

Disease Specific Documents for XII Plan

Dengue/Chikungunya



INDIAN COUNCIL OF MEDICAL RESEARCH

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ICMR INSTITUTES WORKING ON DENGUE/CHIKUNGUNYA

1. Centre for Research in Medical Entomology (CRME), Madurai (lead institute)
2. National Institute of Virology (NIV), Pune
3. Regional Medical Research Centre (RMRC), Port Blair
4. Regional Medical Research Centre for Tribals, Jabalpur
5. Desert Medicine Research Centre (DMRC), Jodhpur
6. Vector Control Research Centre (VCRC), Puducherry
7. National Institute of Malaria Research (NIMR), New Delhi
8. Virus Research Unit, Kolkata
9. Division of Epidemiology and communicable Diseases

1. Current situation of the Disease/Disease burden with contribution of ICMR

According to a WHO release dated the 16th Jan., 2013, dengue ranked as the fastest spreading vector-borne viral disease in 2012, with an epidemic potential in the world, registering a 30 fold increase in disease incidence over the past 50 years. India too has been suffering with dengue during past several years as both the morbidity and mortality continued to rise in many states, on one hand, whereas many other hitherto virtually a *terra incognita* for the infection were invaded afresh with new foci established, on the other. The culmination of severity of dengue can be gauged simply by the fact that during 2012 a total of 47029 cases with 242 deaths were reported which surpassed last ten years' incidence. Chikungunya made resurgence in India in 2005 after a gap of nearly 32 years, reporting more than 1.4 million cases in 16 States across the country. The virus variant A226V was identified to be pathogenic and highly virulent. Burden due to CHIK outbreak during 2006-07 was estimated to be 17502 DALYs in India. Comparatively, dengue epidemiology is quite complicated since in several countries it is also a zoonosis in sylvatic cycle. Although *Aedes aegypti* is the main dengue vector, in certain ecological settings *Aedes albopictus* may also transmit the disease equally. Both these mosquito species are also transmitting chikungunya. Since dengue/chikungunya has neither a disease specific antidote nor a vaccine in sight, the disease management depends mainly on the vector control aided by community involvement. This is high time a national policy on dengue/chikungunya could be formulated, since dengue is a notifiable disease and is the most fatal disease amongst all vector-borne diseases.

Detailed ecological, biological and social components of the main dengue vector, *Aedes aegypti*, has been studied in varied ecosystems in metropolitan cities and rural environments. The invasion of *Aedes aegypti* in xeric ecosystem in north-western India by replacing malaria vector, *Anopheles stephensi*, in the age-old abandoned underground water storing 'tanka', where the malaria vector ceased to breed, has been very useful in comprehending its distribution vis-à-vis dengue in the Thar Desert. In Kerala's high altitudinal sylvatic environment it is *Aedes albopictus* which abounds predominantly and also transmits both dengue and chikungunya, even without the presence of primary vector. Indigenous products/methodologies have been devised to control *Aedes albopictus* in Kerala. All the four serotypes prevail in several parts of the country, increasing likelihood of more incidence of DHF.

2. Major Achievements with leads emerged during XI Plan:

Discovery of emergence of African genotype A226V of CHIKV having association with increased epidemic potential and disease severity including co-morbidities with systemic complications and associated mortality.

1. Determination of components of Cytoskeleton and inter-cellular trafficking of dengue viral proteins identified for development of intervention strategies.
2. Development of real time RT-PCR for diagnosis of dengue viral RNA
3. Development of MAC ELISA for dengue/chikungunya diagnostic kits and supplied for the national programme.
4. Development of an "*Aedes albopictus* breeding preventer in rubber plantation" to reduce vector population.
5. Discovery of *Aedes albopictus* as a major primary vector transmitting dengue in the sylvatic mountainous ecosystem of Kerala even without the co-existence of *Aedes aegypti*.
6. Detection of DENV antigen through ELISA in the dry/desiccated mosquitoes.
7. Development of a larvicidal product against dengue vectors from the wild grown shrub, *Calotropis procera*. This will be validated once a potential partner for the same is identified.
8. Detection, isolation and serotyping of dengue virus from *Aedes* vectors by using Toxo-IFA system in various States of the country.
9. Demonstration of presence of transovarially transmitted virus as possible maintenance mechanism of dengue virus in nature and that 200 kDa protein in mosquito ovaries could block occurrence of transovarial transmission to prevent dengue.
10. Switch in Dengue-2 genotype associated with increase in severity of outbreaks.

11. Revealed that chronic arthropathy in chikungunya is inflammatory erosive in nature similar to rheumatoid arthritis but different from rheumatoid arthritis as rheumatoid factor and anti-CCP found to be negative among the patients with chronic sequelae.
12. Virus Research Unit, Kolkata is recognized by the NVBDCP, Delhi as the “Apex Referral Centre” for dengue/chikungunya in Eastern India.

3. Number of publications:

Dengue : 71

Chikungunya : 42.

4. List of patents

- i. 01. (Indian Patent Application No. 389/DEL/2008) - A herbal composition as new bio-larvicide against Dengue vectors (Calotropin, a new bio-larvicide against vector of Dengue).

5. Technologies developed / technologies transferred to the industry

- Diagnostic kits for Japanese Encephalitis, Dengue and West Nile Viruses
- Diagnostic of Dengue in Vector Mosquitoes
- Multi angular viewer for mosquito taxonomical studies
- A new plant based Insecticide for mosquito (Appln No. 3234/DEL/2005)
- A botanical formulation for mosquito control- Malaria, Filariasis and Dengue (Appln. No. 2405/DEL/2007)
- A rapid cost-effective RT-PCR method for the mass scale detection of common arboviral infection to find out actual disease burden in that area.

6. Manpower trained:

Sr. No	Training/Officials trained	No. trained
1	Medical/paramedical staff	43
	Biosafety training	44
	Viral Diagnosis training	16
2	Training to Public Health personnel on taxonomy, surveillance and control	220
	WHO-TDR Asian Biosafety/ biosecurity Training re: GMV of malaria and Dengue to participants from 13 Asian countries	45
	National Workshop on dengue	25
	Training to NCDC/NVBDCP officials on Antigen capture ELISA for JE and Dengue virus detection in mosquitoes.	30

7. New human resources generated

	No. Generated
M.Sc.	33
Community volunteers	225
Ph.D.	5
MSc/B.Tech/M.Tech dissertation-cum- projects	60
Research fellows	8

Table 1: Status of Completed Research Studies undertaken during XI Plan

Sr. No.	Thematic area and Title of the Study	Objectives	Completed with outcome of the study	If off-shoot, Refer to XII th plan study	Institution
Basic Research					
1	Molecular evolution of dengue viruses based on envelope gene	To determine the molecular evolution of dengue viruses	India played a critical role in the dissemination of dengue viruses. The tMRCA of all serotypes indicated that DENV emerged in the early 1800s. Their entry into India was dated to the early 1900s except for DENV-4 which perhaps originated in India >200 years before. It was clearly demonstrated that the change in disease severity observed in India since the 1990s was accompanied with genotype/lineage shifts in all four serotypes.	To answer which genes contributed to change in disease pattern, full genome sequence analysis is required to be done through XII th plan	NIV, Pune
2	Characterization of the humoral /cell mediated immune response in dengue	To characterize the humoral /cell mediated immune response in dengue	Characterization of the antibody response was completed. IgM was found to be protective whilst IgG and IgE were found to be associated with progression to severe disease. Pro-inflammatory cytokines and neutralizing antibodies were also found to be higher in severe disease. Studies on innate immunity suggested that higher concentrations of vitamin D might be associated with secondary DHF while deficiency of MBL may be associated with primary DHF.	Further studies on T cell mediated immune response and genetic polymorphisms of the host are planned in XII th plan	NIV, Pune
3	Role of cytoskeleton and endo membrane system in DENV morphogenesis	To study the role of cytoskeleton and endo membrane system in DENV morphogenesis	It was shown by con-focal microscopy and inhibitory studies that all three components of the cytoskeleton were intimately involved in DENV replication. DENV proteins associated with dynein and kinesin, the two motor proteins involved in microtubule dependent trafficking. The time kinetics of DENV proteins in endoplasmic reticulum and golgi apparatus were determined. Mechanisms of egress were studied. The Mitochondria were intimately associated with DENV replication from entry to egress. The study therefore revealed some new interactions of viral components with cellular components essential to DENV replication.	The core protein interaction will be studied further	NIV, Pune

4	Dengue virus antigen detected in desiccated specimens of <i>Aedes aegypti</i> .	To detect DENV in desiccated mosquitoes	Laboratory based dengue virus antigen detection in vector mosquitoes has been developed and published.	To be extended to the field in endemic areas with improved modern techniques (e.g. Xeno monitoring) under process during XII th plan. Efforts will also be made for its validation by other ICMR Institutes before transferring of Technology to State Govt/ Industry.	CRME, Madurai
5	Detection, isolation and serotyping of dengue virus from <i>Aedes</i> vectors by using Toxo-IFA system in various States of the country	To detect & isolate DENV from vectors	<i>Aedes albopictus</i> was identified as the only vector of dengue in Kerala, and DEN-2 isolated for the first time in this State. This study will be continued to see the susceptibility of different serotypes in nature.	Extended to endemic areas in Southern states of India	CRME, Madurai
6	Confirmed the Prevalence of chikungunya virus affecting humans in Lakshadweep islands which belonged to Central/East African origin.	To detect the genotype of CHIKV in Lakshadweep Islands	Genotyped detected as central/east African origin from the human sera	The role of the predominant species <i>Aedes albopictus</i> in transmitting chikungunya in Lakshadweep Islands will be demonstrated.	CRME, Madurai
7	Taxonomically lesser known vector species as well as their aquatic stages of development like <i>Heizmannia (Heizmannia) chandi</i> Edwards (Diptera: Culicidae) were described	To identify vector species and their aquatic stages taxonomically	<i>Heizmannia (Heizmannia) chandi</i> Edwards (Diptera: Culicidae), as one of the several lesser known vector species in Western Ghats were identified taxonomically and described which is listed in CRME museum and fully vouched for their ecological data. The same has been published in <i>Zootaxa</i> Journal. These studies have so far been made on morphological characters and in many of the closely allied species barcoding is the need of the hour to provide obligatory marker for identifications.	In addition to repository of type and paratype specimens, a supplementary repository of barcodes will be highly useful for specific identification even at sub species level. Already CRME has brought out recently one pictorial key of Indian vector species on the basis of Wing venation and certain morphological characteristics. Other pictorial keys including genitalia and other features will be produced during XII plan in the line of revising the Fauna of British India Volume on Culicidae.	CRME, Madurai

8	Role of cytokines in Chikungunya infection in order to understand generate information with a view to alter current treatment strategies	To assess the role of cytokines in the causation of chronic arthritis in Chikungunya and generate information with a view to alter current treatment strategies if any.	Study showed that macrophages play an important role in pathogenesis. Cytokines IL6, IL1RA, MIP1 and MCP1 play a role in the pathogenesis of chronic arthritis following Chikungunya virus infection. The findings have implication in the management of patients.	Study objectives have been accomplished. Therefore, no further studies are planned during the XII th plan	RMRC, Port Blair
9	DNA vaccine development for Chikungunya	To develop and evaluate a vaccine against Chikungunya using DNA vaccine technology	This initiative is a collaborative project between the RMRC Port Blair and the Pennsylvania University, USA. DNA constructs encoding envelope proteins of CHIKV found to be immunogenic and protective. These constructs would be used for vaccine development.	Study objectives have been accomplished. The left over research to carry out clinical trials involves many ethical issues and efforts are being made with the experts for the same. Therefore, further studies are yet not being planned during the XII th plan	RMRC, Port Blair
10	Role of HLA-alleles in dengue clinical spectrum in Pondicherry and identification of epitopes	1.To assess the role of HLA- class I and class II, and non-classical HLA gene allele polymorphism in clinical outcome of dengue viral infection 2. To demonstrate immunogenic potential of dengue peptides specific against the HLA allele with high frequency among Pondicherry people, and their validation with patient sera.	Completed- identified a genetic risk factor for DHF.	No.	VCRC, Puducherry

11	Can dengue viral activity in the community and vector breeding potential in respective areas predict an outbreak of dengue?	To assess the level of dengue antibody prevalence in the community and to examine if there is any relationship between antibody prevalence and dengue vector breeding indices.	Completed – IgM antibody prevalence was 3.6% and there was a significant relationship between antibody prevalence and vector indices.	No.	VCRC, Puducherry
12	Role of 200 kDa protein in mosquito ovaries to block transovarial transmission of dengue viruses	<ol style="list-style-type: none"> 1. Determination of mid gut protein responsible for dengue virus transmission (horizontal and vertical) among mosquito vector species in different ecotypes of Rajasthan. 2. Extrapolation of observations in GIS across different ecotypes of Rajasthan to develop molecular markers of transmission risk of dengue in Rajasthan. 	Completed. A 200 kDa protein was reported associated with the blocking of dengue virus through transovarial route of mosquitoes.	Further studies on inheritance pattern of 200 kDa are being proposed in XII plan.	DMRC, Jodhpur

13.	New Herbal Composition development as larvicide against dengue vectors	1. To study the efficacy of plant as larvicide and repellent against vectors of dengue. 2. To isolate active larvicidal ingredient of latex of <i>Calotropis procera</i> .	A new herbal composition as larvicide against dengue vectors was identified and filed patent application (2008).	Project developed to study field efficacy of herbal product in Aedes positive containers of Jodhpur. Suitable partners for validation of this product will be identified in XII Plan.	DMRC, Jodhpur
Clinical Research					
1	Outbreak investigations in various parts of the country	To investigate the viral infections in various endemic areas	Detected dual and multiple viral infections (dengue and chikungunya as well as chikungunya and JE viruses) from various parts of the country. Also dual infection of malaria parasite (<i>P. vivax</i>) and dengue detected.	Completed	CRME, Madurai
2	Investigation of Chikungunya outbreak –observation of unusual complications in Chikungunya infection	To understand the cause of the outbreaks of Chikungunya in Andaman and to document unusual clinical manifestations if any.	Investigations showed high attack rates in excess of 60% in the community. Unusual clinical presentations such as Acute flaccid paralysis resembling Guillain Barre Syndrome was observed for the first time. Molecular characterization of the isolates recovered from the patient's show that strain belonged to the East Central South African (ECSA) lineage.	Study objectives have been accomplished. Therefore, no further studies are planned during the XII th plan	RMRC, Port Blair
3	Studies on chronic arthropathy, a complication in chikungunya infection -to assess whether patient management strategies could be altered	To understand the nature of chronic arthritis in Chikungunya and to study the joint lesions through imaging and using roentgenogram.	Studies revealed that chronic arthropathy in Chikungunya is inflammatory and erosive in nature similar to rheumatoid arthritis. Follow up of the CHIKV infected patients revealed that it is an important complication of about 50% of the people continued to have the chronic arthropathy up to one year and 14% up to 4 years. Observations from the study have implications in the treatment strategies.	Studies conducted in the XI th plan show that chronic arthropathy is an important complication and mimics rheumatoid arthritis but it is not a RA on its pathogenesis. Therefore, in depth studies to understand mechanism of pathogenesis at molecular level is needed. Hence the study is being continued in the XII th plan.	RMRC, Port Blair

4	Investigations and documenting Dengue Fever, Dengue Hemorrhagic Fever for the first time in A & N islands	To identify the etiology of dengue like illness that emerged in Andaman and to characterize the causative agent	Detected the first ever upsurge of dengue, dengue hemorrhagic fever and dengue shock syndrome. Identified circulation of DEN1 and DEN2 serotypes.	Dengue Fever was first reported in 2008. Dengue Hemorrhagic Fever and dengue shock syndrome was observed for the first time in 2009. The upsurges were also reported in 2009 and 2010. Thereafter, inter epidemic and sporadic cases were also reported. Information could be generated on other circulating serotypes of dengue virus. Therefore, continuous surveillance is needed for prevention of outbreaks and inter epidemic sporadic cases	RMRC, Port Blair
Epidemiological/Operational Research					
1	Provide dengue diagnosis and identify serotypes during outbreaks	To diagnose and identify serotypes of dengue during outbreaks.	During 2007-2012 ~900 samples/ year were tested and observed 40% positivity for dengue. Number of cases peaked in September-October; major age group affected was 21-30 yrs. DHF cases ranged from 20% (2005) to 6.8% (2011) of total cases. In 2012, 634/1877 samples were positive for dengue. In most urban outbreaks multiple serotypes seem to be circulating. In 2012 in Tirunelveli , all four serotypes were found. In Bangalore , DENV-1, 2 & 3 were detected. In Yelshi , Maval, Maharashtra DENV-3 was identified.	This is a continuing exercise Data generated shared with NVBDCP & State Health Department.	NIV, Pune
2	Determination of sero-prevalence of dengue	To study the sero-prevalence of dengue	A pilot study was undertaken to determine the sero-prevalence of dengue . As the population in the city is not demographically well defined, the study was carried out in the rural population of Vadu area. The pilot study was completed and urbanization and population density were found to be confounding factors.	A larger study including sero-prevalence and disease burden is required and will be carried in XII th plan	NIV, Pune

3	Establishment of Grade II viral diagnostic laboratory	<p>-To give serological and molecular diagnosis of public health importance.</p> <p>-To investigate outbreaks suspected of virus origin</p>	<p>Quick and reliable diagnosis was provided for the Dengue (> 500), Influenza (> 2500) Hepatitis (> 300) and other viruses.</p> <p>Two outbreaks of dengue were investigated in central India</p>	Up-gradation of Grade II viral diagnostic laboratory to grade I	RMRC-T, Jabalpur
4	<i>Aedes</i> breeding survey in Delhi	To identify the areas of <i>Aedes</i> breeding	<p>Comparison of last few years data between domestic breeding habitats, e.g. Overhead Tank, Ground Cement Tank, etc. (key containers) and peri-domestic sites e.g. Dump Tyre, Vases, Mud Pot, Pits etc. (Amplification containers) shows that during monsoon and post-monsoon season (May to November) container index of peri-domestic is higher than domestic containers whereas during pre-monsoon season (December to April) container index of domestic containers is higher than peri-domestic containers. It revealed that there is shift of <i>Aedes</i> breeding from indoor during pre-monsoon season to outdoor during monsoon and post-monsoon season.</p> <p>The study will suggest mitigation measures to control dengue to MCD and NDMC. Entomological surveillance activities in NDMC areas will be undertaken since NDMC does not have any entomological surveillance capacity.</p>	This is a continuing study and the generated data will be shared with MCD/NDMC for strategic vector control measures to avoid any imposing outbreaks.	NIMR, New Delhi
5	Evaluation of the potential of cyclopoid copepod as an effective bio control agent for the control of disease vectors “	To assess the prevalence of mosquito larvae and copepods in different mosquito breeding habitats and assess the predatory efficiency of different cyclopoid species in controlling mosquito larvae in relation to larval instars and density in laboratory and fields.	The copepod-imposed larval removal was higher in early adult stage (age 10 days) than in late adult stage (age 35 days). At higher larval density ($\geq 30L/250$ ml water), the presence of alternate prey, either <i>Ceriodaphnia cornuta</i> or <i>Brachionus calyciflorus</i> facilitated higher removal of <i>Ae. aegypti</i> larvae; whereas at lower density, alternate prey reduced the mosquito larval consumption by the copepod.	No	Extramural funding

6	Surveillance and control of <i>Ae. aegypti</i> , vector of dengue and chikungunya, using attracticide (oviposition pheromone in combination with insect growth regulator) at Delhi, Bangalore and Alappuzha district of Kerala (Multicentric Trial)	Surveillance and long-term control measure of dengue and chikungunya mosquitoes, using C-21 attractant and IGR compound.	The results revealed that C-21 attracticide is working well for surveillance of <i>Ae. aegypti</i> , vector of dengue and chikungunya (except at Kerala where <i>Ae. albopictus</i> is predominant) as the positivity of ovitraps & number of eggs were much higher in experimental as compared to control ovitraps and can be used as a management tool to control <i>Ae. aegypti</i> . Completed	Completed in XI plan.	NIMR, New Delhi
7	A study on prevalence of Dengue / Chikungunya virus activity in NE region (2007-2009)	To detect the activity and find out the prevalence of Dengue and chikungunya virus in Assam	Serological testing by MAC ELISA of 359 acute phase sera from suspected dengue fever cases from various areas of Assam 53 (13.6%) were found positive for anti dengue antibodies. Randomly selected 151 dengue negative sera samples were subjected to MAC ELISA against chikungunya antigen resulting in 10 positive sample (6.6%) for chikungunya. Males were 1.9 times more likely to be infected with dengue virus while females were more commonly infected in case of chikungunya. Vector incrimination was unsuccessful.	As an offshoot of this exploratory study further studies on the epidemiology of mosquito borne arboviral diseases will be taken up in XII th Plan period	RMRC, Dibrugarh
8	An epidemiological survey of vector borne diseases and control strategies for tribal health development through remote sensing and GIS for Sitheri hills Dharmapuri district of Tamil Nadu	To delineate vector abundant areas and correlate with local environment conditions and to study the population density and distribution	Entomological survey and spatial analysis revealed a total of 2533 female mosquito specimens contributing to 19 species belonging to 7 genera. The vector surveillance map also revealed the highest and lowest percentage of dengue and chikungunya surveillance in Sitheri hills.	No	Extramural funding at ICMR Hqrs

Translational Research/Techniques Developed					
1	Development of Real time PCR for early diagnosis of dengue/ CHIK	To develop RT-PCR for early diagnosis of dengue/CHIK	Dengue group specific real time RT-PCR has been developed. A multiplex real time RT-PCR for simultaneous detection of dengue and Chikungunya viruses has been developed.	The real time RT-PCR assays for DENV and other viruses are ready for multi-centric validation	NIV, Pune
2	Development of NS1 detection ELISA for early dengue diagnosis	To develop NS1-ELISA for early dengue diagnosis	Recombinant NS1 has been produced and purified. The rNS1 is recognised by human anti-NS1 antibodies. Polyclonal and monoclonal antibodies produced. NS1 detection ELISA has been developed but with low sensitivity.	The test will be improved with multiple monoclonal antibodies	NIV, Pune
3	Demonstration of a community based control strategy for <i>Aedes</i> spp using Temephos and environmental management in a peri-urban area	To assess the efficacy of vector control measures implemented through community participation in Chikungunya and Dengue vector control	Successfully demonstrated control of <i>Aedes</i> spp using temephos and environmental management in a peri-urban area through involvement of community volunteers in association with an NGO in the Andaman & Nicobar islands	Successfully demonstrated the community involvement for the control of <i>Aedes</i> spp. No further study is planned to be undertaken in the XII th plan. Completed.	RMRC, Port Blair
4	Developed some new products/processes and/or mechanisms like the Cymbopogon sp. related mosquito repellent, multi-angular viewer for mosquito taxonomic studies, and ELISA based antigen detection system for both the JE and Dengue mosquitoes	To develop mosquito repellent; To facilitate taxonomic studies of vector mosquitoes in field; Antigen detection to JEV/DENV in desiccated mosquito	Demonstrated repellency for more than four hours of the repellent. Transferred technology of multi angular viewer to DPH,TN on 18.10.2012. Transferred technology of JEV/DENV antigen detection in desiccated mosquitoes to DPH,TN on 25.07.10	Completed	CRME, Madurai
5	Developed an <i>Ae. albopictus</i> breeding preventer for latex collecting cups in Kerala	To prevent breeding of <i>Ae. albopictus</i> in rubber plantation	An " <i>Ae. albopictus</i> breeding preventer in rubber plantation" has been indigenously developed (<i>AlboTyagi</i>) pending improvement in field deployment following a pilot study exhibiting 100% prevention of breeding vector in the <i>AlboTyagi</i> during 11 th plan. However to make it user-friendly it needs to be improved in its design which is to be taken up in the XII plan.	Improvement in the design and functionality of the " <i>Ae. albopictus</i> breeding preventer" (<i>AlboTyagi</i>) will be made in XII plan.	CRME, Madurai

Table 2. Important and essential activities which need to be continued In XIIth Plan

Sr. No.	Thematic area and title of the study	Justification	Time frame	Deliverable outcome with public impact	Institution
Basic Research					
1	DNA barcoding for identifying vector mosquitoes	Currently, species are identified based on morphological characteristics. For accurate and reliable identification, particularly with reference to closely allied species, barcoding is considered integral since it is species-specific.	2013	Identification of molecular markers is helpful in taxonomic keys of vector mosquitoes.	CRME, Madurai
2	Development of pictorial key for Dengue/ Chikungunya vectors and revision of FBI volumes(Culicidae)	The inventory of Indian vector mosquitoes and taxonomic keys for certain vector species have already been done to facilitate vector identification, and a pictorial key with respect to dengue/ chikungunya vector will need to be carried out to facilitate field workers in their vector surveillance work	2016	Updated refined pictorial key will be prepared for <i>Aedes</i> mosquitoes, vectors of dengue/chikungunya, as a sequential activity to revise the FBI volumes. Pictorial Identification key of Indian Anophelines in English, Hindi and other regional languages (Telugu, Oriya, Bengla) has already been prepared by ICMR Hqrs in collaboration with NIMR, New Delhi	CRME, Madurai
3	Immune Response (non-MHC) gene polymorphisms in Dengue Disease Pathogenesis	The role defined for humoral and CMI in disease progression makes host genetics important in defining dengue pathogenesis	Till 2013	Whether the genetic make-up of the Indian population has any relevance to dengue disease severity?	NIV, Pune
4	Evaluation of diagnostic & reference services for Dengue.	Facility developed for molecular diagnosis of Dengue have proved very useful in providing advance laboratory support to state health department. To continue support to state health department and advance the ongoing research continuation of the facility is strongly requested.	2012-17	Molecular diagnosis of Dengue will be provided to state health department whenever needed. Genomic epidemiology of dengue viruses will be undertaken. The studies will deliver advance genomic constitution of viral pathogens to solve the clinical mysteries and offer appropriate solutions for outbreaks of Dengue.	DMRC, Jodhpur

5.	Bio-Manipulation of Aedes Mosquitoes to reduce adult Mosquitoes life span and inhibit viral competence through Wolbachia transfection	To study prevalence, diversity, density of Wolbachia in various Aedes population, to introduce Wolbachia in Aedes aegypti and study its phenotypic expression, to determine its localization in various tissues, to evaluate its interaction with the pathogenic virus and determine CI properties and fecundity of the bio manipulated strain.	2012 to 2015	The experiment will help in understanding the effect of Wolbachia in their mosquito host and the competitive inhibition it induces on the pathogenic viruses.	Supported in extramural research (Bangalore University)
Clinical Research					
1	Pathogenesis in chikungunya infection-chronic arthropathy and acute flaccid paralysis	Studies during the XI th plan on the pathogenesis of chikungunya showed that chronic arthropathy as a complication of chikungunya infection is a chronic destructive arthritis resembling Rheumatoid arthritis, but it is not a RA. Follow up of the CHIKV infected patients revealed that it is an important complication about 50% of the people continued to have the chronic arthropathy up to one year, and 14% up to 4 years. Unusual clinical presentations such as Acute flaccid paralysis resembling Guillean Barre Syndrome was observed for the first time. Our experimental studies showed that CHIKV- induced AFP is not a Guillean Barre Syndrome where demyelination is known to occur. But in CHIK induced AFP mainly due to peri-vascular oedema and Schwann cell necrosis. Therefore, in depth studies are needed to understand the pathogenesis, which would help in devising specific treatment strategies for complications induced by CHIKV infection.	2012 to 2014	Data on pathogenesis of chikungunya arthritis and acute flaccid paralysis which will be useful for identifying targets of new treatment strategies for morbidity reduction	RMRC, Port Blair

2	Assessment of long term morbidity due to chikungunya and related quality of life	Justification: Cases with long term morbidity need to be investigated to understand dynamics of pathogenesis and case management. The study involves screening of population for IgG reactivity and clinical manifestations over a period of time, 2 - 5 years post-chikungunya infection. Recruitment of population for 4-5 yrs category falls during 2012-13. Therefore, the study continues as originally planned.	2011-2013	<u>Deliverables:</u> (a) Methodology/tool to assess quality of life of chikungunya patients (b) Estimates of long term burden due to chikungunya in terms of quality of life. <u>Outcome with public impact:</u> Inputs for the development of guidelines for morbidity management	VCRC, Puducherry
Epidemiological/Operational Research					
1	Establishment of Grade II viral diagnostic laboratory	Only virology diagnostic laboratory in the state of Madhya Pradesh at present giving diagnosis for 11 different viruses. It is essential to monitor viruses in central part of country to understand epidemiology of these viruses and initiate evidence based appropriate intervention measures	This project is initiated in Dec. 2011 and is five years project; more tests will be added to its array of diagnosis in coming years (3-4 diagnostic tests / year).	Timely and accurate diagnosis of viruses will help in patient management, and will aid the programme to undertake control measures in time, more over this will help in understanding epidemiological patterns of the target diseases that will help in long term strategic planning.	RMRC-T, Jabalpur
2	Aedes breeding survey in Delhi for control of dengue and chikungunya	Since NDMC does not have any entomological surveillance capacity and MCD also needs entomological and technical support; study on <i>Aedes</i> breeding survey in Delhi (Intramural) is likely to continue in 12 th Plan also	Ongoing till 2017	Identified Key containers along with mitigation measures will be suggested to MCD/ NDMC/ Delhi Administration to control disease which will be helpful to community of Delhi.	NIMR, New Delhi

3	Surveillance of viral diseases: dengue, DHF and DSS and chikungunya	Dengue Fever was first reported in 2008. Dengue Hemorrhagic Fever and dengue shock syndrome was observed for the first time in 2009. The upsurges were also reported in 2009 and 2010. Thereafter, inter epidemic and sporadic cases were also reported. Information on other circulating serotypes of dengue virus needs monitoring. The RMRC has been identified as Sentinel Surveillance Hospital (SSH) by the NVBDCP. Therefore, continuous surveillance is needed for prevention of outbreaks and inter epidemic sporadic cases.	2012-2017	A laboratory based surveillance system against vector-borne viral diseases. Early detection of outbreaks and emergence of new diseases would help in the control of viral infections.	RMRC, Port Blair
4	Development of Integrated Vector Management for the control of chikungunya in rubber plantations.	<u>Justification:</u> Long term sustainable strategy is required to control vectors of dengue/ chikungunya, particularly <i>Ae. albopictus</i> in rubber plantations . Situation analysis was made in the chikungunya infected rubber plantation areas of Kottayam, Kerala (Detected - Chikungunya virus in wild population of <i>Aedes albopictus</i> and a mutation (A226V) of the CHIKV enabling <i>Aedes albopictus</i> to be an efficient vector; 68.0% of the population ositive for CHIKV antibodies). Community based intervention was developed with emphasis on source reduction and implemented jointly with the Rubber Research Institute of India (RRII), Rubber Society and State Health Department for the control of vector. Now, the VCRC is evaluating the impact of control activities by the Rubber Society and Rubber Research Institute and formulating measures for pine apple plantations.	2008-2013	<u>Deliverables:</u> A model for control of vectors in rubber plantations; Community level self-sustained preventive measures for dengue/ chikungunya <u>Outcome:</u> Drastic reduction in the vector breeding was observed. No new cases of chikungunya reported. Source reduction activities as a part of the routine programme of Rubber Society and RRII.	VCRC, Puducherry

5	Studies on <i>Aedes</i> mosquitoes to determine vectors of Dengue and Chikungunya virus in Kottayam and Alappuzha district of Kerala	Identify and stratification of breeding habitats of <i>Ae. albopictus</i> and <i>Ae. aegypti</i> will be undertaken to identify the most prevalent and productive larval habitats and their distribution in wet & dry seasons. Detection /isolation of viruses by cell culture & RT PCR	2012-13	Detailed investigations with respect to larval densities and their preference towards breeding containers in different settings has been undertaken in two districts Alappuzha and Kottayam, Kerala. Virus isolation by RT PCR found dengue in 5 pools and all pools were negative for Chikungunya.	supported in extramural research NIV, Kerala Field Unit
6	Bio-ecology of <i>Aedes aegypti</i> and <i>Aedes albopictus</i> vector of Dengue and Chikungunya in Andaman & Nicobar Islands with special reference to its invasion into human habitation	To map the distribution of <i>Ae.aegypti</i> and <i>Ae. Albopictis</i> , to understand breeding sites/larval ecology and seasonal fluctuation/population dynamics in larval occurrences and assess status of vector of Dengue and Chikungunya	2012-13	The proposed study is being carried out in South Andaman district in three tehsils viz Port Blair, Ferrargunj and Little Andaman Data Capture formats have been designed for recording field surveys and laboratory emergence data.	supported in extramural research RMRC, Port Blair
7	Mapping of <i>Aedes aegypti</i> and <i>Aedes albopictus</i> mosquito distribution in Pune and identifying breeding sites using entomological (larval & pupal) indices	Mapping of <i>Aedes aegypti</i> distribution in Pune, detection of subspecies in <i>Aedes group</i> in Pune and detection/isolation of dengue/ Chikungunya virus. The survey would be carried out in areas of recent disease distribution and where prior data is available with respect to vector density in Pune	2012-2013	The larval collection would identify key containers contributing <i>Aedes</i> population. The subspecies of <i>Aedes</i> would be identified. Quantitative analysis on the replication and tropism of dengue/ chikungunya will be obtained	Supported in extramural research (NIV, Pune)
8	Mapping and entomological studies of <i>Aedes aegypti</i> in Chennai and pathogenesis of Chikungunya and Dengue viral infections	Periodic surveillance of vectors transmitting Dengue and Chikungunya, draw vector distribution maps, sero molecular diagnosis, culture and isolation of viruses from clinical samples, detection of extracellular matrix components in plasma and urine of patients standardization of fibroblast and macrophage infection by the viruses, analysis of cytokine levels in infected macrophages and serum samples in acute and convalescent patients	2012-2014	Vector density measurement by larval indices, Analysis and correlation of viral infection with areas of vector distribution, standardization of macrophage co infection by Chikungunya and Dengue virus, determination of level of susceptibility of fibroblasts to the viruses and comparison of cytokine levels from infected patients with in vitro studies.	Supported in extramural research (KIPM & R, Chennai)

9	Seasonal abundance of <i>Aedes (Stegomyia) albopictus</i> and <i>Aedes (Stegomyia) aegypti</i> in Guwahati metropolis and suburban settlements, Assam Northeast India	To ascertain seasonal abundance of <i>Ae. Aegypti</i> and <i>Ae. Albopictus</i> in Guwahati metropolis and its suburban settlements, to characterize species specific breeding habitats, to characterize member species of <i>Aedes albopictus</i> sub group.	2012-2013	An understanding of the bionomics of the two species will be possible. The relative abundance of these vectors will be possible	Supported in extramural research (NIV, Pune)
10	Dengue virus typing in <i>Aedes</i> mosquito in different areas of Rajasthan	Isolation of circulating Dengue virus types among <i>Aedes aegypti</i> and <i>Aedes albopictus</i> , characterization and typing of viruses from human patients of DHF, extrapolation of results of heterogeneity of circulating virus types	2012-2014	It will be possible to map the circulating DEN types in different districts of Rajasthan. It will be possible to predict risk areas for prospective emergence of DHF.	Supported in extramural research (DMRC Jodhpur)
Translational Research/Techniques Developed					
1	Development of multiplex Real time RT-PCR for early diagnosis of dengue and chikungunya	The tests have been developed. Multi-centric validation is awaited	Till 2013	The assay will be a great help for early diagnosis of dengue/CHIK and help in NIV patient/outbreak management	(NIV, Pune)
2	An " <i>Ae. albopictus</i> breeding preventer in rubber plantation" was developed during the course of studies on dengue vector in Kerala.	In Kerala, <i>Ae. albopictus</i> is the primary vector for Dengue and most recently has been incriminated for Chikungunya as well. The maximum breeding of this vector in Kerala occurs in rubber plantation. An " <i>Ae. albopictus</i> breeding preventer" has been developed which needs further improvement and evaluation.	2013-2014	An effective vector control tool having potential for patent.	CRME, Madurai
3	Translational Research on developing a unique model of dengue prevention/control.	The study envisages developing a unique model of dengue prevention/control through ongoing translational research. The project has started in 2011 and with its present duration of two years will continue across 11 th to 12 th plan period.	2011-14	A unique model of dengue prevention/control will be offered through conclusions of ongoing research.	DMRC, Jodhpur
4	Control of Dengue and Chikungunya by controlling the <i>Aedes</i> breeding in key containers in pre-monsoon season in one of the endemic zone of Delhi	To map key containers of <i>Aedes aegypti</i> , vector of Dengue and Chikungunya in selected endemic West zone of Delhi, to control the breeding in key containers and evaluate the impact of controlling the vector population	2012 to 2014	The study would identify key and amplification containers of breeding of <i>Aedes aegypti</i> . The control of breeding at the time of mapping in the premonsoon would be helpful in controlling breeding in post monsoon season. This technique could be replicated in other zones.	Supported in extramural research (NIMR Delhi)

3. New Proposals to be undertaken during 12 th Plan						
Sr. No.	Thematic area and Title of the study	Justification		Time frame	Deliverables	Institution
		Off-Shoot of an earlier completed programme	De Novo idea which is either nationally relevant or it is likely to lead to a new scientific breakthrough.			
Basic Research						
1.	Development of a multiplex real time PCR method for the detection of flaviviruses (Japanese encephalitis, West Nile and Dengue) and Alpha virus(Chikungunya) in the vector mosquitoes.	Individual PCR based detection techniques were available. To quicken the process of detection of various viruses, multiplex real time PCR method would be essentially required.	-	Till 2014	Multiple infections will be detected simultaneously to facilitate decision on treatment	CRME, Madurai
2.	Study of inheritance pattern of 200 kDa protein and transovarial transmission of dengue virus across mosquito generations	Offshoot of earlier study. We need to further comprehend the issue of availability of virus transmission or blocking proteins in mosquitoes to predict the vector competence of fauna of an area.	Not Applicable	2014-17	Proteomic Constitution of mosquito body systems involved in virus transmission will be comprehended and their inheritance pattern across vector generations will be predicted to report transmission susceptibility of fauna of an area.	DMRC, Jodhpur
3.	Study of interaction of structure and orientation of membrane proteins of mosquito cells and human leucocytes, versus dengue virus	Not Applicable	A new approach in which entire process of pathogen internalization into host cell has been hypothesized as the structural interaction of the participants depending upon their proteomic constitutions.	2014-17	A new concept of structural basis of host cell protein and pathogen will be revealed as a research of global importance.	DMRC, Jodhpur

4	Molecular and genomic studies on DEN types, their dynamics and possible risk for dengue hemorrhagic fever	Not Applicable	A study in which the risk of DHF can be evaluated depending upon the extent of heterogeneity of DEN types circulating in a setting.	2014-17	Genomic trans community flow of different DEN types will be studied and adopted as possible cause of erupting DHF in study areas.	DMRC, Jodhpur
5	Studies on functional genomics of mosquitoes for studying the transmission and maintenance of dengue	Not Applicable	A new study where available whole genome of <i>Ae. aegypti</i> can be referred to derive the genes functionally responsible for its capacity to transmit and maintain dengue virus.	2014-17	<i>Aedes aegypti</i> mosquitoes will be studied in terms of their infectivity and corresponding genes with reference to available whole genome, to derive functional genomics of dengue virus transmission and maintenance	DMRC, Jodhpur
6	Evolution of dengue viruses based on full genome analysis	Off shoot of project 1 of XI th Plan.	Changes in the virus genome contribute to changes in transmissibility and virulence. Therefore full genome analysis of Indian viruses is important for identifying changes that may have contributed to change in disease pattern observed in India	2013-15	Identification of genomic changes associated with change in virulence	NIV, Pune
7	Characterization Of The T regulatory cell response In Dengue	Off shoot of project 2 of XI th Plan	Understanding relevance of immune response in dengue immune-pathogenesis	2012-2017	Function of T regulatory response in dengue	NIV, Pune
8	Identification and characterization of epitopes inducing T lymphocyte responses in dengue	Off shoot of project 2 of XI th Plan	Will help to identify T cell epitopes that are protective/detrimental	2013-2017	Identification of T cell epitopes	NIV, Pune
9	Studies on innate immune responses to Dengue Virus in the context of Host Genetic diversity	Off shoot of project 2 of XI th Plan	Association of host genetics with disease pathogenesis is an important facet of disease management	2013-2016	Gene polymorphisms relevant to dengue	NIV, Pune

10	Role of Dengue virus Core protein in viral replication	Off shoot of project 3 of XIth Plan	Novel data will be generated on the interaction of DENV core protein with cellular components.	2012-2015	Interactions of core with cellular proteins	NIV, Pune
11	Screening of different compounds to determine their efficacy in inhibition of Chikungunya virus.		A <i>de novo</i> proposal that will be integrated into the umbrella program of antiviral development described earlier.	5 Years	Antiviral are being recognized as a major intervention strategy for most viral diseases. This would involve development of infrastructure for virus cultivation, understanding of replication strategies, bioinformatics and cell-free, cell-based and <i>in vivo</i> systems for assessing virus inhibitory activity.	NIV, Pune
12	Inhibition of Chikungunya virus in vero cell cultures with Morpholino Oligomers.		This program will be integrated as a part of the umbrella program on antiviral development described earlier.	5 Years	This Morpholino Oligomers can be used as antiviral compound	NIV, Pune
13	Dengue, Chikungunya- a study on host gene expression using microarray, protein analysis and epigenetic.		A <i>de novo</i> proposal to understand population genetic response and variation in these two arboviruses of public health importance in India.	5 Years	To understand the immune response produced by CHIKV and DENV	NIV, Pune

14	Screening of antiviral compounds from different sources		The origin of this program is based on a need-of-hour requirement is developing an integrated platform using combinatorial approaches, screening and viability testing of potential antiviral compounds of synthetic as well as indigenous origin.	5 Years	Antiviral are being recognized as a major intervention strategy for most viral diseases. This will be of National importance and a multi-institutional collaboration with relevant stakeholders will be set up. The program will be in several operational phases. The major focus will be on medically important viruses of public health importance in India.	NIV, Pune
15	Role of host and viral factors in different vector borne viral diseases.		This project is a de -novo proposal that will strengthen the knowledge base in understanding in detail vector biology component of arboviruses.	5 Years	Increase the understanding of host and vector borne viral disease	NIV, Pune
Epidemiological/Operational Research						
1	<i>Aedes aegypti</i> pupal surveys in three different physiographic ecosystems	The conventional <i>Stegomyia</i> indices are inadequate to predict the prevalence of the vector, hence the Pupal Index (PI) will be investigated as an alternative.	-	Till 2015	Pupal survey in different ecosystems will bring adult estimates close to that of adults.	CRME, Madurai

2	Control of dengue and chikungunya by controlling the <i>Aedes</i> breeding in key containers in pre-monsoon season in one of the endemic zone of Delhi (Funded by ICMR, VSF)	Control of dengue and chikungunya by controlling the <i>Aedes</i> breeding in key containers in pre-monsoon season in one of the endemic zone of Delhi (Funded by ICMR, VSF) West Zone of Delhi is being selected as pilot study site for control of dengue and chikungunya by controlling the <i>Aedes</i> breeding in key containers in pre-monsoon season. West Zone is the second largest zone in respect of population and consists of 36 wards & about 275 colonies. Number of dengue cases in West Zone increased gradually from 2006 to 2011 and from 6 th position in 2006 it comes to 2 nd position in 2011.	-	2012 – 2014 (2 years)	<ul style="list-style-type: none"> • Study will map key containers of <i>Aedes aegypti</i>, vector of dengue and chikungunya in selected endemic West zone of Delhi • Breeding in key containers in pre-monsoon season will be controlled in collaboration with state health departments • The study will evaluate the impact of controlling vector population in key containers on amplification of breeding, dengue and chikungunya cases during post-monsoon season. 	NIMR, New Delhi
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3	Spatio-epidemiological analysis of Dengue in Delhi (<i>Aedes</i>)	-	<p>Spatio-epidemiological analysis of Dengue in Delhi (<i>Aedes</i>) with the following objectives</p> <p>a. Principal Objective</p> <p>i. Identification of key factors determining transmission and outcome of dengue infection</p> <p>b. Second Objective</p> <p>i. Role of asymptomatic infections in Dengue epidemiology</p> <p>ii. Community incidence of infection and Index case community study of dengue epidemiology</p> <p>iii. Impact of human genetics on the outcome of infection</p> <p>iv. Spatio-temporal analysis and modelling of Dengue diffusion at micro level</p>	2013-2015	There is clearly a need for an enhanced research effort on understanding the transmission dynamics and the epidemiology of this important viral infection. For effective disease management, whether control, prediction or risk mapping, a better understanding of the transmission dynamics of the virus is a key. This project should as important scientific impacts but should as well propose new way to tackle the disease.	NIMR, New Delhi
4	Surveillance of different viral diseases in Kerala state to determine the dynamics of transition.		Kerala has multiple vector borne disease. This proposal strengthens the mandate for a separate NIV Kerala to study multidisciplinary aspects of these infections with respect to public health burden.	5 Years	Provide diagnostic support to Kerala and understand the prevalence of disease	NIV, Pune
5	Molecular diagnosis and epidemiology of arbo virus infections in Karnataka.			5 Years	Provide diagnostic support and understand the prevalence of viral diseases before any impending epidemic breaks out.	NIV, Pune

6	Sero-prevalence and disease burden of dengue in the rural population of Vadu area	Offshoot of Project 5 of 11th plan	It is of great relevance to the policies that will be framed by the Nation for control of dengue	2013-16	Data on the cost of dengue to the nation will be generated	NIV, Pune
7	Epidemiology of dengue/ chikungunya/West Nile virus in Assam	Offshoot of the studies carried out during 11 th Plan period which established emergence of Dengue, Chikungunya and West Nile virus activity in Assam.	-	3 Years during the 12 th Plan period	Epidemiology of these diseases with particular emphasis on vector incrimination and their bionomics will have direct relevance to National programme as research inputs.	RMRC, Dibrugarh
8	Up-gradation of Grade II viral diagnostic laboratory to grade I	Off shoot of ongoing programme	National Relevance: at present diagnosis of viruses is given however up-gradation will support isolation and characterization of viruses of public health importance This will help understand molecular characteristics of virus in relation to pathogenesis and disease burden they cause	Upon approval Virus isolation and molecular and tissue culture based characterization studies will be initiated, this will take about one year for development of infrastructure and establishment of facilities. These studies will be continued for next three years.	Viruses of public health importance will be isolated and characterized. This will help understand intricate virus diseases dynamics in central part of India which at present is unavailable.	RMRC-T, Jabalpur

9	Ecology of <i>Aedes albopictus</i> in A&N Islands		Dengue is emerging as an important public health problem in A&N Islands. Chikungunya had caused large outbreaks and these outbreaks are emerging in new places. <i>Aedes albopictus</i> has been identified as an important vector of these diseases. Not much information about the distribution and bionomics of <i>Ae. albopictus</i> in A&N Islands is available.	2012-2014	The project will develop a map of Andaman and Nicobar Islands depicting the distribution of <i>Aedes albopictus</i> . It will also generate data on ecological determinants of <i>Aedes albopictus</i> infestation and role of <i>Aedes albopictus</i> in the transmission of Chikungunya and Dengue in A&N Islands	RMRC, Port Blair
10	Epidemiology, transmission dynamics and control of dengue in rural, urban and plantation settings in South India	Earlier studies indicated that dengue is spreading to newer areas with a complexity in the prevalence of different dengue serotypes, pathogen-vector combinations and ecosystems. Epidemiological and entomological studies are necessary to develop and demonstrate site-specific intervention measures for control and prevention of dengue/chikungunya		2013 - 2015	The goal is to (a) understand transmission dynamics during epidemic and inter-epidemic periods and (b) develop site specific interventions for control and prevention of dengue/chikungunya The outcome will provide inputs to the national guidelines for dengue/chikungunya control	VCRC, Puducherry

11	Development and validation of sampling strategies for monitoring dengue/chikungunya vector population and vector infection.	There is a need for improved vector surveillance system for dengue for better planning of preventive interventions, in view of the increasing trend in the incidence and spread to newer areas.		2013 -2016	The goal is to develop sampling strategies for monitoring vector density and viral infection in vectors. A protocol will be available for an improved vector surveillance system	VCRC, Puducherry
12	Development of Geo-environmental risk model for dengue.	There is a need to strengthen dengue vector surveillance under National programme, exploiting the RS – GIS technology for forecasting dengue outbreaks.		2014 - 2016	The goal is to develop a risk model for predicting the spatial and temporal dynamics of dengue. A GIS-RS based surveillance tool for management of dengue at regional scale.	VCRC, Puducherry
13	Task Force project on Insecticide resistance monitoring in Aedes vectors' under Vector Science Forum	New study	Resistance monitoring should be a continuous process and data needs to be generated from across the country. Besides monitoring of resistance, factors influencing resistance like operational factors, genetic factors <i>etc</i> should also be studied. Change in vector behaviour after use of LLINs and ITNs (wherever used) should also be studied. Resistance to insecticides is to be monitored in vectors of dengue/chikungunya, JE, filariasis & cutaneous leishmaniasis (wherever possible), in addition to those of malaria and visceral leishmaniasis.	2013-2017	Country –wide data on insecticide resistance will be generated, which will be useful to decide on the national programme policy	CRME, Madurai NIMR, New Delhi VCRC, Puducherry

14	Task Force study on Role of transovarian transmission in Dengue	New study	It is important to understand the transovarian transmission dynamics of dengue vector	Three years	Insight into transmission dynamics	RMRC, Bhubneshwar NIMR, New Delhi RMRCT, Jabalpur
Translational Research/Techniques Developed						
1	Development of recombinant envelope protein for DEN MAC ELISA kit		Required for improving the DEN MAC-ELISA kit which is already being used in the national program (NVBDCP)	2013-2015	Improved DEN MAC-ELISA kit	NIV, Pune
2	Development of Virus Like Particles (VLPs) or pseudovirions as candidate vaccine for Dengue using the measles virus replicon system – A concept proposal		National relevance as vaccines are a major tool to fight viruses and no vaccine is available for dengue	2013-2016	Development of a concept vaccine candidate for dengue	NIV, Pune
3	Screening of antiviral agents against dengue virus		National relevance. Many organizations require their candidate antiviral agents to be tested against infectious virus	2013-2015	identification of a possible antiviral agent	NIV, Pune
4	Development of alternate strategies for surveillance and control of container breeding vector mosquito species by using trapping methods for gravid females	Offshoot of earlier studies to use the modified design of ovitraps and use of different chemicals/plant derivatives as ovipositional attractants for trapping gravid females would help in enhancing the trap efficacy and effectiveness of the surveillance /control strategy.	Not Applicable	2014-16	The studies would help in the surveillance and control of <i>Ae. aegypti</i> and reduction of vector population as well as dengue cases. The method also has potential of evaluating an ongoing control programme.	DMRC, Jodhpur

4. Status of projects funded by other than ICMR							
Sr. No.	Thematic Area and title of the Study	Objectives	Completed/ongoing with outcome of the study	Justification for continuation	Time frame	Institution	Source of Funding
Basic Research							
1	Population Genetics analysis of dengue vectors, <i>Aedes Aegypti</i> and <i>Ae.albopictus</i> using biochemical markers	To study and characterize the genetic diversity in different populations of <i>Ae. aegypti</i> and <i>Ae.albopictus</i> in a dengue endemic environment using epidemiologically relevant phenotypic characters in association with analysis of enzyme markers.	Completed. The study demonstrated that <i>Ae. aegypti</i> and <i>Ae.albopictus</i> from highly populated urban areas could be considered as a population with multiple local populations that can be monitored to control the emergence and spread of focal outbreaks of dengue.	No	2007-2010 (3 years)	CRME	DBT
2	Cloning and expression of PRM and NSI Gene of dengue virus and its application in the diagnosis of dengue	The development of rapid and accurate diagnostic kit for dengue antigen detection.	Completed. The usefulness of the recombinant antigen of dengue was determined in ELISA using known positive and negative human sera collected in the field during the recent outbreak occurred at Tamil Nadu.	No	2009-2012 (3 years)	CRME (Collaboration with Anna University)	DST
3	Immuno-genetic profiling of Dengue infected patients from Pune, Maharashtra (Extramural)	Identification of host HLA gene polymorphisms associated with dengue disease	Nearing completion Certain polymorphisms were found to be associated with dengue and/or DHF	-		NIV, Pune	DBT

4	Capacity Building to MCD/NDMC Workers/officials	Capacity Building to MCD/NDMC Workers/officials	9 training courses were conducted during 11 th Plan and first year of 12 th Plan. About 2000 Health Officials/Investigators/ Spray squad workers were trained during the period	Since NDMC does not have any entomological surveillance capacity and MCD also needed entomological and technical support.	Continued.	NIMR, Delhi	MCD/NDMC
5	Studies on chronic arthropathy and Acute Flaccid Paralysis in chikungunya infection, pathogenesis of chronic arthritis and neurological complications associated with CHIKV infection	To understand the pathogenesis of chronic arthropathy and acute flaccid paralysis in CHIKV infection	<p>Study has been completed and the objectives have been accomplished. Salient findings are as follows:-</p> <p>Studies have revealed that chronic arthropathy in Chikungunya is inflammatory erosive in nature similar to rheumatoid arthritis.</p> <p>Follow up of the CHIKV infected patients revealed that it is an important complication. Experimental studies showed that CHIKV induced acute flaccid paralysis is not a Guillean Barre Syndrome where demyelination is known to occur. But in CHIK induced Acute Flaccid Paralysis mainly due to peri-vascular oedema and Schwan cell necrosis.</p>	Not planned to be continued in the XIIth plan.	-	RMRC, Port Blair	DBT

Epidemiological/Operational Research							
1	Community based control of dengue carried out by exercising the principle of eco-bio-social components of human ecosystem in Chennai City.	To study matrix in dengue related context of eco-bio-social factors.	Completed. Increased community understanding, acceptance and support of vector control efforts and develop partnership between the stakeholders. Develop community ownership and broader community development issues such as solid waste management and recycling.	No	2007-2011	CRME, Madurai	WHO/TDR & IDRC
2	Assessment of the economic cost of dengue in India	To estimate the disease and economic burden of dengue.	Ongoing.	Final analysis is being carried out and will be completed March 2013.	2012-2013	CRME along with INCLEN Trust, Brandeis university USA, NHFW, Delhi	Sanofi Pasteur Institute.
3	Climate variability and dengue in Delhi	To determine the role of climatic variables in dengue outbreaks	Study completed. The findings revealed that the prediction of dengue outbreak is possible with rainfall and Sea Surface Temperature with one/two month time lag. 3 rd quartile method of epidemic threshold was found best for detecting outbreaks of Dengue.	Long term study is planned with Malaria by setting up of climate change cell	No	NIMR, N. Delhi	MoEF

4	Assessment of the Impacts of Climate Change on Malaria and Dengue at National Scale and Adaptation Strategies for Short, Medium to Long Term Scales.	To assess the impact of climate change on dengue	Study completed. Most part of India is suitable for dengue transmission from temperature point of view. Based on the analysis of A1B scenario of climate change, the northern states of India like Uttarakhand, Sikkim J&K, Northeastern states, Some part of MP and West Bengal are vulnerable to increase in windows of dengue transmission. However, the other factors like water storage practices, water supply, life style and socioeconomics also play major role in dengue transmission.	Climatic suitability of dengue is for larger part of India, while the current distribution is still confined indicating other factors like water supply and storage practices, life style and socioeconomics warranting further study to identify the risk factors. Further work is proposed to be undertaken with prospective study with malaria.	2009-10	NIMR	MoEF
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