multiple virus serotypes are co-circulating; and the disease is gradually expanding geographically within the country. Category C countries, represented by Oman, have no evidence of endemicity. There are data that show evidence that outbreaks in some of these countries are interrelated in terms of timing. The lessons learned in the Region are that eradication of dengue fever is not realistic and has never been reported by any country, and that additional efforts are required in countries with complex emergencies and that more transparency is needed.

Dengue fever control should not be left to ministries of health alone; it needs involvement of other relevant sectors. Excellent opportunities are possible for integration, coordination and collaboration between different partners in dengue fever control if intersectoral coordination at national and regional levels is established. This would be translated into setting priorities, developing a national strategy, strengthening collaborative (non-competitive) joint activities, developing detailed plans of action for surveillance, control measures, outbreak and risk communication, etc. Partnership with policy-makers, media and the community would be possible which would enhance transparency in addition to cross-border activities for surveillance/preparedness/response chances and development of written guidance for establishing efficacious and efficient mechanisms for coordination.

Strengthening vector surveillance and entomological activities in countries is an integral part of disease surveillance as clearly supported and enhanced by resolution EM/RC52/R.6 One of the lessons learned is that the dengue problem exceeds the capabilities of ministries of health. There is a need to emphasize the importance of creating community awareness; make the dengue control programme more efficient and cost-effective. The currently identified challenges in the Region include the relatively weak epidemiological, entomological, diagnostic and laboratory capacities in most affected countries; under-utilization of available data, resources and lessons identified; competing priorities; inadequate and timely transparency; inadequate coordination between concerned stakeholders within and between Member States; and defining roles and responsibilities between partners and distribution of allocated funds.

2.3 Country presentations

2.3.1 Djibouti

Djibouti has a well functioning entomology surveillance system in place. Recent entomological survey showed that the highest mosquito density is during the period February to April and the highest risk for dengue infection is in June. Entomological data on spatial and temporal distribution of *Aedes aegypti* in different parts of the country is available. Recent entomological data showed that in Ilot Du Heron, 10 out of 25 female *Aedes aegypti* mosquitoes are positive to chikungunya virus and 5 are positive to DENV3 at different times of the year. The whole positive mosquitoes comprise 60% of total (40% chikungunya, 20% dengue).

The first dengue fever outbreak reported was in 1991 and recent ones were in 20 and 2009. An outbreak of chikungunya was reported in 2007. Dengue fever surveillance does exist and relies on active and passive case detection. Future plans include setting up an active human surveillance plan including clinical and laboratory criteria.

2.3.2 Egypt

Dengue is a notifiable disease in Egypt as part of routine surveillance of Ministry of Health. It requires immediate reporting and is included in haemorrhagic disease surveillance. There is no confirmed case as yet. All suspected cases are usually hospitalized and the clinical

management guidelines are available. A recent epidemiological investigation mission was carried out in May 2010 in the Red Sea area in connection with an outbreak reported in northeastern Sudan. The investigation did not identify any case of dengue or the vector in the Hallaib peninsula.

2.3.3 Oman

Dengue fever/dengue haemorrhagic fever is a notifiable disease under Group A-diseases/syndromes. A national registry has been maintained from year 2000 and all suspect cases are investigated and classified. During the period 2000 to 2010, a total of 28 suspect cases of dengue were on record based on laboratory evidence of IgM. All other 27 cases were travel-related. Almost two thirds of these positive cases were associated with history of travel to India. Presence of the vector is confirmed in the southern part of Oman. The dengue diagnostic algorithm was recently updated.

2.3.4 Pakistan

Before early 1990s of the last century, dengue fever was not known in Pakistan. The first outbreak was detected in Karachi during 1994–1995 followed by 2003, 2005 and 2006 outbreaks. *Aedes aegyptei* is the known vector in urban settings and *albopectus* is known in rainy forest areas in the north. The national strategy for the prevention and control of dengue fever/dengue haemorrhagic fever was developed in 2006. One of the challenges identified is strengthening both epidemiological and entomological surveillance. The available opportunities include decentralization/devolution of health service delivery management to the provinces, availability of strong malaria control programmes, disease early warning systems and functioning health information systems for dengue outbreak detection and routine surveillance, and community and media involvement.

2.3.5 Saudi Arabia

The first appearance of dengue fever in Saudi Arabia was reported in Jeddah province in 1994 and in 2006 and the cases continued to be reported up to the present. In 2004 dengue fever was reported, for the first time, in Makkah and continues on. In addition, cases were found in Jazan region in the south. The general diseases pattern shows that cases begin to rise usually in February and March. The peak in Makkah and Jazan is during April and May, but in Jeddah it is during May and June, sometimes during July. Cases decline at the end of July, sometimes August. To combat this situation, Royal decree number 36 was issued on 13 March 2006 assigning the role of each concerned ministry in the process of dengue control and prevention. The Ministry of Health, Ministry of Municipal and Rural Affairs, Ministry of Agriculture and Ministry of Finance are the concerned ministries. A comprehensive plan to control dengue fever was established by the concerned parties addressing the issues of disease surveillance and case management, vector inspection and control and health education.

2.3.6 Somalia

Dengue fever is not among the notifiable diseases in Somalia. Notification is only done when cases are suspected. Dengue fever annual incidence, trend and hospitalization rates are unknown. There is no facility to diagnose dengue fever within Somalia. Laboratory diagnosis relies on sending samples to Kenya or South Africa. This latter process is usually facilitated by WHO. There are no country-specific clinical guidelines. Weak and late detection and limited access to affected areas, populations and probable cases are the main challenges with regard clinical management and control of dengue fever/dengue haemorrhagic fever cases.

2.3.7 Sudan

Dengue fever/dengue haemorrhagic fever is a notifiable disease (immediate and weekly basis) and it is reported under “hemorrhagic fever. The disease annual incidence, trend and hospitalization rates are well known in the country. More than 70% of all cases are treated in hospital. Dengue fever/dengue haemorrhagic fever is diagnosed clinically (during the season) in addition to rapid tests, serology and PCR. National management guidelines are available and being prepositioned at different states. Dengue haemorrhagic fever has been observed several times with continuous fatal rectal bleeding even after receiving fresh blood and plasma. Cases of dengue shock syndrome in infants have been diagnosed. Treating irritable young infants with dengue fever, lack of sufficient and adequately-prepared intensive care unit, treating pulmonary oedema and haemorrhage in adults and dengue fever in pregnancy are the main identified clinical challenges in managing dengue haemorrhagic fever cases.

2.3.8 Yemen

Dengue fever/dengue haemorrhagic fever is a notifiable disease in Yemen since 2005. The first dengue outbreak was confirmed in 2002, in Shabwah governorate. Transmission period is usually in April to October. Dengue fever/dengue haemorrhagic fever is a growing problem in Yemen. The number of cases and outbreaks has been increasing since 2005 and the disease has spread to 9 governorates in Yemen. Delay in outbreak detection and investigation is observed. Factors influencing the disease transmission in Yemen include lack of safe water supply leading to increased use of uncovered water storage containers, increase in human population density particularly in urban areas, increased population movements between governorates and poverty. With regard to case management limited use of WHO dengue fever protocol, insufficient training lead to low awareness among health care providers about dengue fever and lack of complete information that affects the implementation of vector control campaign.

In spite of the considerable control efforts conducted by the malaria control programme in the area of vector control, there is a strong need to allocate more resources and conduct more control activities. Often, community mobilization and health education are not sufficient to contain the outbreaks early. There is weakness in intersectoral cooperation. Dengue fever is endemic in Yemen and all coastal areas are at high risk of dengue fever epidemics. The increased dengue fever incidence has escalated the risk of dengue haemorrhagic fever. In addition, lack of case definition has impacted the ability of the routine surveillance system to

detect outbreaks in a timely manner. Lack of physician awareness and lack of laboratory capacity result in late detection of outbreaks. Delayed and fragmented interventions resulted in a massive outbreak in 2010. Massive health education by school students played a great role to contain the dengue outbreak in a short time at low cost. Recommendations include the establishment of sentinel entomological surveillance to ensure early warning of dengue fever outbreaks and proper vector control, strengthening laboratory capacity through training and regular provision of kits, enhancing coordination between laboratory and surveillance, strengthening early detection and response using a comprehensive approach and engaging the community in control and prevention efforts.

2.4 Risk factors for dengue fever/dengue haemorrhagic fever in the Region

2.4.1 Basic information on vulnerability of countries to infection with dengue

Dr Zuhair Hallaj, WHO Regional Office for the Eastern Mediterranean

Dengue fever is a re-emerging disease in the Region due to the fact that it is not yet mapped and known in the affected Member States. Not enough epidemiological data are being generated as yet. Many factors are responsible for the emergence of the disease in the Region. These include demographic changes explained by unprecedented population growth, unplanned and uncontrolled urbanization. This has led to enhancement of vector breeding and thus increased contact between humans and vectors (i.e. more mosquitoes living closer to more people). Other factors responsible for the emergence of the disease include increased air travel, inadequate and deteriorating public health infrastructure and changes in vector distribution and density associated with lack of effective mosquito control.

2.4.2 Dengue fever: vector competency and distribution

Dr Raman Velayudhan, WHO headquarters

Along the above-mentioned factors favouring rapid spread of pathogens and vector, vectors are needed to bridge the animals to human interface. It is also known that RNA viruses predominate the list of causes of new emerging infections and most of these infections tend to be zoonotic diseases. In the last 30years, both strains of dengue vectors *(Aedes aegypti* and *A. albopictus)* have increased their geographical spread. These vectors are effective in bridging ecological niches (forest-villages-city). Increased opportunity for viral mutation may be a result of complex epidemiology, climate changes, pathogen amplifications and transmissions. Complex transmission cycle gives pathogens the opportunities to increase their probability of survival without increasing pathogenicity. Studies have shown that vector competency varies from place to another and among the strain. The infection rate in the African strain of *A. aegypti* is lesser than in the Asian strain. Senegalese *A. aegypti* populations have lower vector competence (infection rate 0–26%, dissemination rate 10%–100%) (Dialo et al 2008).

2.4.3 Dengue virus host interaction
Proessor Leo Yee Sin, WHO Temporary Adviser

There are 4 serotypes of dengue virus (dengue 1, 2, 3 and 4). Infection to one serotype confers lifelong immunity to that serotype but not to the other 3 and that all serotypes can cause severe and fatal disease. In addition, up to 85% of dengue haemorrhagic fever is associated with secondary infection. The virus undergoes extrinsic incubation period of 8–10 days and intrinsic incubation period of 3–14 days (an average of 4–6 days). Viraemia onset is at or just before symptoms and last about 5 days. There are 3 phases of typical dengue fever/dengue haemorrhagic fever illness categorized as febrile, critical and re-absorption phases. The febrile phase (days 1–3) is characterized by fever of rising temperature which may exceed 40°Celsius. There is a decrease in platelets and white blood cell counts. In the critical phase (days 4–5), the body temperature returns to normal, but with declining count of white blood cells, rising haematocrit (possibly shock) and severe reduction in platelet counts. In the re-absorption phase (days 6–10) the body temperature shows slight increase before resuming normal again, while the white cell count, haematocrit and platelets resume normal standards. There are many factors affecting viraemia level, they include secondary infections, host factors and possibly mosquito factors.

2.5 Discussions and feedback

- Long-lasting insecticide-treated curtains were tested in some countries and proved effective in vector control.
- There is a need to review the existing case definition.
- It is essential to look at the results of the vector surveillance combined with clinical and cross-border data and information.
- One issue now with malaria control programmes is how to dispose of used bednets in environment-friendly way.
- Saudi Arabia and Sudan have conducted sero-prevalence surveys.
- Evidence of the spread of dengue fever to rural areas was noted in some countries (Pakistan, Sudan and Yemen).
- With regard to use of laboratory testing in the Region there is no unified system and different commercial kits are in use. Reliance on IgM in the diagnosis is not enough.
- When sending samples they should be kept at a temperature of –20 degrees.
- Viral RNA detector would be an ideal diagnostic tool.
- It was recommended that NAMRU-3 design an algorithm for laboratory diagnosis and WHO make available an algorithm for vector control.

3. MEDICAL AND LABORATORY SERVICES AND STANDARD CASE MANAGEMENT DURING EPIDEMICS

3.1 Medical services and patient care for dengue fever/dengue haemorrhagic fever: managing patients with dengue infection

Proessor Leo Yee Sin, WHO Temporary Adviser

Manifestation of dengue virus infection varies considerably. Following infection with dengue virus, a patient can be asymptomatic with no sign of disease. Others will develop symptoms of dengue disease which can manifest as dengue fever, dengue haemorrhagic fever or dengue shock syndrome. Depending on clinical and laboratory tests the severity of the spectrum of dengue haemorrhagic fever is further categorized in to 4 grades. In addition, age factor is important when considering the comparing the severity of the symptoms and signs of the disease.

There is a suggested dengue classification scheme which describe two main categories: dengue ± warning signs, and severe dengue. With regard to diagnosing dengue fever/dengue haemorrhagic fever, the right tool should be used at the right time. However, simple clinical and or laboratory tools are needed to better diagnose dengue and that are able to diagnose dengue early. Simple, user-friendly, reliable tools to predict, triage cases for appropriate level of care are now available in the market. The decision on where (whether at home or hospital) to treat the patient depend on many factors. A patient who can tolerate an adequate volume of oral fluids, pass urine at least once every 6 hours and has no warning signs can be treated at home. At home he should be encouraged to take plenty of oral fluids, given symptom relief such as paracetamol, etc, given advice on warning signs and be monitored daily at a health care facility. Cases with presence of warning signs or underlying conditions likely to complicate dengue treatment, such as pregnancy, infancy, old age, obesity, diabetes mellitus, renal failure, chronic haemolytic diseases, should be referred for in-hospital management.

3.2 Laboratory support/differential diagnostic testing for dengue virus

Dr Barbara Johnson, National Center for Zoonotic Vector-borne and Enteric Diseases, United States of America

Dengue diagnosis presents a lot of challenges in practice. We need to ensure the accuracy, rapidity sensitivity and specificity of the test in addition to availability of standardized diagnostic assays. The diagnosis is through direct or indirect methods. The direct method includes virus isolation, genome detection (RT-PCR for nucleotides) and antigen detection (non-structured 1 protein detection). The indirect methods include mainly IgM and IgG serologies (ELISA). The sensitivity of the method used is dependent on the time the specimen was collected from onset of symptoms of disease. The direct method is more sensitive in the first week from onset of disease while the sensitivity of the indirect method (serology) starts to increase after two weeks from onset of symptoms. In chikungunya, viraemia often precedes clinical illness. There is some crossover period where people who are clinically ill are viraemic, and are IgM positive; but this is a rare event. The typical patient presents with clinical illness and is NAT negative, IgM positive. Chikungunya viral infections are often confused with dengue viral infection as both diseases can present with high

temperatures and myalgias in people living in or returning from tropical areas. In addition, both viruses are transmitted by the same species of mosquitoes and may co-circulate leading to dual infections and concurrent epidemics. While both chikungunya and dengue share similar clinical features, prominent arthalgias are more consistent with chikungunya, and haemorrhage is more common in dengue cases. Malaria is often confused with chikungunya in travellers returning from tropical areas but again chikungunya tends to cause more prominent arthralgias.

The challenges in dengue fever diagnosis include:

- False positive clinical diagnosis: clinical symptoms similar to those of other viral infections
- Low specificity of serological assays: cross-reactivity of serum antibodies to heterologous flaviviruses in serological assays
- Low sensitivity of RT-PCR in samples collected >7 days post-onset of illness
- Low sensitivity of IgM ELISA in 2° dengue virus infections: weak IgM response below level of detection
- Low specificity of serological assays (ELISA, PRNT) in 2° dengue virus infections.

In conclusion, RNA detection is the most rapid and accurate assay, while the most sensitive: <7 days RNA detection and >7 days IgM detection. The standardized assays: IgM ELISA, real-time RT-PCR. Highest specificity testing is the RNA detection.

3.3 Sustained dengue vector control and social mobilization

Dr Raman Velayudhan, WHO headquarters

Many challenges face dengue vector control, among which are the lack of resources. Dengue control is very often used as a last resort, with equipment and plans developed after the outbreak is under way. A delay of over a week makes control ineffective and the decentralization of health services is often blamed for failure to control. Dengue vector control should be based on integrated vector management which should allow a rational decision-making process for the optimal use of resources for vector control. Interventions based on integrated vector management should address the following components.

- advocacy, social mobilization and legislation
- collaboration within the health sector and with other sectors
- integrated approach to disease control
- evidence-based decision-making
- capacity building.

Several control methods are available for integrated vector management. The main methods include: use of biological methods (e.g. fish); chemical control such as indoor residual spraying, space spraying and larviciding; use of insecticide-treated nets; physical control (i.e. elimination of breeding sites and preventing human–vector contact); cultural control including communication for behavioural impact (COMBI) and community participation; and legal control that requires legislative support. Very often combination

vector control is used, targeting egg control, larvae control and adult control. Integrated dengue vector management should be sustained through effective programme management, vector surveillance, clinical surveillance/notifiable disease, utilization of data, identification of dengue areas (mapping) and resource and personnel management.

In summary, integrated vector management for dengue should focus on source reduction and combination vector control based on cost effectiveness and sustainability. Peri-focal spraying, insecticide-treated materials, curtains and other innovative tools must be sustained for 2–3 years. Finally, the programme must have a monitoring and evaluation component.

3.4 Group work and summary of discussions

In the afternoon, the participants were split into three discussion groups based on their areas of speciality. Group one was the case management group and consisted mainly of clinicians. Their discussions focused on improving medical services (patient care), management of dengue fever/severe dengue, and the prevention or minimizing of dengue death. Group two discussed the role of laboratory support in the control of dengue. The group consisted mainly of experts on laboratory work. Their discussions focused on development and strengthening laboratory support, serological diagnosis and support during an epidemic and recommended essential equipment and reagents needed to support diagnosis of dengue fever/severe dengue and chikungunya. Group three was asked to review and discuss coordination and logistic supports needed for control of vector borne diseases including dengue. The group's discussion focused on the identification of key stakeholders required for the formation of dengue control coordination committee with the roles and responsibilities of each partner clearly specified. The group also discussed the need for joint planning, implementation and mapping out logistics support and training needs. The group was composed mainly of policy-makers and decision-makers from countries. Each of the three groups was guided during the discussions by facilitators with expertise in the relevant subject for discussion.

Group 1: Case management

The group focused their discussions on required medical services (patient care), how to manage cases of dengue haemorrhagic fever and dengue shock syndrome and prevention/minimizing of dengue deaths. The group discussed the case definition of 1997 and 2009 WHO guidelines and the reporting criteria/requirements and recommended the following.

- Adoption of the latest case definition and management protocol as defined in the 2009 WHO guidelines for the management of dengue.
- Orienting health care workers at the first level of care to suspect dengue in all cases of fever to allow for early detection, triage and early management decisions.
- Encouraging early notification of all suspected dengue cases to public health authorities for early identification of dengue outbreaks.

- Appropriate management of patients in the early febrile phase of dengue, monitoring and recognizing the early stage of the critical phase of the disease and initiating fluid therapy
- Management decision depending on the clinical categorization into group A, B and C patients; with group A given treatment and sent home with instructions of when to come back, group B referred and retained for hospital management and group C requiring emergency treatment and urgent referral
- The group recommended health education and raising awareness of family, patient and community for timely recognition of symptoms and seeking medical care.

Group 2: Laboratory support group

This group focused their discussions along the lines of predefined areas of discussion on laboratory support, serological diagnosis and support during an epidemic and the equipment and medications issues. The group indentified the needs in area of training, reagents and equipment along the following lines.

- Build on the current laboratory support system for measles
- Make ELISA testing available at subnational and national levels and send a few specimens for testing at reference laboratories
- Use any of the several commercial assays that exist
- WHO to support/promote the distribution of standard reagents within the country and in the Region
- Countries to use consistent algorithm for testing and confirmation
- During outbreak: decide on a number of specimens to be tested to confirm cause of outbreak
- Recognize that storage and shipping of specimens can be a challenge that should be jointly addressed
- Pre-stock media for storage and shipping specimens to reference laboratories.

Group 3: Coordination and logistics

This group focused their discussions along the lines of predefined areas for discussion (identification of key stakeholders, formation of coordination committee, roles and responsibilities, joint planning and implementation, logistics support and training). The group concluded the following five recommendations.

- Countries to form an intersectoral coordination committee, comprising relevant stakeholders to fulfil the identified relevant functions.
- Countries to formalize the constitution of the committee at the national level, if not already in existence, and to determine the frequency of meeting and reporting structure.
- Countries to draw up a national/local logistics plan to ensure the availability of tools for surveillance, vector control (insecticide/spray machine) and transportation.
- With support from WHO countries to finalize materials needed for the training in surveillance, case management, vector control and advocacy.

- Countries to integrate dengue control activities with existing programmes, e.g. malaria control.

These recommendations are to be linked to pre-set functions (strategic planning, advocacy, resource mobilization, vector control, surveillance, case management, community mobilization/participation, solid waste management, safe water supply and monitoring and evaluation of the whole process).

4. DENGUE FEVER/SEVERE DENGUE: SURVEILLANCE AND CONTROL

4.1 Dengue epidemiological surveillance

Mr Tan Han Kiat, WHO Temporary Adviser

Dengue has been endemic in Singapore since the 1960s. To tackle this public health problem, in the early 1970s Singapore established a nationwide *Aedes* control programme comprising source reduction, public health education and law enforcement. However, while this has successfully kept the disease incidence low and also maintained the *Aedes* house index at 1% to 2% since the 1980s, the incidence started to rise from the 1990s, with successive epidemics occurring in 6-year cycles, in 1992, 1998 and 2004, with the largest ever recorded epidemic with some 14 000 cases in 2005. This has been attributed to the changing epidemiology of dengue, where it shifted from being a childhood infection to one involving young adults of 15–34 years, and in the recent years, those aged 55 years and above.

To stem the rising trend in incidence, Singapore revised the dengue surveillance and control programme after the 2005 epidemic. The revised programme has four pillars: 1) case surveillance, which aims to detect cases as early as possible for prompt intervention; 2) virus surveillance, which aims to give early warning of impending outbreaks; 3) vector surveillance, which aims to keep mosquito as low as possible at all times; and 4) integrating these with an understanding of how ecological factors such as climate and population density enabled disease transmission. This integrated approach has kept the annual dengue incidence on a downward trend since 2005, against the backdrop of rising dengue incidence seen in countries in the region. It was also the first example since the global resurgence of dengue in the 1990s of reversal of the rising trend in dengue incidence.

4.2 Dengue laboratory and virological surveillance

Dr Emad Mohareb, U.S. Naval Medical Research Unit no. 3, Cairo, Egypt

The presentation provided an overview of the spread of dengue during the last outbreak in Yemen. Data from the national central public health laboratory in Sana’a indicated that cases of dengue were first confirmed from samples received from Barakish and Shuqra in January 2010. By the time WHO was notified in June 2010, the outbreak was already reported from eight provinces. This kind of delayed reporting resulted into delayed response and all the unpleasant consequences that followed. This scenario can be avoided if there is functional dengue surveillance with a strong laboratory component in place. Regular reporting of suspected and confirmed dengue can help in early detection of outbreak of the disease.

Virus isolation to determine serotype of the infecting virus and the origin of the virus, molecular assays. PCR (conventional/real time and sequencing) and serologic (ELISA, IFA, PRNT) are the general laboratory methods used for the diagnosis of viral infection. The suitability of each method is determined by the antigen and antibody kinetics which varies with the time from the date of onset of symptoms.

In dengue fever, secondary infections are often more dangerous than primary infections and can produce dengue haemorrhagic fever in 10% of cases and may cause death. Immune response in primary and secondary infections varies. IgM is elicited in primary infection between day 3 and day 6 post onset of symptoms and can stay for more than 2 months in primary infections. While IgM appears for a shorter duration in secondary infections with low titres and may not appear at all in 30 % of secondary infections. With regard to IgG which appears after 14 days post symptoms onset in primary infections and can be detected from day 2 in secondary infection and is usually with a very high titre. All laboratory tests should be interpreted with clinical presentation.

NS1 is a non-structural protein that is expressed at the surface of the infected cell and is not part of the virion. It is secreted into the blood in high concentrations. It is secreted in primary and secondary infections during the entire clinical phase of the disease and the first few days of convalescence. It has group specific and type specific determinants. NS1 is very useful in the laboratory diagnosis of dengue. All levels of laboratories should adopt the dengue infection algorithm.

Dengue infections testing algorithm

Primary infection
-0–5 days (virus isolation, PCR, NS-ELISA)
-5–9 days (NS-ELISA, IgM ELISA)
-> 5 – 21 days (IgM and IgG ELISA)

Secondary infection
-0–5 days (virus isolation, PCR, NS-ELISA, IgG ELISA, (IgM ELISA?)

Interpretations of results

Positive IgM and Negative IgG may suggest an acute 1ry Deng case:
Test sample by NS1-ELISA
Test sample by PCR
Interpret results in view of clinical signs
Send for reference laboratory for confirmation and differential diagnosis

Negative IgM and positive IgG may suggest a secondary infection:
Test sample by PCR
Test sample by NS1-ELISA
Check patient history
Interpret result in relation to date of symptom onset

Look for clinical symptoms of dengue fever or dengue haemorrhagic fever

Positive IgM and Positive IgG may suggest primary or secondary infection
Check date of onset and date of sample collection. Look for titer change in convalescent sample
Test sample by PCR
Test sample by NS1-ELISA

4.3 Dengue integrated vector surveillance

Dr Raman Velayudhan, WHO headquarters

The dengue case classification is currently undergoing review. Four classifications are under consideration: dengue fever without warning signs; dengue fever with warning signs; severe dengue; and dengue septic shock. The ongoing review will determine the case definitions. The three major areas of action for dengue surveillance include clinical surveillance/laboratory confirmation, entomological surveillance and control, and advocacy (community awareness and cooperation). The surveillance system must have an outbreak alert and response mechanism which focuses on forecasting and readiness, early detection and appropriate response and control. There are important biological factors to be considered with regard to integrated vector management: that population peaks of the larvae precede those of the adult by almost 2 months while pupal stage development is 32–36 hours for males and 49–52 hours for females. Adult longevity varies on environmental conditions and strains, host preference includes a wide range of mammals and birds, the vector has a bimodal peak activity and that the adult range of flight is up to 134 to 500 metres.

Dengue integrated vector surveillance should be part of dengue surveillance system that: establishes fever surveillance in sentinel sites with weekly reporting; includes case screening for malaria; triggers an alert system when non malaria fever cases increase and requires sample testing; medical doctors and nurses should be trained on detection and management of dengue cases; vector surveillance and control should be made available and activated at the same time the alert system is activated; and outbreak areas should be intensively screened for breeding sites, fever cases and mosquito control measures implemented for 3–4 weeks until cases have declined significantly.

4.4 Discussions

Laboratory

- All laboratories in the Region should use unified diagnostic reagents.
- The need for a unified sample testing algorithm.
- It is important to collect acute and convalescent samples for accurate diagnosis.
- It is important to collect epidemiologic and clinical data and interpret lab results in view of this information.
- Rapid strip test should be considered **ONLY** for screening but not for confirmation
- It is important to collect acute and convalescent samples for accurate diagnosis..
- Almost all countries require specific arbovirus training
- The minimum equipment for country laboratories will be ELISA.

- Ideal sample transportation condition is in dry ice or Liq Nit. RNA later can replace cold chain for RT-PCR.
- Surveillance for serotype in endemic areas is important to control secondary infections.
- There is a need for continuous monitoring of laboratory proficiency through routine quality assurance and control.
- IgG/IgM ratio can't confirm secondary infection. We need to rely on PCR and NS antigen.

Vector control

- Establish fever surveillance in sentinel sites with weekly reporting
- Cases should be screened for malaria
- Increase in non malaria fever cases should trigger the alert system and samples should be tested
- Medical doctors and nurses should be trained on detection and management of dengue cases
- Vector surveillance and control should be made available and activated at the same time the alert system is activated.
- Outbreak areas should be intensively screened for breeding sites, fever cases and mosquito control measures implemented for 3–4 weeks till cases have declined significantly.
- Pockets without *Aedes aegypti* need to be monitored.
- Seroprevalence studies in mosquitoes may not be helpful due to short half-life of the mosquito (6–7 weeks).
- IVM resources are outside of the hands of ministries of health. Regional commitments need to be translated into action. 10 countries in the Region have established steering committees. It is proposed that leadership be within the Ministry of Health to decide on how and when to conduct vector control.
- Global Fund support is recommended to expand to include vector-bone diseases.
- Encourage involvement of community.
- Urbanization issues need to be addressed.

5. DENGUE CONTROL PROGRAMME

5.1 Coordination and intersectoral collaboration for control of dengue fever/dengue haemorrhagic fever in Saudi Arabia

Dr Abdul Hafiz Maaroof Turkistani, Saudi Arabia

Dengue control requires expertise in many different fields by involving a variety of stakeholders (WHO). In Saudi Arabia, a "partnership concept" was established to coordinate the activities of all stake holders involved in the control of dengue in the country. This partnership is responsible for equitable distribution of available resources, supervision and coordination of dengue control activities among the diverse stakeholders. It also ensures that an effective mosquito control programme is put in place, resolves arising interagency issues, defines the responsibilities of each agency and enhances communication and coordination among the partners.

This coordination and intersectoral collaboration partnership is put under the patronage of His Majesty the King, the Ministry of Health and Ministry of Municipality. The partnership has four levels of coordination: the Ministerial Committee (national level); the Deputy Ministers Vector Control Committee (national level); the Executive Committees for Vector Control (regional level); and the Triple Committee for Infectious Diseases Control (provincial level). The Ministerial Committee was established by a ministerial decree and is composed of Ministry of Health, Ministry of Municipal and Rural Affairs, Ministry of Agriculture and Ministry of Finance. This committee is responsible for advocacy and ensuring political commitment in addition to being the overall coordinator and supervisor of all the different stakeholders. The Deputy Ministers Vector Control Committee is composed by the Deputy Ministers from the concerned ministries to supervise the implementation of the vector control programmes by the Executive Committees at the local level.

The other coordination levels also work, as per the specified term of reference, against a predefined comprehensive plan of action that is prepared for handling disease surveillance, vector inspection and control and comprehensive health education campaign targeting the affected area.

5.2 Vector control for the containment of epidemics

Aliaa Zayed, U.S. Naval Medical Research Unit No. 3, Cairo, Egypt

The presentation was based on field experience during recent response to a dengue and chikungunya outbreak in Al-Hodeidah, Yemen. NAMRU-3 runs GEIS Project that employs an Integrated Entomological, Molecular and Geographical Information Component to assess dengue vector status in select Red Sea Cities (Jeddah, Port Sudan, Al-Hodeidah and Djibouti). The programme identified factors involved in the chikungunya outbreak in Yemen to be water scarcity, human movement, illegal escape through Red Sea and vector abundance and favourable breeding environment. The vector response team carried out collection and analyses of vectors to understand the distribution and biology of the insects. The team used different methods of collection including indoor trapping, indoor aspirations, spray sheet collection and trapping using BG sentinel trap. The team also collected mosquito larvae from infested water containers and calculated immature *Aedes aegypti* larval indices. The collected mosquitoes were processed and analysed at NAMRU-3 laboratory using RT-PCR for viral RNA, and cell culture for viral isolation. Chikungunya virus was isolated from both adult and larvae of *Aedes aegypti* and *Culex* larvae collected from Eritrean refugee camps in Al-Hodeida.

5.3 Management of post-dengue haemorrhagic fever epidemics

5.3.1 Entomological monitoring and evaluation (key indicators for data reporting)

Dr Daniel Pilger, London School of Hygiene and Tropical Medicine

The purpose of entomological monitoring is to maximize the impact of vector control activities and to account for dynamic nature of *A. aegypti* breeding pattern. The *Stegomyia* indices and the number of pupae aim to focus on vector control activities, while adult abundance will monitor vector control activities and insecticide susceptibility monitors and

manages resistance. Vector control measures need continuous monitoring in order to maximize impact, and monitoring need to adapt to *A. aegypti* breeding patterns. Rapid surveys with *Stegomyia* indices are suitable to monitor *A. aegypti* populations. Pupal surveys can help to evaluate vector control efforts and identify new targets.

5.3.2 Data reporting (regional and global web-based reporting)
Dr Raman Velayudhan, WHO headquarters

The situation of dengue fever/dengue haemorrhagic fever in the African and Eastern Mediterranean regions is unknown. The numbers of outbreaks are increasing in recent years with deaths (40% of deaths in Cape Verde among pregnant women). There is need for regional plan for dengue fever prevention and control including outbreak response. There is also a need to streamline the reporting system to include time period expressed in weeks, number of clinical cases, number of confirmed cases, serotype %, number of severe dengue and number of deaths. Countries need to respond promptly to outbreaks and to initiate cross-border exchange of information.

6. THE ROLE OF PUBLIC INFORMATION, MEDIA AND COMMUNITY INVOLVEMENT

6.1 Advocacy and public information
Mr Omid Mohit, WHO Regional Office for the Eastern Mediterranean

The media are important to public health. Through the media we can reach out to more audience with public health messages. The media are our partners. Reserve a place for them and get them involved. To facilitate media partnership, one may understand that reporters need good stories every day. Keeping journalists informed can increase coverage on health issues and we should understand journalist’s need for information (for statistics, personal stories, photos, spokespeople). Public health professionals need to maintain good relations with journalists. It is always advisable to train communication lead spokespersons and public information officers responsible for promoting advocacy and public information.

6.2 Crisis and outbreak communications
Mr Omid Mohit, WHO Regional Office for the Eastern Mediterranean

It is important to understand that outbreaks inflict harm, and outbreak communications cannot undo the harm, but they can help prevent further damage. Poor communications can do more damage and often a lot more. The impact of an outbreak may not be known for weeks or months, which leads to speculation and uncertainty. Decisions are often made when reliable information is limited: initial information will be incomplete and may be wrong. Public health crises cause social and economic disruption and worry about public panic may lead to over-reassurance.

We are often tempted to believe that if we say nothing the problem will go away, but this will only lead to greater loss of trust when information is revealed first by another source. The public may panic, but panic is rare. What is more common is anxiety about public panic.

Countries are often concerned about the economic impact of an outbreak, but poor communication will make it worse.

It is always good to get bad news out as soon as possible. Delay is a magnifier of rumour. The longer bad news is withheld, the worse the perception. Get the facts right. Repeat them consistently. Ensure credible sources have the same facts and speak with one voice: inconsistency will diminish trust. Key messages, 3 maximum, should be short, clear and memorable. Pre-test on individuals and groups, if possible.

6.3 Control of dengue fever in Jeddah

Dr Naeema Akbar, Saudi Arabia

In recent years some socioeconomic changes were observed in Jeddah e.g. high population density and informal settlements, insufficient and inadequate water distribution, increased number of water storage containers, abundance of non-biodegradable containers and improper disposal of used tyres. In this the experience of dengue fever control in Jeddah was highlighted along the above-mentioned lines of comprehensive plan of action in the presence of multisectoral involvement.

The national dengue programme was initiated after a royal decree during 2006, with generous budget allocated for both long-term and short-term programmes. The long-term programme aims at eliminating indirect causes of dengue. It is included in the development and implementation of infrastructure projects such public sewage system and provision of sustained municipality water for domestic uses. Short-term projects included dengue case detection, health education and vector control. The responsibilities were distributed among three sectors. The Ministry of Health is responsible for case detection, case management and health education, while the Ministry of Municipality is responsible for vector control in Jeddah district. The role of the Ministry of Agriculture is limited to vector control outside the residential areas as agricultural aircrafts used in spraying insecticides.

The Ministry of Health focuses on early case detection and case management and health education. The dengue surveillance focuses on epidemiology, laboratory and vector surveillance; the cases management focuses on training, diagnosis and hospital care; and health education is organized through campaigns, door to door approach and media campaigns. The Ministry of Health ensures community participation through involvement of the educational sector, Islamic affairs, chambers of commerce, the Supreme Commission for Tourism and charities.

In the municipalities like Jeddah, the municipality team plus Ministry of Health team, the district mayor and key figures are alerted. In addition, the team gets additional support from the police or Ministry of Interior for entering private property. When a case of suspected dengue fever is reported to the preventive affairs department, a team of health care workers visits the patient’s house, conducts epidemiologic surveillance, educates the patient and family and provides educational materials. The team will also inspect the house for presence of any mosquito adult or larval or any mosquitoes or mosquito breeding sites, and apply anti-mosquito actions. In addition an area of up to 4km surrounding the suspect case is inspected

for any breeding site, sites such as areas of shallow water collection during the rainy season. Enclosed areas are usually problematic as such areas are hidden and are usually private properties, where permissions are needed to go in to apply control measures. Removable breeding sites are eliminated, and larger areas are reported to the municipality.

7. PROSPECTS OF DENGUE PREVENTION AND CONTROL: RESEARCH PRIORITIES AND VACCINE UPDATES

Dr Raman Velayudhan, WHO headquarters

For case management, research priorities should focus on three areas; improved clinical outcome based on improvement of capacity of health system, case management, clinical warning signs, severity evaluation, diagnostic and prognostic markers, impact and validation of suggested classification; maintenance of research on vaccine and antiviral therapeutic development; and identifying the mechanisms involved in plasma leakage, bleeding and organ involvement.

Within vector control, the research priorities should target insecticide resistance monitoring, discovering new tools for vector control, evaluation of field interventions (including cost effectiveness) and improving vector control surveillance.

Other priorities include GIS and mapping systems, understanding of vector ecology in rural areas, laboratory-based molecular identification of vectors, new modes of action of insecticides, understanding the burden of disease, KAP studies and advocacy and evaluation of behavioural changes.

Challenges to the development of dengue vaccines are as follows.

- No animal model reproduces human disease
- There is no known true correlate of protection, however neutralizing antibody appears to be an indicator of protection.
- Absolute titre for protection is not known, and titre can vary between strains within a serotype and between serotypes.
- There is need for developing balanced immune response by the four serotypes whereby a protective immune response is induced against all four viruses simultaneously.
- Lifelong homotypic immunity but only short-term cross-protective immunity.
- Immune enhancement, including antibody dependent enhancement.
- Possibility of viral interference with a tetravalent vaccine (live).

8. CONCLUSIONS

Dengue, the most widespread mosquito-borne infection in human beings is an emerging public health problem in countries of the Region. Epidemics of dengue fever/severe dengue have been reported in the Region in the past 40years with increasing frequency and expanding geographic distribution of both the viruses and mosquito vectors. An outbreak of dengue fever/severe dengue was first reported in the Region from Somalia in 1982. This was followed by an outbreak in Djibouti in 1991–1992. Pakistan, Saudi Arabia, and Yemen reported their

first dengue fever/severe dengue outbreaks in 1994. From 2004, Sudan has been facing recurrent outbreaks of dengue fever/severe dengue. All dengue sub-types have been identified and have caused outbreaks in these countries. Lack of planned programme remains the most important challenges in dengue prevention and control in the Region. In 2005, the Regional Committee for the Eastern Mediterranean in its 52nd session passed resolution EM/RC52/R.6, requesting Member States to establish or strengthen national units for integrated vector management and ensure adequate human and financial resources. The resolution further requested Member States to identify needs, gaps and opportunities for vector control and develop national integrated vector management strategies including plans for all vector-borne diseases. This resolution has been partly implemented in 10 countries of the Region. However, intersectoral and intrasectoral coordination for vector control, which is the main intervention in vector-borne diseases – including for dengue, is still very weak. Moreover, routine entomological surveillance which is key for early warning and response has not been effectively implemented in most dengue-affected countries.

The subregional meeting on dengue fever/severe dengue (dengue haemorrhagic fever) for the Red Sea rim critically reviewed and discussed the burden and magnitude of dengue and chikungunya at the global and regional level, and the prospects of dengue prevention and control in the Eastern Mediterranean Region. The meeting recognized that affected countries in the Region vary significantly in terms of their preparedness, their capacity to respond and their allocation of financial resources needed in the prevention and control of dengue. The meeting encouraged reorientation of the existing activities for the control of dengue outbreaks towards integrated vector-borne disease surveillance and control. Aware that dengue can cross international boundaries, the meeting believes that meaningful and effective dengue control is only possible if all affected countries are involved in regular cross border exchange of information. The meeting stressed that dengue control requires a unified national and regional approach; through collaboration among relevant national sectors and among affected countries. The meeting believes that implementation of interventions be based on evidence and use of the best affordable practices.

9. RECOMMENDATIONS

To affected countries

Administrative arrangements for the control of epidemics

1. Establish or strengthen dengue fever/severe dengue and chikungunya control as a vector-borne diseases prevention and control programme. This should be accompanied by evidence-based affordable implementation plans.
2. Review and assess the status of implementation of national activities in line with Regional Committee resolution EM/RC52/R.6.
3. Establish and strengthen intrasectoral and intersectoral collaboration mechanisms for effective coordination to maximize the provision of services and strengthen vector control programmes.
4. Prepare operational plans that identify funding gaps and devise an advocacy plan for mobilizing resources on a sustained basis.

5. Develop contingency plans to ensure the availability of capacity for the prevention and control of dengue as an integral part of strengthening the health system for improving the control of vector-borne diseases.

Dengue surveillance and outbreak response

6. Establish or adopt the WHO case definition for dengue fever/severe dengue and other vector-borne diseases.
7. Develop/strengthen routine sentinel surveillance (using fever syndromic surveillance) for vector-borne diseases including dengue within an integrated disease surveillance system.
8. Establish an early warning system for outbreak early detection, alert and response and develop standard operating procedures including triggers for declaring outbreaks and identification of stakeholders and their roles and responsibilities.
9. Establish fever surveillance in sentinel sites with weekly reporting and screen cases for malaria. An increase in non-malaria fever cases should trigger the alert system and samples should be tested for dengue and chikungunya.
10. Activate or strengthen vector surveillance and control at the same time as the alert system is activated. Outbreak areas should be intensively screened for breeding sites and fever cases, and mosquito control measures should be implemented for 3–4 weeks until cases have declined significantly.
11. Include in all activities a sound monitoring and evaluation component for periodic assessment.

Standard case management of dengue fever and severe dengue

12. Adopt the WHO 2009 guidelines for dengue diagnosis and treatment to develop national management guidelines complete with treatment algorithms. Medical doctors and nurses should be trained to detect and manage dengue cases in clinics and hospitals.
13. Increase health worker capacities to diagnose and treat patients, emphasizing health care workers training/education at all level-right from the village heath workers to intensive care unit internists. Countries need to establish dengue referral network system in public and private sector as a way to reduce case fatality rate.

Basic laboratory diagnostic facilities

14. Establish or strengthen national laboratory for sampling, testing and referring to regional reference laboratory for advance analysis and viral isolation and characterization. This can be built on the current system for measles which uses commercial assays to conduct ELISA testing and send few specimens for confirmation testing at reference laboratory.
15. Use consistent algorithm for testing and confirmation and during outbreak countries should decide on a number of specimens to be tested to confirm cause of outbreak.

Vector control

16. Carry out vector mapping and establish entomological surveillance to ensure early warning of dengue fever outbreaks and proper vector control.

17. Ensure that all vector breeding sites are identified by types, productivity in space and time. This information is then used as an early sign that predicts the onset of cases as well for rapid response that target control of such breeding sites (source reduction).
18. Put more emphasis on the control of breeding sites of the dengue vector rather than adult mosquito control, which should only serve as complimentary to source reduction.
19. Establish routine monitoring of insecticide resistance in the vectors at sentinel sites and develop resistance management strategies.

Social mobilization

20. Promote collaboration among affected communities, national health agencies and major stakeholders to implement dengue control programmes, including initiatives for community participation, effective communication of key messages and specific behavioural change throughout the year.

Subregional networking

21. Establish a subregional body to promote information sharing, collaboration and cooperation for effective and sustained prevention and control of dengue and other vector-borne diseases in the countries of the Red Sea rim.
22. Designate a subregional reference laboratory for dengue diagnostics and vector confirmation in at least one of the countries and enhance country collaboration.

To WHO

23. Provide technical support and guidance in the areas of guidelines development and capacity-building and support the distribution of standard reagents to countries.
24. Assist in the designation of a referral laboratory in the Region and assist countries in establishing a regional coordination mechanism for dengue and chikungunya control.
25. Raise funds and support research on vector-borne diseases in affected countries through the Special Programme on Research and Training in Tropical Diseases (TDR).

Annex 1

PROGRAMME

Wednesday 20 July 2011

08:30– 09:00	Registration	
09:00 – 9:30	Opening session	
	Opening remarks	Dr J. Mahjour, DCD/EMRO
	Presentation of the objectives and agenda	Dr H. El Bushra
	Introduction of participants	
Session 1: Magnitude of dengue/dengue haemorrhagic fever and chikungunya		
10:00–10:20	DF/DHF and chikungunya: global overview	Dr R. Velayudhan
10:20–10:40	DF/DHF: EMR overview	Dr H. El-Bushra
10:40–11:50	Country presentations	Countries
11:50–12:20	Q&A: Discussions	
12:20–13:00	Risk factors for DF/DHF in the Region	
	Basic information on vulnerability of countries to infection with dengue	Dr Z. Hallaj Dr R. Velayudhan and Dr A. Mnzava
	DF: vector competency and distribution	
	Virus host interaction	Prof. Leo Yee Sin
Session 2: Medical and laboratory services and Standard case management of DF/DHF/DSS during epidemic		
14:00–14:15	Medical services and patients' care for DF/DHF	Prof. Leo Yee Sin
14:15–14:30	Laboratory support/differential diagnostic testing for dengue virus	Dr B. Johnson and Dr E. Mohare
14:30–14:45	Vector control and social mobilization	Dr R. Velayudhan and Dr A. Mnzava
14:45–15:45	Group 1: Discussions (case management)	Prof. Leo Yee Sin
	Medical services (patient care)	
	Management of DHF/DSS	
	Prevention/minimizing of death	
	Group 2: Discussions (laboratory support)	Dr E. Mohareb and Dr B. Johnson
	Laboratory support	
	Serological diagnosis and support during an epidemic	
	Equipment and medications	
	Group 3: Discussions	Mr Tan Han Kiat
	Training	
	Appointment of coordination committee	
	Logistics support	
16:15–17:00	Presentation of group work	Groups

Thursday 21 June 2011

Session 3: DF/DHF: Surveillance and control

09:15–09:35	Dengue epidemiological surveillance Case definition and	Mr Tan Han Kiat
09:35–09:55	Dengue laboratory and virological surveillance	Dr E. Mohareb
09:55–10:15	Dengue integrated vector surveillance	Dr A. Mnzava, Dr A. Zayed and Dr R. Velayudhan
10:30–12:00	Group work on: dengue surveillance	
	Epidemiology	Dr D. Pilger
	Laboratory	Dr E. Mohareb
	Vector	Dr A. Zayed, Dr A. Mnzava and Dr R. Velayudhan

Session 4: Dengue control programmes

12:00–12:20	Coordination and intersectoral collaboration for control of DF/DHF	Dr A. Hafiz Turkistani
12:20–12:40	Vector control for containment of epidemic	Dr A. Zayed
12:40–13:00	Management of post-DHF epidemics	
	Entomological monitoring and evaluation	Dr D. Pilger
	Data reporting	Dr R. Velayudhan

Session 5: Role of public information, media, and community involvement

14:00–14:20	Advocacy and public information	MAC/EMRO
14:20–14:40	Role of the media	MAC/EMRO
14:40–15:00	Community participation: experience of Saudi Arabia	Dr Naeema Akbar
15:30–16:30	Plenary discussions	

Friday 22 July 2011

Session 6: Prospects of dengue prevention and control

09:15–10:00	Disease and vector surveillance Regional guidelines for management of epidemics Research Vaccine	Mr Tan Han Kiat, Dr A. Mnzava and Dr H. El Bushra

Session 7: Conclusions and recommendations

10:30–11:30	Administrative arrangements for control of DHF epidemics Preparedness for dengue Standard case management of (DHF/DSS) Basic laboratory diagnostic facilities Disease surveillance system Vector surveillance and control	Dr J. Mahjour, Dr Z. Hallaj and Prof. Leo Yee Sin
11:30	Closing session	

Annex 2

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