

**DRAFT**

**GUIDELINES FOR PREVENTION & CONTROL  
OF CHIKUNGUNYA FEVER**



**World Health  
Organization**

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## **PREFACE:**

Chikungunya is an emerging, epidemic prone vector-borne disease of much significance for WHO's South-East Asia Region. The disease has been reported from countries of South and East Africa, South Asia and South-East Asia. In WHO's South-East Asia Region, outbreaks have been reported from India, Indonesia, Myanmar, Sri Lanka, Thailand and Maldives. Massive outbreaks of chikungunya fever have occurred in recent years in India and in the island countries of the Indian Ocean. Similarly, Maldives reported outbreaks of chikungunya fever for the first time in December 2006. Although not a killer disease, high morbidity rates and prolonged polyarthrititis leading to considerable disability in a proportion of the affected population can cause substantial socio-economic impact in affected countries.

Factors incriminated for the recent resurgence of chikungunya fever in and around the Indian sub-continent include viral mutation and emergence of *Aedes albopictus* as one more efficient vector besides *Aedes aegypti* for the disease transmission. Absence of herd immunity and lack of efficient vector control activities in the affected areas are other important factors.

Socio-economic factors and public health inadequacies that facilitated the spread of this infection in the past continue to exist. Environmental factors and community behaviours play significant role in chikungunya outbreak and spread. Heavy rains followed by stagnation of rain water in flower pots, broken and abandoned pots, and utensils in and around the houses, abandoned vehicular tyres in the vicinity of human dwellings or workplace or in any other container that allows stagnation of water promote the breeding of *Aedes* mosquitoes. There is an urgent need to strengthen national

surveillance and response capacity by securing multi-sectoral support and active participation of the communities to prevent and contain this emerging infectious disease.

Specific treatment is not available and there is no vaccine for the prevention of chikungunya fever. Vector control is the only way to prevent and control the outbreaks. Vector control is not an easy task and insecticide spraying is not always effective and desirable. Strategy of integrated vector management is necessary to tackle the vector. The emergence of the disease in the SEA Region made us realize for the first time that there is no expertise or a standard guideline for the proper surveillance, clinical case management, and control and prevention of chikungunya fever. In addition, many countries of the Region lack technical and financial resources for case detection, surveillance and case management. Socio-economic burden of the disease can be devastating in the outbreak areas due to very high attack rate affecting a large proportion of the population, sometimes as much as 45%. Therefore outbreaks of chikungunya fever have to be seen as a political issue. There is a need to understand the epidemiology of the disease in every country of the region so as to develop and implement a rational policy on its prevention and control. With that objective, WHO Regional Office has developed a regional strategy consisting of six key components. The six components of the Regional strategy are:

1. Strengthening surveillance system for prediction, preparedness, early detection and response to chikungunya outbreaks
2. Improvement in early case detection and case management of chikungunya fever
3. Integrated vector management (IVM)
4. Social mobilization and communication
5. Partnership

## 6. Operation research

This guideline for the prevention and control of chikungunya fever is intended for use by all peripheral health workers in the Region and is based on the strategy outlined above. This document will focus mainly on preventing and detecting outbreaks, and after detection, investigating and containing them.

There are important gaps in our knowledge base about chikungunya fever and priorities for research have been outlined in a separate SEARO publication. A set of guidelines for the case management of chikungunya fever, based on our current level of understanding of the disease, has also come out recently as a separate publication.

I hope that this guideline will be useful for its intended users and will contribute substantially to strengthening of prevention and control of chikungunya in the Region and beyond.

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Regional Director

November 2008.

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## **BACKGROUND AND RATIONALE**

In recent years, large epidemics of chikungunya fever with considerable morbidity and suffering have occurred in a number of Member countries of the South-East Asia (SEA) Region of WHO. The epidemics have also crossed international borders and seas with manifestation of the disease among the North American and European travellers returning from South India and the islands in the Indian Ocean. There is also potential for the disease to establish itself in new areas of North America and Europe where the vector responsible for the disease transmission is present in abundance. Eighteen vector borne disease specialists and public health professionals from Bangladesh, India, Indonesia, Maldives, Sri Lanka and Thailand together with experts from WHO-SEA Regional Office and Headquarters shared their knowledge and experience on chikungunya fever in Aurangabad, India from 27 to 29 September 2007. The discussions brought forth the need to develop guidelines at the SEA regional level for the prevention and control of chikungunya. Based on the current level of understanding about the disease, World Health Organization/ South-East Asia Regional Office (WHO/SEARO) is recommending certain public health actions for the prevention and control of chikungunya fever. As the knowledge base expands, WHO/SEARO will review these guidelines and update them as necessary.

### **TARGET OF GUIDELINES:**

The intended users of these guidelines are health workers at the district and sub-district levels.

### **OBJECTIVES:**

General objectives are to prevent and control the outbreaks of chikungunya fever by surveillance, case detection, investigation and triggering of necessary public health actions.

## **1. INTRODUCTION:**

Chikungunya virus, or in short, the CHIK virus, is an RNA virus that belongs to the *Alphavirus* genus of the *Togaviridae* family, comprising a number of viruses that are mostly transmitted by arthropods. Infection with CHIK virus results in chikungunya fever. The name Chikungunya derives from a root verb in the Kimakonde language meaning “that which bends up” or to become contorted and it describes the stooped appearance of sufferers with arthralgia. Epidemics of fever, rash and arthritis resembling chikungunya fever were recorded as early as 1824 in India and elsewhere<sup>1</sup>. However, the virus was first isolated in 1952-53 from both man and mosquitoes during an epidemic of fever that was considered clinically indistinguishable from dengue in Tanzania<sup>2</sup>. More outbreaks have subsequently occurred in both Africa and Asia. In Asia, CHIK virus strains were isolated in Bangkok in 1960s<sup>3</sup>; from various parts of India including Vellore, Calcutta and the state of Maharashtra in 1964; Sri Lanka in 1969; Vietnam in 1975; Myanmar in 1975 and Indonesia in 1982<sup>4</sup>.

### ***Recent outbreaks in Asia:***

In Indonesia, chikungunya fever occurred sporadically until 1985 after which there were no reports until a series of outbreaks between 2001 and 2007. Between January 2001 and April 2007, Indonesia reported 15 207 chikungunya cases from 7 provinces, with a peak in 2003. Over 1200 suspected cases of CHIK were reported from 23 sub-districts in the year 2007. Most of the reported cases were from the province of Java.

In February 2005 outbreaks started to appear in the Indian Ocean islands, namely the Comoros, Madagascar, Mayotte, Mauritius, La Réunion and the Seychelles. Attack rates peaked in these islands in 2006 and in the La Réunion it affected roughly one third of the population. Large outbreaks emerged in India in 2006 and starting from the state of Andhra Pradesh the disease spread to 16 other states infecting more than 1.39 million people before the end of the year. In the Year 2007, 59 535 cases were suspected of having chikungunya fever and in 2008 the provisional figure up to mid-October is 71 222. In general, new cases have appeared in areas not involved in the previous epidemic. No deaths have, however, been attributed to CHIK in India so far. *Aedes aegypti* remains the major vector in the country although in some of the affected areas *Aedes albopictus* are found in high density. Outbreaks in 2006 also spread to the Andaman and Nicobar Islands, Sri Lanka and Maldives. The CHIK outbreak in Maldives started in December 2006 and lasted for three months. Nearly eleven thousand (4.5% of the population) suspected cases of CHIK were reported in 2006 from Maldives. The attack rate in affected communities ranged from 38-41%. Cases, although lesser in number, were also reported in 2007. All this highlights the capacity of the disease to emerge, re-emerge and spread quickly in these communities and also raises questions about factors that can trigger the appearance or the disappearance of the disease. Chikungunya has established endemicity in several parts of South-East Asia Region<sup>5,6</sup>.

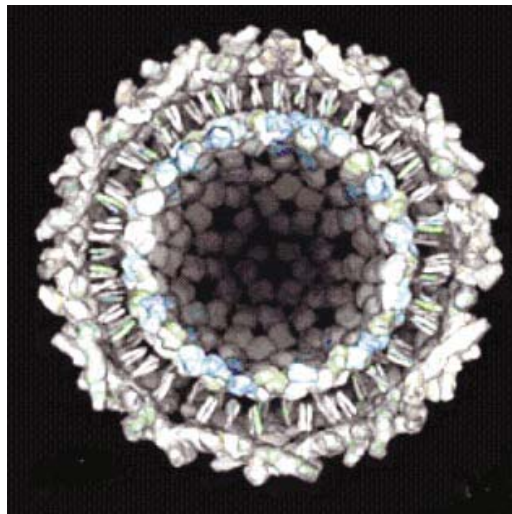
### ***Spread to other continents:***

Nine imported cases of chikungunya fever were recorded in the Caribbean in 2006, occurring in travellers from the Indian Ocean islands. Similarly, 35 cases were reported in the United States, 2 from La Réunion and 33 from India. In 2007, Libreville in Gabon experienced a large outbreak with *Aedes albopictus* as the vector. Ravenna and Forli-Cesena Provinces in the Emilia-Romagna region of north-east Italy recorded a smaller outbreak between June and September in 2007. The index case is believed to be a person returning from a chikungunya affected area in Kerala, India. The vector in Italian outbreak was identified as *Aedes albopictus*<sup>6</sup>. Imported cases were seen in large numbers in France coinciding with the outbreak in La Réunion. Cases were also reported from Germany, Norway and Spain.

## **2. EPIDEMIOLOGY**

### **Causative Agent and Vectors:**

***Figure 1. Chikungunya virus by electron microscopy***



Source: ENVIS Newsletter 2006; 3(2): 1-10

Chikungunya is caused by an arbovirus that belongs to the genus *Alphavirus* under the *Togaviridae* family. It has a single-stranded RNA genome, a 60-70 nm diameter capsid and a phospholipids envelope. It is sensitive to temperatures above 58<sup>0</sup> Celsius and also to desiccation. Believed to be enzootic throughout much of Africa, CHIK virus probably spread to other parts of the world from this origin. African and Asian strains are reported to differ biologically with distinct lineages. Three lineages with distinct genotypic and antigenic characteristics have been identified: two phylogenetic groups, east-central-southern and west African groups from Africa and the other Asian phylogroup. Isolates from the recent outbreak that started in the Indian Ocean islands belong to a distinct clade within the large east-central-southern African phylogenetic group and the isolates from the on-going outbreaks in India are closely related to this<sup>7</sup>. The different geographical genotypes exhibit differences in their transmission cycles: in Asia, the virus appears to be maintained in an urban human-mosquito-human transmission cycle with *Aedes aegypti* and *Aedes albopictus* while the CHIK virus transmission in Africa involves a sylvatic cycle, primarily with *Aedes furcifer*, *Aedes vittatus*, *fulgens*, *luteocephalus*, *dalzieli*, etc as the vectors<sup>8</sup>. A high vector density in the post-monsoon season accentuates virus transmission in Asia.

Chikungunya fever is primarily transmitted by bites of mosquitoes of the genus *Aedes*, the same mosquito that transmits dengue fever. Only the female mosquitoes are infective, because they require a blood meal for the formation of the egg. Of the two vectors in Asia, *Aedes aegypti* is believed to be the principal

vector responsible for transmission during human outbreaks. *Aedes aegypti* breeds in stored fresh water in urban and semi-urban environments<sup>9</sup>. However, in the past two years *Aedes albopictus*, the “Asian Tiger Mosquito” has been increasingly implicated in both urban and rural areas. This vector is much more resilient, able to survive in both rural and urban environment, and has a much wider geographical distribution across the world. It is also found and thrives well in parts of Europe, North, Central and South Americas. It is aggressive, silent and diurnal, making bednets a tool of rather limited use or efficacy. Evidence from recent genotyping studies suggests that some time after the virus reached La Réunion, before transmission rates rose steeply, mutation(s) occurred that enabled more effective transmission by *A. albopictus*<sup>10,11,12,13</sup>.



*Aedes albopictus*



*Aedes aegypti*

Source : Lancet Infect Dis 2007; vol 7.

The *Aedes* mosquitoes breed in domestic settings such as flower vases, water-storage containers, desert coolers, etc and peri-domestic areas such as construction sites, coconut shells, discarded household junk items (vehicular tyres, plastic and metal cans, etc.). Adult mosquitoes rest in cool and shady areas in domestic and peri-domestic settings and bite humans during day time.

**Vector habitat:**



**Source:** Dr. R.V.S.N. Sarma., M.D., M. Sc., (Canada)



**Source:** Dr. R. Sajith Kumar



Flower pot



Flower pot plate



Hardened soil of potted plants



Collar of the toilet bowl



Gully trap



Roof gutter



Roadside drain



Scupper drain

### Breeding grounds of *Aedes* species in urban dwellings

Source: ENVIS Newsletter 2006; 3(2): 1-10

Cases of mother-to-foetus transmission have been reported and will be described later.

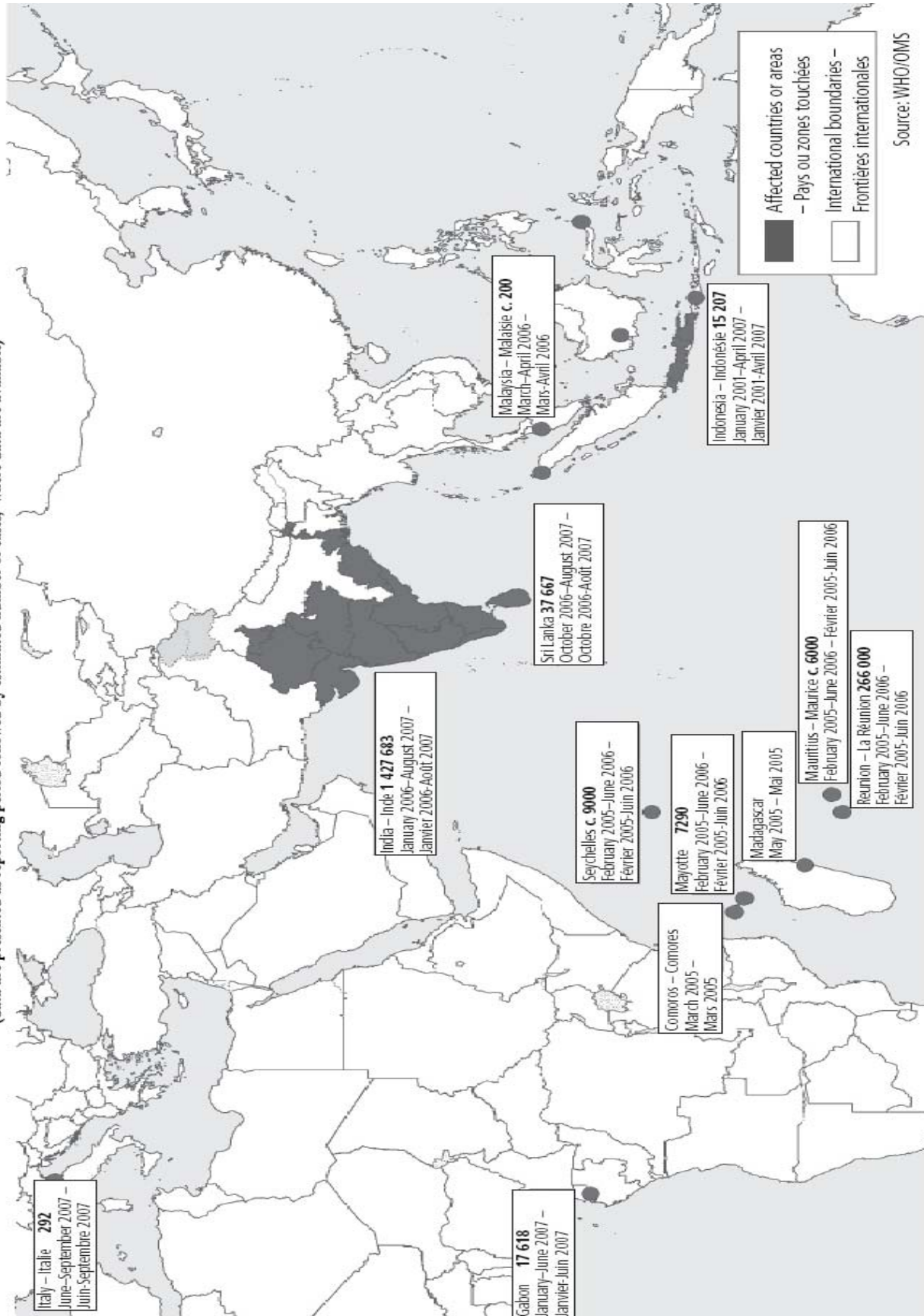
#### Reservoirs:

Human beings serve as the chikungunya virus reservoir during epidemic periods. During inter-epidemic periods, a number of vertebrates have been implied as reservoir. These include monkeys, rodents, birds, and other vertebrates.

**Seasonal trends:**

Chikungunya epidemics display secular, cyclical and seasonal trends. There is an inter-epidemic period of 4-8 years (sometimes as long as 20 years). Outbreaks are most likely to occur in post-monsoon period when the vector density is very high. In the past, chikungunya fever used to be a disease mainly of the tropics until its spread to Italy in 2007 and the subsequent local transmission by the vector, *Aedes albopictus*. It has been reported from Africa, Indian Ocean islands, Pacific, South and South-East Asia. In the South East Asia Region of WHO, outbreaks were reported from India (1963, 1973, 2006, and 2007), Indonesia (1979, 1985, 2001, 2003-2007), Myanmar (1975, 1984), Maldives (2006-2007), Sri Lanka (1965, 2006) and Thailand (1960, 1978, 1988, 1995–1996). The outbreaks in the region prior to 2000 were due to the Asian strain. However, the 2006 outbreak that affected the Indian Ocean islands, India, Maldives and Sri Lanka were due to strains from the central/east African genotype.

**Geographical distribution of Chikungunya cases 2001-2007**  
 (data are presented as reporting period followed by estimated number of cases, where data are available)



Source: WHO/IOMS

Reference: Weekly epidemiological record (WER) No. 47, 2007, 82, 409-416

### 3. CLINICAL FEATURES

The disease occurs in all ages and both sexes. Following a bite by an infected mosquito, the disease manifests itself after an average incubation period of 2-4 days (range: 3-12 days). The disease has an abrupt onset with high fever, myalgia and intense pain in one or more joints. In a series of 876 patients admitted to a hospital in south India during January-September 2006, abrupt onset of fever of short duration (100%) and severe and crippling arthritis involving the knees, ankles, wrists, and hands and feet (98%) were the most significant clinical manifestations. Bleeding (3%), fulminant hepatitis (2%) and meningoencephalitis (1%) were the rare manifestations of the disease<sup>14</sup>. In most series, fever and joint pains are almost universal at the onset. Fever is sudden onset, high grade (> 40° C, 104° F) with chills and rigors; fever is biphasic or saddle-back (fever subsides in 2 to 3 days and then comes back after 1 day); the second phase of fever may be associated with relative bradycardia<sup>15</sup>. Fever, in general, tends to last only for 3 to 4 days. Ankle, knee and wrist are the usual joints to get involved but involvement of the small joints of hands and feet is not uncommon. The joint involvement has two phases: initial severe eruptive arthritis followed later by disabling, protracted peripheral rheumatism that can last for several months<sup>16,17</sup>. In general, the acute phase is severe and incapacitating in all cases with severe pain, tenderness, swelling and stiffness. Skin rash has been reported in about 40-50% of cases, usually appearing between the 2<sup>nd</sup> and 5<sup>th</sup> day. Rash is mostly of pruriginous maculopapular type on the chest but bullous or other forms can also be seen. Bullous rash with sloughing is more

common in children. Maculopapular rash can sometimes be accompanied by petechiae. Observation in 145 patients from the recent outbreak in south India showing dermal manifestations noted skin pigmentation (42%), maculopapular eruption (33%) and intertriginous aphthous-like ulcers (21.4%). Generalized vesiculo-bullous lesions were seen only in infants (2.75%). Exacerbation of existing dermatoses, such as psoriasis, was also observed<sup>18</sup>. Haemorrhagic fever has been reported in Thai patients. Facial oedema may be present. Other symptoms may include headache and back pain; sometimes with nausea and vomiting, coryza, conjunctivitis, photophobia, other ocular symptoms and retro-orbital pain. Ocular complications include iridocyclitis and retinitis, and less commonly nodular episcleritis, all of them with a benign course and good recovery of vision<sup>19</sup>. Neurology of chikungunya fever as studied in 359 patients from 5 centres in India comprised encephalopathy (48.7%), myelitis (19.2%), neuropathy (35.9%), entrapment neuropathy (9.5%), and muscle injury (14.8%)<sup>20</sup>. Neurological features in these patients tended to arise with the febrile phase of the disease and were associated with pleocytosis and the presence of IgM antibodies in the CSF. Virus was isolated from CSF in one case.

<b>Table 1. Frequency of clinical manifestations in different series</b>				
	<b>Symptoms</b>	<b>Andhra Pradesh (India) outbreak: Jan-Sep 2006 (%)</b>	<b>Reunion outbreak: 2005-2006 (%)</b>	<b>Malaysian outbreak: 1998 (%)</b>
1.	Fever	100	100	100
2.	Arthralgia/Arthritis	98	100	78
3.	Skin rash	Frequency not reported	39	50
4.	Headache / spinal pain	Frequency not reported	70/ Frequency not reported	50/50
5.	Myalgia	Frequency not reported	60	50
6.	Number of cases reported in the series	876	504	51

The acute phase of the chikungunya fever lasts for 3-10 days but the convalescent phase can usually last from weeks to months with joint pain, swelling and tenderness. Sometimes it can last for even a year or more. Frequency of major symptoms in different series is shown in Table 1. The Réunion outbreak identified a severe form of the disease in some patients that required management in the intensive care units for supporting at least one vital function. Some deaths were also reported<sup>21</sup>. Such cases have not been observed in other CHIK outbreaks.



**Chikungunya**, that which bends up!

**Arthropathy:** wrists and small joints

Source: Dr. R.V.S.N.Sarma.

### **Overlap and confusion with dengue fever:**

Chikungunya fever has to be distinguished from the dengue fever which has the potential for much worse outcomes including death. The two diseases can often occur together in the same patient. Observations from previous outbreaks in Thailand and India, have characterized the principal features distinguishing chikungunya from dengue fever. In the former, shock or severe haemorrhage is not observed. The onset is more acute and the duration of fever is much shorter in chikungunya fever. In chikungunya fever, maculopapular rash is more frequent than in dengue fever (Table 2). In the early stage when rash is absent, malaria has to be ruled out. With rash, measles or German measles need to be ruled out. Differential diagnosis with other arthropod borne viruses of the *Alphavirus* genus (Ross River, Barmah Forest, o'nyong nyong, Sindbis, and Mayaro viruses) is difficult, but these are comparatively rare.

**Table 2. Differentiation from Dengue Fever by major manifestations**

Distinguishing features	Chikungunya fever	Dengue fever
<b><i>Clinical signs and symptoms</i></b>		
1. Onset of fever of 40 °C	Acute	Gradual
2. Duration of fever	1-2 days	5-7 days
3. Maculopapular rash	Frequent	Rare
4. Presence of shock and severe hemorrhage	Rare	Common
5. Arthralgia	Frequent and lasting over a month	Infrequent and shorter duration
<b><i>Laboratory parameters</i></b>		
1. Leukopenia	Frequent	Infrequent
2. Thrombocytopenia	Infrequent	Frequent

**Neonatal disease and mother-to-child transmission:**

There have been cases of mother-to-foetus infection which have occurred between 3 and 4.5 months into pregnancy. Vertical transmission has been observed during near-term deliveries in the context of intrapartum viremia; 19 cases of vertical transmission out of 39 women with intrapartum viremia in one series, giving the vertical mother-to-child transmission rate of 48.7%<sup>22</sup>.

During the outbreak in La Réunion, 38 neonatal cases were studied retrospectively. All of them developed symptoms on day 3 to day 7 (mean, day 4). Mean interval between the onset in mothers and in the babies was 5 days.

Frequent and prominent signs in the neonates were rash (82%), fever (79%) and peripheral oedema (58%). Raised serum aspartate aminotransferase level (77%), reduced platelet count (76%), diminished prothrombin value (65%), and low lymphocyte count (47%) were observed. Seizures, haemorrhagic and haemodynamic complications were noted. Positive RT-PCR in CSF and abnormalities on Magnetic Resonance Imaging studies of the brain were noted in high percentage of neurological cases (22/24 and 14/25 respectively). Mother-to-child peri natal vertical transmission was deemed responsible<sup>23</sup>. In another study from the same outbreak, 3 of 9 miscarriages before 22 weeks of gestation were attributed to the CHIK virus infection (RT-PCR positive in amniotic fluid)<sup>24</sup>.

#### **4. Laboratory Diagnosis of Chikungunya Fever: <sup>25</sup>**

As the clinical manifestations of chikungunya fever resemble those of dengue and other fevers caused by arthropod borne viruses of the *Alphavirus* genus, laboratory confirmation is critical to establish the diagnosis.

##### ***Types of Laboratory tests available and specimens required:***

Three main laboratory tests are used for diagnosing chikungunya fever: virus isolation, serological test and molecular technique of Polymerase Chain Reaction (PCR). Specimen is usually blood or serum but in neurological cases with meningo-encephalitic feature, CSF (cerebro-spinal fluid) may also be sent.

##### **Virus isolation**

Virus isolation is the most definitive test. Between 2-5 ml of whole blood is collected during the first week of illness in commercial heparinized tube and

transported on ice to the laboratory. The CHIK virus produces cytopathic effects in a variety of cell lines including BHK-21, HeLa and Vero cells. The cytopathic effects must be confirmed by CHIK specific antiserum and the results can take between 1-2 weeks. Virus isolation must only be carried in BSL-3 laboratories to reduce the risk of viral transmission.

### **RT-PCR**

Recently, a reverse transcriptase, RT- PCR technique for diagnosing CHIK virus has been developed using nested primer pairs amplifying specific components of three structural gene regions, Capsid (C ), Envelope E-2 and part of Envelope E1. PCR results can be available in 1-2 days. A specimen for PCR is exactly similar to the one for virus isolation i.e. heparinized whole blood.

### **Serological diagnosis**

For serological diagnosis, serum obtained from 10-15 ml of whole blood is required. An acute phase serum must be collected immediately after the onset of illness and the convalescent phase serum 10-14 days later. The blood specimen is transported at 4 degrees Celsius and not frozen for immediate transfer to the laboratory. Only if the testing cannot be done immediately, the serum specimen should be separated and then stored and shipped frozen.

Serologic diagnosis can be made by demonstration of four-fold rise in antibody titre in acute and convalescent sera or by demonstrating IgM antibodies specific for CHIK virus. A commonly used test is the Immunoglobulin M Antibody (IgM) capture enzyme-linked immunosorbent assay (MAC-ELISA). Results of MAC-ELISA can be available within 2-3 days. Cross-reaction with other flavivirus

antibodies such as o'nyong-nyong and Semliki Forest occur in the MAC-ELISA. The latter viruses are relatively rare in South East Asia and if further confirmation is required by ruling these viruses out, it can be done by neutralization tests and Hemagglutination Inhibition Assay (HIA).

**Interpretation of results:**

Sero-diagnosis rests on demonstrating a four-fold increase in CHIK IgG titer between the acute and convalescent phase sera. However, getting paired sera is usually not practical. Alternatively, the demonstration of IgM antibodies specific for chikungunya virus in acute-phase sera is used in instances where paired sera cannot be collected. A positive virus culture supplemented with neutralization is taken as the definitive proof for the presence of chikungunya virus. Positive PCR result for E1 and C genome either singly or together from the specimen (serum, cerebro-spinal fluid, etc) also constitutes a positive evidence of chikungunya virus infection.

**Existing laboratory network for diagnosing chikungunya:**

The virology laboratory network in South East Asia, from India, Indonesia, Myanmar, Sri Lanka and Thailand can perform many of the laboratory tests for CHIK virus. The regional office of the South East Asia Region is prepared to advise and help with testing in the region; for further information contacting Dr Rajesh Bhatia at [Bhatiaraj@searo.who.int](mailto:Bhatiaraj@searo.who.int) is advised.

**Collection, storage and transportation of samples:**

Proper collection, processing, storage and transportation of the specimens are an essential aspect of the laboratory diagnosis.

### **Collection of samples for isolation & molecular diagnosis**

**Sample:** Serum, or plasma or whole blood (in heparinized tube).

**Time of collection:** Within first five days of illness

#### **To collect serum:**

- Aseptically collect 4-5 ml of venous blood in a tube or a vial.
- Allow blood to clot at room temperature, centrifuge at 2 000 rpm to separate serum. Collect the serum in a clean dry vial.
- Use adhesive tape marked with pencil, indelible ink, or a typewritten self adhesive label to identify the container. The name of the patient, identification number and date of collection must be indicated on the label.
- All clinical samples should accompany the clinical information as per the proforma.

### **Collection of samples for serology**

**Sample:** Blood in plain vial / serum

#### **Time of collection:**

**1st sample:** 5 days after onset of illness for IgM detection as these antibodies appear at this time

**2nd sample:** At least 7 to 14 days after the first sample or, in the event of a fatality, at the time of death.

### **Other types of specimen for laboratory investigation:**

**Specimens:** CSF in meningo-encephalitis cases

Synovial fluid in arthritis with effusion

Autopsy tissues - liver, spleen, lymph nodes and thymus

## Mosquitoes collected in nature

### **Transportation of samples**

- Transport specimens to the laboratory at 2 – 8<sup>0</sup> C (ice box) as soon as possible.
- Do not freeze whole blood, as haemolysis may interfere with serology test results.
- If more than 24-hour delay is expected before specimens can be submitted to the laboratory, the serum should be separated and stored at refrigerated temperature.
- Samples for virus isolation and molecular diagnosis should always be stored and transported frozen.

### **5. CASE MANAGEMENT**

To prevent infecting others in the household or in the community, a patient of chikungunya should strictly avoid coming in contact with an *Aedes* mosquito during the viremic phase, which is usually the first 4 days of illness. As the *Aedes* mosquito bites during dawn-to-dusk daytime, this can be done by resting in bed with a drug-impregnated net during daytime also. The disease is self-limiting. There is no specific treatment for chikungunya. Symptomatic treatment is recommended after excluding more serious conditions. Symptomatic or supportive treatment basically comprises rest and use of acetaminophen or paracetamol to relieve fever and ibuprofen, naproxen or other non-steroidal anti-inflammatory agent (NSAID) to relieve the arthritic component. Using aspirin is

not advised because of the risk of bleeding in small number of patients and the risk of developing Reye's syndrome in children less than 12 years of age. Patients with persistent or chronic phase of arthritis who fail to respond to NSAID may show some response to chloroquine phosphate<sup>25</sup>. The latter may act as a weak broad spectrum anti-viral agent apart from being an anti-inflammatory agent. A recent double-blind placebo-controlled randomized trial has however shown it to be of no real value in acute phase of the disease<sup>26</sup>. Disabling peripheral arthritis that has a tendency to persist for months, if refractory to other agents, may occasionally respond to short-term corticosteroids<sup>27</sup>.

Use of corticosteroids in managing CHIK arthropathy has in general been a contentious issue and has to be a last resort clinical decision.

Patients should be advised to drink plenty of fluids to replenish fluid lost from sweating, vomiting, etc.

While recovery from chikungunya is the expected outcome, convalescence can be prolonged (sometimes up to a year or even more), and persistent joint pain may require pain management including long-term anti-inflammatory therapy. Movement and mild exercise tend to improve morning stiffness and pain, but heavy exercise may exacerbate symptoms. Cases that have prolonged arthralgia and joint stiffness may be benefited from a programme of graduated physiotherapy.

## 6. SURVEILLANCE AND OUTRBEAK RESPONSE

The peripheral health staff should be alerted to report increase of clustering of acute febrile illness that is compatible with the standardized case definition. Based on currently available data, the suggested case definitions are:

### ***CASE DEFINITION***

Though case diagnosis can only be made by laboratory means, chikungunya should be suspected when epidemic occurs with the characteristic triad of fever, rash and joint manifestations.

The chikungunya case definition here is adapted from that proposed by the European Centre for Disease Control (ECDC).

**Clinical criteria:** acute onset of fever  $>38.5^{\circ}\text{C}$  and severe arthralgia/arthritis not explained by other medical conditions

**Epidemiological criteria:** residing or having visited epidemic areas, having reported transmission within 15 days prior to the onset of symptoms

**Laboratory criteria:** at least one of the following tests in the acute phase:

- Virus isolation
- Presence of viral RNA by RT-PCR
- Presence of virus specific IgM antibodies in single serum sample collected in acute or convalescent stage.
- Four-fold increase in IgG filters in samples collected at least three weeks apart

On this basis, cases are to be categorized as

**Possible case:** a patient meeting clinical criteria

**Probable case:** a patient meeting both the clinical and epidemiological criteria

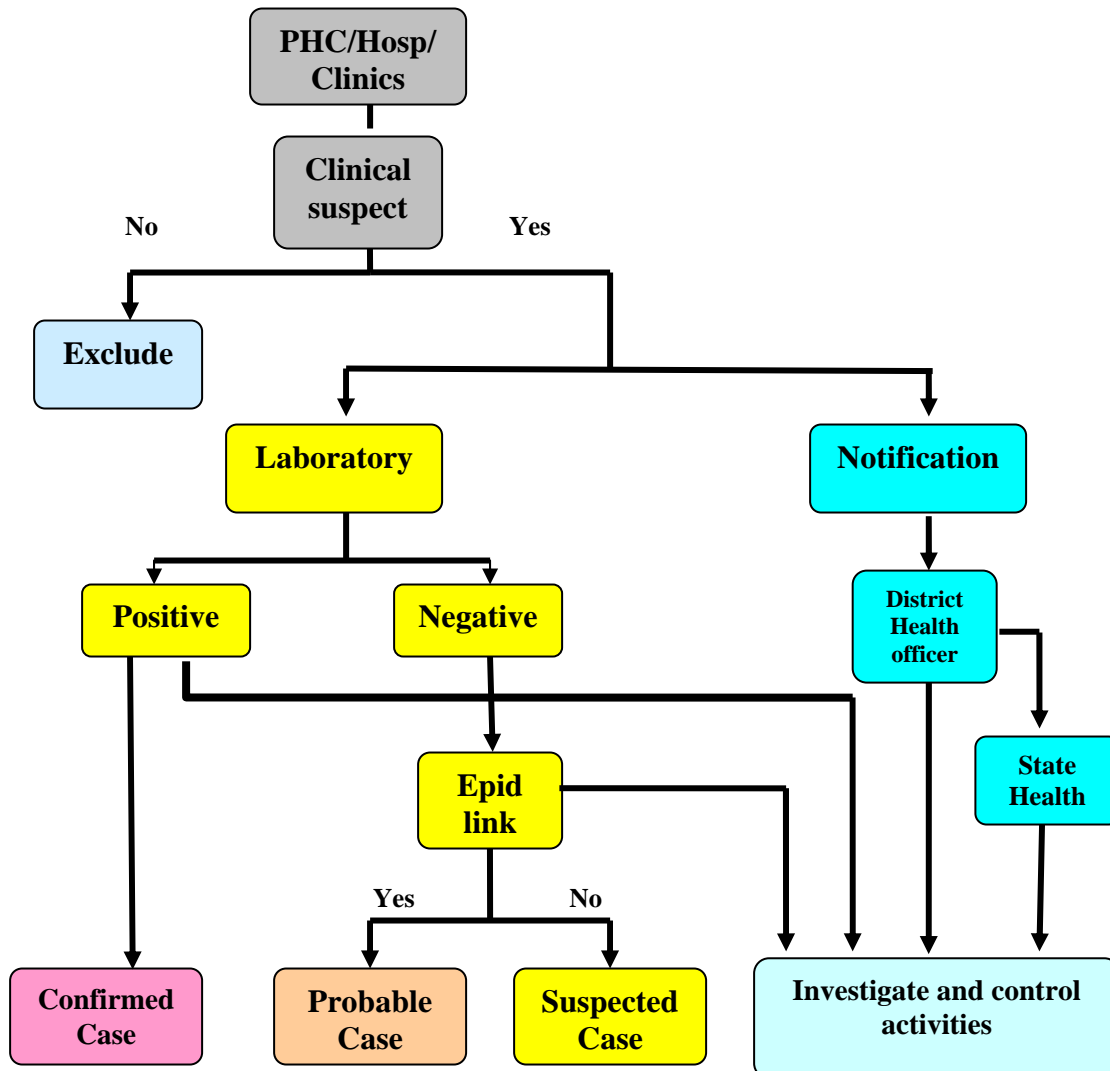
**Confirmed case:** a patient meeting the laboratory criteria, irrespective of the clinical presentation

*(It may be noted that during an epidemic, all patients need not be subjected to confirmatory tests as above. An epidemiologic link may be sufficient. Clinical management as of now does not differ between a probable case and a confirmed case)*

### **NOTIFICATION & REPORTING**

Chikungunya is not a notifiable disease in most of the countries. However, depending upon the spread, countries in the region may make it mandatory for the primary health centres, other clinics and hospitals, both in the public and private sectors to notify suspected cases to authorities. A positive test for chikungunya may emerge from a laboratory in which case the laboratory should report it to the nearest district / civic authorities. Occurrence of clustering of cases compatible with the definition of a suspected case should indicate a possible outbreak and this should be immediately reported to the nearest health authority.

**Scheme for the Notification of a Suspected Outbreak of Chikungunya and Response:**



***ACTION BY LOCAL HEALTH AUTHORITY***

Local health authorities are well advised to be proactive if outbreaks are occurring in the neighbouring states or provinces or if the outbreaks have happened in the previous years. The preparatory steps should be initiated 2-3 months in advance of the onset of the rainy season.

- The District Health Committee / Civic Health Authorities should call and conduct a planning meeting to develop a plan of action.

- The entomological team should monitor vector density in domestic and peri domestic areas and inform the authorities of the trend. Rising trend could be the early warning sign of an impending outbreak.
- Rapid response teams should be in place to conduct epidemiological investigations.
- The community representatives, NGOs, etc. should hold meeting(s) for social mobilization with a view to eliminating the breeding sites, keeping the surroundings clean and improving basic sanitation.
- Hospital administrator should assess the hospital preparedness and review the hospital disaster plan to manage additional outpatient attendance and to augment inpatient treatment capacity.
- Local health administrator should assess the available resources and plan to meet additional manpower and material resources (insecticides and equipments) required for fogging, Ultra Low Volume (ULV) spraying, distribution and application of larvicides, etc. IEC (Information, Education and Communication) materials should be prepared and distributed on time for reduction of mosquito breeding sites and to minimize contact between mosquito and human-beings. Use of both print and visual media is advised to put across the messages. During an outbreak, daily reports should be generated on the number of cases. All deaths reportedly attributed to chikungunya should be investigated. Media should be briefed regularly for them to reflect the correct information. The situation needs to

be closely monitored and additional resources should be mobilized based upon the epidemic curve and trends.

## **COMMUNITY ACTION**

Community has a major role to play in keeping the environment clean, eliminating the vector breeding sites and also in minimizing the human contact with the vector. Social mobilization for these outcomes is the key to the containment of chikungunya outbreak. These activities need to be done at the individual household level and also at the institutional levels such as the schools, universities, hospitals and other establishments.

### **At household level**

- *Aedes* mosquitoes bite during day times only, between dawn and dusk.

Adult mosquitoes can be rendered ineffective by using commercially available pyrethroid-based aerosols for spraying. They are considered quite safe for use in the living areas provided that the food-items are well covered or removed from the area that is being sprayed. Spray bedrooms including the closets, bathrooms and kitchens for a few seconds and close the room for 15-20 minutes. The timing of the spray should coincide with the peak biting times of the mosquito, e.g., early morning or late afternoon. Alternatively, mosquito coils, electric mats vaporizers, etc. can be used.

- All members of the household should ensure that they wear clothes that cover extremities. Use commercially available insect repellents during the day time on exposed parts.
- Have infants and others required to sleep during the day time do so under bed nets.
- Any member in the household suspected of chikungunya should be made to rest under bed nets during the viremic phase which usually is the first four days of illness.
- If possible, install wire mesh / nets on doors and windows.
- Intensify efforts to reduce actual or potential larval habitats in and around houses, remove stagnant water from all junk items lying unattended in the peri-domestic area. Water in bird baths and plant pots or drip trays should be changed at least twice each week.
- In ornamental water tanks, garden pools, etc. Larvivorous fish (e.g., Gambusia, Guppy) should be introduced to diminish the vector population.

### **At school level**

- School children should be provided with health education on all aspects of chikungunya fever: what it is, how it spreads, the role of mosquitoes, where and how they breed/rest, and how they can be controlled.
- All actions for reducing man-mosquito contact and actions targeted at source reduction as listed above should also be applied by school children in their settings.

- Weeds and tall grasses in the school premises should be cut short as adult mosquitoes look for these shady places to rest during the hot daylight hours.

### **At community level**

- People should form groups to supplement and reinforce efforts at the household levels. Social mobilization efforts should focus in keeping the surroundings clean and improving basic sanitation in peri-domestic and public utility areas.
- Community groups should conduct house to house visits to ensure that all community members are taking action at household level. Empowered community groups can also be instrumental in forcing the civic authorities to act.

## **7. OUTBREAK COMMUNICATION**

Communicating risk to the community is crucial for community sensitization and participation. People need to be educated about the disease, its mode of transmission, unavailability of specific treatment, available means of symptomatic and supportive treatment and adoption of control measures. The communication has to be targeted at modifying behaviours regarding practice of storage of water, leaving junk items unattended in peri-domestic areas, keeping the environment clean and personal protection. A media plan has to be drawn up

identifying clearly the messages and the modality of communicating them to the public.

Community should also be reassured that this is a preventable and self-limiting disease. People should be encouraged to use personal protection measures in the form of full sleeved cloths, use of mosquito repellent preparations over the exposed body parts, and insecticide treated bed-nets and window screens even while sleeping during daytime. They should be advised to cooperate during spraying, fogging and application of larvicides.

Special campaigns may be carried out with the involvement of mass media including local newspapers/magazines, radio and TV as well as outdoor publicity like bill boards, rallies, etc. Health education materials should be developed and widely disseminated in the form of posters, pamphlets, handbills, bill boards, inter-personal communication through group meetings and optimal utilization of traditional / folk media.

The process will benefit from the involvement of non-governmental, faith-based, community-based organizations including residents' welfare organizations, self-help groups, professional associations, etc.

## **8. VECTOR SURVEILLANCE AND CONTROL**

Vector surveillance during pre-monsoon and monsoon, if done appropriately, will provide an early warning indicator prior to the outbreak of chikungunya (Annex 1).

Vector control can be done through anti-adult and anti-larval control of mosquitoes. Details of each intervention are shown in Annex 2.

Vector surveillance and control of chikungunya outbreak should be approached in an integrated manner. It should be part of the Integrated Vector Management (IVM), which besides pesticide application also covers advocacy, social mobilization through socio-cultural approach and private-public collaboration. Due to the complex nature of vector control, the core elements of IVM are summarized in the box below and have been further elaborated in Annex 3.

**BOX: Summary of Integrated Vector Management (IVM)**

Integrated vector management is a process for managing vector populations in such a way as to reduce or interrupt transmission of disease. It consists of vector surveillance and vector control through better knowledge of characteristics of vector biology, disease transmission, morbidity as well as range of interventions and collaborations of all related parties. It also requires community empowerment in order to increase their participation in vector surveillance as well as vector control and in developing and implementing regulations concerning healthy public policy and environment.

The five key elements of IVM include:

- *Advocacy, social mobilization and legislation*
- *Collaboration within the health sector and with other sectors*
- *Integrated approach*
- *Evidence-based decision-making*
- *Capacity-building*

## 9. CONCLUSION

In recent years there have been explosive outbreaks of Chikungunya Fever in several parts of the SEA Region and elsewhere. Although the disease is self-limiting, morbidity can be very high in major outbreaks resulting in heavy social and economic toll. The disease should be preventable and it would require a planned approach, besides knowledge and awareness of early warning signs, for prevention. Integrated vector management through the elimination of breeding sites, use of anti-adult and anti-larval measures and personal protection will contribute to preventing an outbreak. Community empowerment and mobilization is crucial for prevention and control. Adult mosquito control measure such as fogging often applied by the civic authorities as a single tool may not in itself contribute to containment of an outbreak.

## 10. REFERENCES:

<sup>1</sup>Krishna MR, Reddy MK and Reddy SR. Chikungunya outbreaks in Andhra Pradesh, South India. *Current Science* 2006; 91(5): 570-571.

<sup>2</sup>Robinson MC. An epidemic of virus disease<sup>2</sup> in Southern Province, Tanganyika Territory, in 1952-53. I. Clinical Features. *Trans R Soc Trop Med Hyg* 1955; 49: 28-32.

<sup>3</sup> Halstead SB, Scanlon JE, Umpaivit P and Udomsakdi S. Dengue and Chikungunya virus in man in Thailand, 1962-64. IV. Epidemiologic studies in the Bangkok Metropolitan area. *Am J Trop Med Hyg* 1969; 18(6): 997-1021.

<sup>4</sup>World Health Organization-South-East Asia Regional Office. Chikungunya Fever, a re-emerging Disease in Asia. <http://www.searo.who.int/en/Section10/Section2246.htm> accessed 21 October 2008.

<sup>5</sup>World Health Organization/ South-East Asia Regional Office. Chikungunya in South-East Asia-Update, January 2008.

<sup>6</sup> World Health Organization. Outbreak and spread of chikungunya. *Weekly Epidemiological Record* 2007; 82(47): 409-415.

- <sup>7</sup> PIALOUX G, GAUZERE BA, JAUREGUIBERRY S and STROBEL M. Review: Chikungunya, an epidemic arbovirosis. *Lancet Infect Dis* 2007; 7: 319-27.
- <sup>8</sup> POWERS AM, BRAULT AC, TESH RB and WEAVER SC. Re-emergence of chikungunya and o'nyong-nyong viruses: evidence for distinct geographical lineages and distant evolutionary relationships. *Journal of General Virology* 2000; 81: 471-79.
- <sup>9</sup> YERGOLKAR P, TANDALE B, ARANKALLE V, et al. Chikungunya outbreaks caused by African genotype, India. *Emerg Infect Dis* 2006; 12: 1580-83.
- <sup>10</sup> SCHUFFENECKER I, ITEMAN I, MICHALUT A, MURRI S, FRANGEUL L, et al. (2006) Genome microevolution of chikungunya viruses causing the Indian Ocean outbreak. *PLoS Med* 3(7): e263. DOI: 10.1371/journal.pmed.0030263
- <sup>11</sup> KUMAR NP, MITHA MM, KRISHNAMOORTHY N, KAMRAJ T, JOSEPH R and JAMBULINGAM P. Genotyping of virus involved in the 2006 Chikungunya outbreak in South India (Kerala and Puducherry). *Current Science* 2007; 93(10): 1412-16.
- <sup>12</sup> DE LAMBALLERIE X, LEROY E, CHARREL RN, TTSETSARKIN K, HIGGS S and GOULD EA. Chikungunya virus adapts to tiger mosquito via evolutionary convergence: a sign of things to come? *Virology Journal* 2008; 5:33. doi: 10.1186/1743-422X-5-33. Downloaded from: <http://www.virologyj.com/content/5/1/33>  
Accessed: 23 October 2008.
- <sup>13</sup> SANTOSH SR, DASH PK, PARIDA MM, TIWARI M and LAKSHMANA RAO PV. Comparative full genome analysis revealed E1: A226V shift in 2007 Indian Chikungunya virus isolates. *Virus Research* 2008; 135(1): 36-41.
- <sup>14</sup> MOHAN A. Editorial. Chikungunya fever: clinical manifestations & management. *Indian J med Res* 2006; 124:471-474.
- <sup>15</sup> SWAROOP A, JAIN A, KUMHAR M, PARIHAR N and JAIN S. Review Article: Chikungunya Fever. *Journal, Indian Academy of Clinical Medicine* 2007; 8(2): 164-68.
- <sup>16</sup> KENNEDY AC, FLEMING J and SOLOMON L. Chikungunya viral arthropathy: a clinical description. *J. Rheumatol.* 1980; 7(2):231-36.
- <sup>17</sup> SIMON F, PAROLA P, GRANDADAM M, et al. Chikungunya infection: an emerging rheumatism among travelers returned from Indian Ocean islands. Report of 47 cases. *Medicine (Baltimore)* 2007; 86(3): 123-37.
- <sup>18</sup> INAMADAR AC, PALIT A, SAMPAGAVI VV, RAGHUNATH S and DESHMUKH NS. Cutaneous manifestation of chikungunya fever: observations made during a recent outbreak in south India. *International journal of dermatology* 2008; 47(2): 154-9.
- <sup>19</sup> MAHENDRADAS P, RANGANNA S, SHETTY R, et al. Ocular manifestations associated with chikungunya. *Ophthalmology* 2008; 115(2): 287-291.
- <sup>20</sup> WADIA RS. Presidential Oration: A neurotropic virus (chikungunya) and a neuropathic amino acid (homocysteine). *Ann Indian Acad Neurol* 2007; 10:198-213.  
Downloaded free from <http://www.annalsofian.org> on October 28, 2008.
- <sup>21</sup> LEDRANS M, QUATRESOUS I, RENAULT P and PIERRE V. Outbreak of chikungunya in the French Territories, 2006: lessons learned. *Euro Surveill.* 2007; 12(36): pii=3262. Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=3262>

<sup>22</sup> Gérardin P, Barau G, Michault A, et al. Multi-disciplinary prospective study of mother-to-child Chikungunya virus infections on the island of La Reunion. *PLoS Medicine* Vol. 5, No. 3, e60 doi:10.1371/journal.pmed.0050060

<sup>23</sup> Ramful D, Carbonnier M, Pasquet M, et al. Mother-to-child transmission of Chikungunya virus infection. *Pediatr Infect Dis Journal* 2007; 26(9): 811-15.

<sup>24</sup> Lenglet Y, Barau G, Robillard PY, et al. Chikungunya infection in pregnancy: Evidence for intrauterine infection in pregnant women and vertical transmission in parturient. Survey of the Réunion Island outbreak. *J Gynecol Obstet Biol Reprod (Paris)* 2006; 35(^): 578-83.

<sup>25</sup> Brighton SW. Chloroquine phosphate treatment of chronic chikungunya arthritis. An open pilot study. *S Afr Med Journal* 1984; 66(6): 217-18.

<sup>26</sup> [http://www.searo.who.int/en/Section10/Section2246\\_12902.htm](http://www.searo.who.int/en/Section10/Section2246_12902.htm)

<sup>27</sup> De Lamballerie X, Boisson V, Reynier Jean-Charles, et al. Vector-Borne and Zoonotic Diseases. Ahead of print. doi: 10.1089/vbz.2008.0049

<sup>28</sup> Simon F, Parola P, Grandadam M, et al. Chikungunya infection: An emerging rheumatism among travelers returned from Indian Ocean Islands. Report of 47 cases. *Medicine* 2007; 86(3): 123\_137.

## **ANNEX 1: VECTOR SURVEILLANCE**

Surveillance for *Aedes species* is important in determining the distribution, population density, major larval habitats, spatial and temporal risk factors related to chikungunya transmission, and levels of insecticide susceptibility or resistance, in order to prioritize areas and seasons for vector control. These data will enable the selection and use of the most appropriate vector control tools, and can be used to monitor their effectiveness.

Vector surveillance before and during the rainy season (pre-monsoon and monsoon in SEA Region) is important to find out the extent of prevalence of vectors in certain selected high risk localities/areas (from where dengue cases have been reported earlier). House index, container index, Breteau index are commonly used for monitoring the vector population. These indices are particularly relevant for focusing control efforts on the management or elimination of the most common habitats and for the orientation of educational messages for community-based initiatives.

Adult mosquito surveillance will help in finding out the susceptibility status to insecticides.

## Larval surveys

A number of indices have been described and are currently used to monitor the larval population. A minimum of 50 houses needs to be surveyed in a locality to calculate the following indices:

1. House Index (HI) – Percentage of houses positive for larvae of *Aedes aegypti*.

$$HI = \frac{\text{Number of houses infested}}{\text{Number of houses inspected}} \times 100$$

The house index has been most widely used for monitoring infestation levels, but it does not take into account the number of positive containers or the productivity of those containers.

2. Container Index (CI) – Percentage of water containers positive for *Aedes* breeding.

$$CI = \frac{\text{Number of positive containers}}{\text{Number of containers inspected}} \times 100$$

Containers are examined for the presence of mosquito larvae and pupae. The container index only provides information on the proportion of water-holding containers that are positive. It is mostly utilized for drawing vector control strategy.

3. Breteau Index (BI) – Number of positive containers for *Aedes aegypti* per 100 houses inspected.

$$BI = \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \times 100$$

The Breteau index establishes a relationship between positive containers and houses, and is considered to be the most informative, but there is no reflection of container productivity. In the course of gathering basic information for calculating the Breteau index, it is desirable to obtain a profile of the larval habitat characteristics by simultaneously recording the relative abundance of the various container types, either as potential or actual sites of mosquito production. Examples are number of positive drums per 100 houses, number of positive tyres per 100 houses, etc.).

4. Pupal Index (PI) - Number of pupae of *Aedes aegypti* per 100 houses inspected.

$$PI = \frac{\text{Number of pupae}}{\text{Number of houses inspected}} \times 100$$

In order to compare the relative importance of larval habitats, the pupal index can be broken down to "useful", "non-essential" and "natural" containers, or by specific habitat types, such as tyres, flower vases, drums, clay pots, etc. Given the practical difficulties and labour-intensive efforts entailed in obtaining pupal counts, especially from large containers, this method does not need to be used in every survey. The pupal index has been most frequently used for operational research purposes.

## **Adult surveys**

Adult vector sampling procedures can provide valuable data for specific studies, such as seasonal population trends, transmission dynamics, transmission risk, and evaluation of adulticide interventions. The collection methods tend to be labour-intensive and heavily dependent on the collector's proficiency and skill.

## **Landing/biting collections**

Landing/biting collections on humans are a sensitive means of detecting low-level infestations, but are very labour-intensive. Both male and female *Aedes aegypti* are attracted to humans. Because adult males have low dispersal rates, their presence can be a reliable indicator of close proximity to hidden larval habitats. The rates of capture, typically using hand nets or aspirators as mosquitoes approach or land on the collector, are usually expressed in terms of *landing/biting counts per person-hour*.

## **Resting collections**

During periods of inactivity, adult mosquitoes typically rest indoors, especially in bedrooms, and mostly in dark places, such as closets for clothes and other sheltered sites. Resting collections require systematic searching of these sites for adult mosquitoes with the aid of a flashlight. The methodology involves capturing the adults using mouth or battery-powered aspirators and hand-held nets with the aid of flashlights. Following a standardized, timed collection routine in selected rooms of each house, densities are recorded as the

number of adults per house (females, males or both) or the number of adults per person-hour of effort. When the mosquito population density is low, the percentage of houses positive for adults is sometimes used.

## **ANNEX 2: VECTOR CONTROL**

### **Prevent man- mosquito contact**

Prevention is entirely dependent upon taking steps to avoid mosquito bites and elimination of mosquito breeding sites.

### **To avoid mosquito bites:**

- Wear long-sleeved shirts and long trousers.
- Apply mosquito repellents to exposed parts of the body.
- Use mosquito coils, electric vapour mats during the daytime to prevent mosquito bites.
- Use mosquito nets – to protect babies, old people and others, who may rest during the day. The effectiveness of such nets can be improved by treating them with permethrin (pyrethroid insecticide). Curtains (cloth or bamboo) can also be treated with insecticide and hung at windows or doorways, to repel or kill mosquitoes.
- Have secure screens/ nets on windows and doors to keep mosquitoes out.

### **Vector control measures:**

For control of epidemics, vector control is considered to be one of the important strategies to interrupt or reduce transmission. Adult mosquitoes can be controlled by the use of chemical insecticides. It should be emphasized, however, that rapid and effective reduction of breeding sites of vector mosquitoes will achieve the same results. Moreover, larval control is more economical and

provides sustainable control by eliminating the source of newly emergent adult mosquitoes.

Chemical space sprays are not effective in most of the conditions and it is rare that an epidemic will be controlled by using only this method. Further, this often creates a false sense of security and impact negatively on individual and community action for source reduction.

### **House and premise inspection**

House and premise in the area where patient lives should be inspected for potential mosquito breeding sites, to get the house index (normal < 1 %) and the Breteau Index (normal < 5%) of the area. The source reduction activities should be carried out to reduce breeding sites in all premises.

### **Anti-adult measures**

Anti-adult measures include using insecticides in the recommended dose for indoor spray, ultra low volume (ULV) spray and thermal fogging. The last method, though visible (fog effect) to the community and able to cover a large area at a time, requires machines and organic solvents in large quantities. Moreover, it is relatively expensive and the dilution with wind makes it less effective. On the other hand, indoor spray and ULV spray can be done by the community or household members, and are less expensive and more effective.

### **Indoor space spraying**

For indoor spraying, pyrethrum extract after dilution is sprayed with Flit pump or hand operated fogging machine fitted with micro-discharge nozzle.

Commercial formulation of 2% pyrethrum extract is diluted with kerosene in the ratio one part of 2% pyrethrum extract with 19 parts of kerosene (volume/volume). Thus, one litre of 2% pyrethrum extract is diluted by kerosene into 20 litres of 0.1% pyrethrum extract ready-to-spray formulation. One litre of ready-to-spray formulation is sufficient to cover 20 households, each household having 100 cubic meters of indoor space.

### **Outdoor space spraying**

Ultra Low Volume (ULV) spray: Malathion is the insecticide used for this purpose. The insecticide is broken down into small droplets with a volume median diameter (VMD) of 40-80 microns with an objective of producing a cloud of insecticide droplets that remain suspended in air for an appreciable time and driven under the influence of wind. Since no diluent is used, the technique is more cost-effective than thermal fogging but it does not generate a visible fog. The ground equipment mostly used for ULV spray includes portable motorized knapsack blowers and cold aerosol generators.

### **Thermal fogging:**

The insecticide (malathion / pyrethrum) is vaporised at a very high temperature inside the fogging machine. Once the fog comes out of the machine, it tends to spread in different directions by mixing with wind. These insecticides are safe in the recommended dose and do not persist in environment for long duration. Thermal fogging is psychologically more acceptable as it generates a highly visible fog. The most common and preferred types of

equipment include portable thermal fogger and mist blowers. Vehicle mounted machines have limitation as their use is restricted to areas with communicable road only. Although thermal fogging produces denser and perceptible insecticide cloud, it is much more expensive and epidemiologically less effective than ULV spray.

### **Larval control measures**

Larviciding or focal control of *Aedes aegypti* is usually limited to containers maintained for domestic use that cannot be eliminated. Temephos (1%) granules should be used to destroy the larval stage of *Aedes* mosquito in potential breeding sites such as drinking water containers. For containers used for holding non-potable water, emulsifiable concentrate formulations of insecticides (Malathion, Fenthion or pyrethroid preparations) may be used for eliminating the larvae.

### **Elimination of breeding sites**

Specific activities for eliminating breeding sites of *Aedes* mosquito are:

- Removing, disposing, burying or burning of all unused tins, cans, jars, bottles, tyres, coconut shells and husks and other items that can collect and hold water.
- Keeping tyres, metal boxes, discarded appliances, sinks, basins, cement tanks, pots and parts of other items in industrial and commercial premises in sheltered areas protected from rainfall.

- Arranging clean-up campaigns once or twice a year by mobilising the local community under the leadership of local health authority or community leaders in order to collect and remove all unused containers and potential breeding sites in and around houses, offices, schools and other establishments.
- Turning water drums and small earthen jars upside down once a week.
- Periodically scrubbing the inside of water containers to destroy *Aedes* eggs.
- Regularly emptying water in flower vases / water coolers in houses, school and offices at least once a week.
- Covering overhead water storage tanks.
- Shredding or cutting old tyres into flat pieces and disposing them in properly constructed and managed landfills away from populated areas.
- Puncturing holes in tyres used for recreational purposes by children in schools and parks.
- Levelling or filling in the top bamboo fences to prevent accumulation of water.

### **ANNEX 3: Integrated Vector Management (IVM)**

Integrated vector management is a process for managing vector populations in such a way as to reduce or interrupt transmission of disease.

Characteristic features of IVM include:

- Methods based on knowledge of factors influencing local vector biology, disease transmission and morbidity;
- Use of a range of interventions, often in combination and synergistically;
- Collaboration within the health sector and with other public and private sectors that impact on vectors;
- Engagement with local communities and other stakeholders;
- A public health regulatory and legislative framework.

An IVM-based process should be cost-effective, should have indicators for monitoring efficacy with respect to impact on vector populations and disease transmission, and should employ sustainable approaches compatible with local health systems.

It should also allow effective planning and decision-making to take place at the lowest possible administrative levels (subsidiaries). IVM has benefited from experience with integrated pest management (IPM) systems used in agriculture. Although insecticides have proved effective in protecting and increasing crop yields, their adverse environmental and health effects and the development of insecticide resistance have required the introduction of pest management

systems encompassing all methods that have an impact on the pest problem. Such integrated approaches help to preserve the integrity of ecosystem and encourage the propagation of natural enemies of pest species, such as pathogens and predators. Making better use of environmental, biological and other measures can extend the useful life of insecticides so that they are available when and where the need is greatest. Crucially, economic analysis has shown that IPM systems are ultimately more cost-effective than heavy reliance on insecticides, even without considering the economic impacts of environmental contamination and unwanted side effects.

Similar principles apply to the control of disease vector insects for which evidence-based, cost-effective and sustainable approaches are needed. However, it should be recognized that the success of IPM systems is due, in part, to the fact that farmers see direct results in the form of increased crop yields and better management of irrigation water, and are able to enjoy the economic benefits. In contrast, the improvements in health resulting from control of vector-borne disease can be more difficult to measure and the associated economic benefits for the community are less obvious.

An additional and key impetus to the adoption of IVM arises out of the need to ensure the sound management and judicious use of insecticides, as requested by the World Health Assembly and the Stockholm Convention on Persistent Organic Pollutants. This has led to a reappraisal of the strategy for vector control and a commitment to the development of effective measures that reduce risk and are compatible with protection of the environment and

sustainable development. Such a commitment requires an approach that effectively integrates the roles of various sectors, including health, within a strategic management framework.

An IVM approach takes into account the available health infrastructure and resources and integrates all available and effective measures, whether chemical, biological or environmental. IVM also encourages effective coordination of the control activities of all sectors that have an impact on vector borne diseases, including health, water, solid waste and sewage disposal, housing and agriculture. Commensurate benefits for non-health-sector partners make it more likely that IVM approaches will be effective. For example, alternate wet/dry (intermittent) irrigation, combined with other vector control methods, has been effective in controlling the vectors of malaria and Japanese encephalitis in China, India, Indonesia and Sri Lanka. It also allows an economic usage of irrigation water, thereby reducing farmers' costs.

An IVM approach is evidence-based and an essential feature is development of the capacity to generate local data on disease epidemiology and vector ecology. IVM integrates all available resources to achieve a maximum impact on vector-borne disease. Integration at the level required for IVM is not a simple task; national leadership and adequate local capacity are essential. This means that the governments and international bodies that fund development projects should respect the principles inherent in IVM and ensure that recipient countries have the funds for human resource development and training in all aspects of IVM. Existing bodies outside the health sector, such as national

economic planning councils, environmental protection agencies and national councils for science and technology, should be explored as vehicles by which the funding of IVM could be embedded in national policy.

While IVM emphasizes effective systems and action at the local level, the support of nationwide programme is essential for major diseases such as malaria, dengue and filariasis. These programmes will be required to provide technical advice on vector-borne disease epidemiology, surveillance and control technologies, and to provide adequate systems for programme monitoring and quality control. However, successful vector control programmes need more than just expertise in vector control technologies; they also need expertise in planning and programme management. The requisite skills remain scarce, particularly in the resource-poor countries that are most in need of effective vector-borne disease control. A massive effort will be required to build the capacity to address these various facets of IVM.

### **Key elements of an IVM strategy**

Effective IVM requires the establishment of principles, decision making criteria and procedures, together with time frames and targets. These principles need to be incorporated into national health policies and supported by legislation and regulation. To be successful, IVM requires an inventory of essential functions and organizational structures that optimize the use of financial, human and technical resources for vector-borne disease control.

The key elements are:

- **Advocacy, social mobilization and legislation**

Promotion and embedding of IVM principles in development policies of all relevant agencies, organizations and civil society; establishment or strengthening of regulatory and legislative controls for public health; empowerment of communities.

- **Collaboration within the health sector and with other sectors**

Consideration of all options for collaboration within and between public and private sectors; application of the principles of subsidiarity in planning and decision-making; strengthening channels of communication among policymakers, vector-borne disease control programme managers and other IVM partners.

- **Integrated approach**

Ensuring rational use of available resources through application of a multi-disease control approach, integration of non-chemical and chemical vector control methods, and integration with other disease control measures.

- **Evidence-based decision-making**

Adaptation of strategies and interventions to local vector ecology, epidemiology, surveillance and resources, guided by operational research and subject to routine monitoring and evaluation.

- **Capacity-building**

Development of essential physical infrastructure, financial resources and adequate human resources at national and local level to manage IVM programmes based on a situation analysis.

The effective control of vector-borne diseases cannot be achieved by the health sector alone. The adoption of IVM provides WHO and Member States an opportunity to work with international agencies, nongovernmental organizations, donors and the private sector to optimize the use of financial, human and technical resources for vector-borne disease control.

To achieve these goals and create strong and effective advocacy for IVM, a strategic plan for the implementation of IVM should be developed. WHO should also take necessary actions to formally endorse the IVM approach to vector-borne disease control.