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SURVEILLANCE STRATEGY AND RESEARCH PRIORITIES OF DF/DHF IN INDIA - A REVIEW

Dengue Fever (DF) associated with Dengue Hemorrhagic Fever (DHF) is an emerging public health problem in the countries of south-east Asia including India. According to recent WHO estimates DF is endemic in 100 countries of the world, emerging at the rate of 50 million new infections, 24,000 deaths and about 2.5-3 billion people at risk every year. There are 5,00000 cases hospitalized every year due to dengue and its total disease burden has been calculated around 465,000 DALY[1]. Recently during 2006, in India, outbreaks of DF/DHF was reported across the country with total number of more than 7,000 laboratory confirmed dengue cases (Unpublished reports).

Although dengue is one of the oldest known human diseases in India, due to lack of region specific, in-depth knowledge on its etiology, epidemiology and pathogenesis, an effective surveillance strategy has not yet been developed. Consequently, a monitoring and prevention plan against this arbo-viral infection is lacking. Present paper reviews available information, highlights research generated by scientists of Desert Medicine Research Centre, Jodhpur on surveillance strategy and host-virus interaction aspects and sensitizes crucial researchable issues of dengue in India.

Distribution of Dengue in India: Current Knowledge and Future Needs

A comprehensive review of occurrence of DF/DHF in different endemic countries including India up to year 1995 has been made by earlier workers[2]. In India, outbreaks of dengue have been reported from 1996 till 2005 from different parts of the country[3-9]. These reports suffice only to highlight records of the virus activities in the different areas. However, due to lack of research on associated attributes with disease occurrence, published reports are insufficient to form an effective surveillance and preventive plan against dengue in the country.

In fact, dengue being circulating between susceptible human hosts and mosquito vectors within domestic premises, is a disease system operating within limited spatial range. The wide social and ecological heterogeneity in different parts of India, influences water storing habits of different population groups and thus forms many dengue transmission systems among which risk factors determining onset, spread and aggravation of disease, differ from one socio-ecological setting to the other. While living style of people specially their water storing habits influence vector breeding, on the other hand agglomeration pattern of houses and ecology of settings influence longevity of mosquito

survival. Similarly, non emptying habits of domestic water utensils promotes retention of vertically transmitted virus in a house and availability of susceptible human hosts in such settings forms transmission supportive conditions for dengue. More are variations of these conditions from one to other setting, more will be the need to launch independent epidemiological enquiries in each of such settings to develop an integrated surveillance and disease management plan. We thus need to stratify each dengue setting on socio-economic criteria and develop a status report on vectors and viruses for quantifying current burden and predicting prospective risk.

Proposed Surveillance Plan for DF/DHF in India

There is a need to develop a surveillance network of DF in all the representative socio-ecological settings of the country. To be precise we need to generate baseline data in three major areas viz.

- Development of status report;
- Derivation of determinants; and
- Development of a dengue information/warning system.

Development of status report

A simultaneous and periodic surveillance of four components of dengue needs to be undertaken in all the representative socio-ecological settings of the country, like

a. Vector surveillance

b. Extrinsic virus surveillance

c. Intrinsic virus surveillance

d. Socio-ecological surveillance

Vector surveillance

Study of distribution, adult and breeding habitats and seasonal rhythms of vector species belonging to Aedes group and association of these parameters with water storing habitats of people of an area during a season, is the important baseline work need to be accomplished for each specific socio-ecological setting existing in India. Although many references are available on one point investigations of vector surveillance in an affected area[10-12] follow up studies on theses aspects to characterize an area for entomological rhythms all across the year are missing. Consequently, glimpses of knowledge of vector species are available but an authoritative knowledge on entomological aspects of dengue are not yet generated. One thus needs to determine adult and breeding habitats of vector Aedes in each of the socio-ecological settings of India. In Rajasthan, India – a dengue endemic state, a comprehensive surveillance of dengue vectors has been undertaken in all the socio-ecological paradiagms of the state. A longitudinal survey conducted in five physiographic regions of the state showed that, summer and springs are the most suitable seasons for the high vector abundance in arid and semi-arid areas of Rajasthan, whereas in areas such as Kota and Jaipur (non arid districts), rainy season marks maximization of Aedes mosquitoes. These observations further suggested that poor socio economy of the people is a strong risk factor associated with high breeding of *Aedes* mosquitoes[13]. Key breeding containers in desert are small cement tanks and underground storage tanks during summer season whereas during same season underground tanks were never key containers for Aedes breeding in non desert areas of Rajasthan (Desert Medicine Research Centre : Unpublished observations). Based on the work undertaken in Rajasthan, it appears that integrated longitudinal studies on dengue vectors for whole of the country are needed so that a robust base for plan of action against dengue vectors could be developed in the country.

Extrinsic virus surveillance

Surveillance of mosquitoes carrying natural infection of dengue virus and its utility as the predictor of infection is relatively newer area of research on dengue viruses. The idea of using mosquitoes as means of propagating dengue viruses was published long back[14], but this factor never attracted epidemiological investigations, as a result scientists continued to speculate the risk of disease transmission in a setting, on the basis of presence of a vector species only. A study was undertaken on mosquito infections with disease onset during 1996[13]. Recently few more studies have been published on mosquito infectivity as a surveillance factor[15,16]. Having published first report of transovarial transmission of dengue virus by Ae. aegypti from India[17], we also subsequently published the epidemiological implication of vertical transmission of dengue virus across 7 generations of Aedes aegypti[18]. DMRC's recent studies on reporting vertical transmission of dengue virus by Aedes albopictus and Aedes aegypti mosquitoes from desert Rajasthan, have revealed a crucial observation that the vertically transmitted virus from mosquito generations marks the precursor of appearance of dengue infection in a family and this is then followed up by human to human transmission to aggravate the infection first at family and then at community level (DMRC, Unpublished reports). It appears that the observations on natural infectivity of mosquitoes along with usual entomological surveillance may serve as an effective surveillance tool to predict onset and subsequent transmission of disease in an area.

Intrinsic virus surveillance

There are many reports of serosurveillance of dengue cases from different parts of the country[6,19-22]. In all of these surveys paired serum samples were obtained from acute and convalescent cases and rising trend of antibodies against dengue in convalescent sera as compared to acute one, has been recorded as evidence of presence of infection. Owing to increasing trend of dengue all over the country, diagnostic kits to capture IgM antibodies as indicative of current infection have been developed and provided at PHC level in many states of India. However, investigations to detect the IgM antibodies against dengue simply serve to confirm the clinically suspected cases of disease. But we need to realize that characterization of dengue infection by antibody detection will appear positive only when sufficient titre of antibodies by strong immune response of human host has been produced in a case. Diagnosis of a case at this stage of virus-host interaction will not help us to pin point active contributors of virus in a population for the reason that virus has been already neutralized by antibodies within cases showing positive test. Detection of IgM antibody serves to diagnose the suspected cases of dengue but simultaneously in blood sample drawn during acute stage of infection, we need to isolate virus and type it so that not only case characterization but prospective risk of DF transmission and DHF causation can also be computed in one effort.

Socio-ecological surveillance

Being transmitted by domestically breeding Aedes mosquitoes, dengue appears to be closely related to socio-economic-educational status of the people and the ecology of surrounding. A survey of different socio ecological pockets existing in a given town and extrapolation of previous history of infection over it, may lead to a criteria of representative sample selection. There is a need to have GIS analysed details of all the dengue endemic towns of the country for an effective prevention/control plan. One report about such attempts has been published[23]. Studies undertaken by the DMRC team in Rajasthan, India, showed that population belonging to poor socio-economic status and areas maintaining peri-domestic water containers are more prone to dengue[13]. The criteria of socio-economic status in urban settings in Rajasthan has emerged as strong basis of stratification for dengue surveillance.

Derivation of determinants

Surveillance module for dengue in India need to include creation of representative surveillance stations across the country and launching investigations for vector, virus (extrinsic and intrinsic) and social surveillance. Observations generated by all such networking stations may lead to the development of the following determinants:

a. Human host determinants (Demographic)
b. Biological determinants (Entomological and Virological)
c. Social determinants (Economic and Educational)

Human host determinants (Demographic)

The observations generated through demographic surveillance will lead to one most important information, that is about availability of members of different age groups in a family. The humans normally below 20 years of age will form susceptible group for dengue and demographic information about this aspect will be of great use in computing overall risk of infection within a family. During course of recent studies of selected dengue infected families in Jodhpur, Rajasthan, we studied relationship among vectors (adult and larval), vector infectivity and number of susceptible subjects present in a family. Observations suggested that if 50% of available mosquitoes in a house are infected and there are inhabitants in a family below 20 years of age, all are likely to develop dengue. This way, demographic parameter of age of inhabitants in a family will carry a crucial role in computing family level risk of transmission of disease in any endemic town (DMRC, Unpublished data).

Biological determinants (Entomological and Virological)

Biological determinants of dengue can be derived from investigations made along entomological, virological and disease prevalence parameters. Through careful analysis of inter-relationship among these parameters, we can derive which of them plays determining role in a particular setting during a particular season of the year. If surveillance of vector, virus and diseased population all across the country is undertaken, analysis of data generated through such comprehensive work will lead to development of biological determinants of DF and DHF at general as well as regional level. Studies carried out by DMRC, Jodhpur in Rajasthan, showed that mosquito infectivity in a family through vertical or horizontal transmission is the most influencing determinant of infection (DMRC, Unpublished reports).

Social determinants (Economic and Educational)

Social habits pertaining to way of storage of domestic water by the inhabitants, has emerged to be the most important attribute relevant in predicting presence of dengue vectors in a family or locality. More importantly

number of many containers for domestic water storage owing to uncertain water supply and poor socio-economic level of a population group has been observed as a directly associated factor with risk of dengue sustenance and transmission in a setting. If we launch a large scale surveillance of major towns and digitize the localities with their socio-economic attributes, social determinants of dengue transmission can always be determined for each of town and this will pave the way for any anti dengue campaign.

Development of a dengue information / warning system

Through all the proposed investigations and derivation a computer based correlation module can be developed which will yields following:

a. Correlation development for Inter-relations of factors;
b. Regional determinants development;
c. Regional predictors development

This analysis module will involve development of a statistical programme in which Odd Ratios (OR) will be derived for evaluating strength of association among all the components of dengue. The analysis could be developed at each of socio-ecological zones. In India such attempts have not been made so far. The most strongly associated factors with magnitude of the disease will form the cluster of determinants and factors associated with the lowest or residual level of infection will serve as predictors.

Host-Virus Interaction Studies on Dengue: Present Status and Prospective Research

Host-virus interaction studies on dengue form an important area of basic research. To explain transmission dynamics of dengue during epidemics and sustenance of virus during inter-epidemics, host-virus interaction aspects of dengue carry crucial significance. It is believed that transovarial transmission (TOT) maintains the virus during inter epidemic periods. However, despite the fact that first report of TOT of dengue virus was published very early from Myanmar[24], epidemiological importance of this phenomenon was not discussed as late as about few years before when persistence of transovarial transmission of dengue virus for 7 generations of Ae. aegypti and its epidemiological significance as persistence mechanism was reported[18]. It was also reported that vertically passaged virus exerts an adverse effect on the reproductive capability of infected mosquitoes but selected population of mosquitoes capable of reproducing in spite of being infected, carry potential significance in sustenance of viraemia in an endemic locality. It is this selected population of vectors which in fact need to be studied further for their vector competence issues[25]. It appears that the host factors responsible for allowing replication of virus molecules within them will determine the susceptibility or refractivity of a species to transmit the disease to human hosts. There are number of un-attended research issues to understand molecular specificities of host factors associated with internalization of dengue virus into cells. The receptor mediated endocytosis of virus needs to be understood in the context of proteins constituency of cell lining internal layer of mid gut cells of susceptible and refractory mosquito species. Number of studies have been made on interaction pf proteins, receptor proteins, proteolytic enzymes and acidic pH, etc., as associated with the entry of dengue virus into human monocytes. On the other hand few reports are also available on interaction of molecules present in mosquito mid guts with entry of dengue virions[26-30].

Our earlier studies have shown that the infected mosquitoes do not lead to 100 % infected progeny through vertical transmission of virus[25]. Under field conditions it has been observed that areas having similar entomological profiles do not present similar transmission quantum of disease. The idea sensitized through these studies is that molecular specificities of individual mosquitoes within a species group and of different vector species may be responsible for intra and inter-species variations of vector competence. The DMRC is pursuing the molecular aspects of mosquitoes associated with their vector competence. Recently studies on resolution of the mid gut proteins contained by three species viz;Ae. aegypti, Ae. albopictus and Ae. vittatus have shown that a protein of 200 kDa is consistently associated with the refractory species Ae. vittatus and this protein is only occasionally expressed in two other vector species viz; Ae. albopictus and Ae. aegypti. These early observations sensitize a new concept that a protein may be responsible for refractiveness of a species than its susceptibility and absence of this protein makes a species vulnerable for dengue transmission. The further progress to derive molecular epidemiological tools of transmission potential of vectors within an area is being currently pursued.

Realizing that in the absence of a vaccine or chemotherapy, management of dengue depends solely on the preventive measures, it is necessary to develop molecular epidemiology of DF and DHF.

In addition, number of other research issues such as the maintenance role of Ae. albopictus mosquitoes in continuing endemic and sylvatic cycles, remains to be

established. It appears that a proper explanation for retention mechanism of the disease in nature still needs more work. Similarly, role of sylvatic cycle of dengue in endemic dengue and DHF also needs more support of observations. Confirmatory understanding of these basic epidemiological issues will be necessary for an effective prevention against DF and DHF under Indian conditions.

References

1. www.who.int/tdr/diseases/dengue
2. Gratz, N.G .and Knudsen, A.B. The Rise and Spread of dengue and dengue Haemorrhagic fever and its vectors– A Historical Review (up to 1995) (CTD/FIL/(DEN) 96.7), Geneva,1995.
3. Kennedy, R.S. Some notes on an epidemic of dengue form fever amongst Indian troops, Calcutta. Indian Med Gaz XVII: 436, 1912.
4. Myers, R.N., Carey, D.E., Banerjee, K., Reuben, R. and Ramamurti, D.V. Recovery of dengue type 3 virus from human serum and Aedes aegypti in South India. Indian J Med Res 56: 781, 1968.
5. Myers, R.M., Carey, D.E., De Rantiz, C.M., Reuben, R. and Bennet, B. Virological investigations of the 1966 outbreak of dengue type 3 in Vellore ,Southern India. Indian J Med Res 57: 1392, 1969.
6. Padbidri, V.S., Mahadev, P.V.M., Thakare, J.P., Pant ,U., Ilkal, M.A., Geevarghese, G., Joshi, G.D., Mavale, M.S., Paramasivan, R. and Athavale, S.S. Virological and entomological investigation of an outbreak of dengue fever in Dhule district, Maharashtra. Indian J Med Microbiol 14: 5, 1996.
7. Padbidri, V.S., Thakare, J.P., Risbud, A.R., Joshi, G.D., Singh, A., Mavale, M.S. and Gupta, V.P. An outbreak of dengue haemorrhagic fever in Jammu. Indian J Virol 12: 83, 1996.
8. Kulkarni, S.M., Banerjee, K., Deshmukh, P.K., Ilkal, M.A. and Venkateshan, C.N. Dengue epidemic in Amalner town, Jalgon district, Maharashtra, India: entomological investigations. J Commun Dis 9: 124, 1977.
9. Kumar, M., Pasha, S.T., Mittal, V., Rawat, D.S., Arya, S.C., Agrawal, N., Bhattacharya, D., Lal, S. and Rai, A. Unusal emergence of Guate 98-like molecular subtype of DEN-3 during 2003 epidemic outbreak in Delhi. Deng Bull 28: 161, 2004.
10. ILkal, M.A., Dhanda, V., Hassan, M.M., Mavale, M.S., Mahadev, P.V.M., Shetty, P.S., Guttikar, S.N. and Banerjee, K. Entomological investigations during outbreaks of dengue fever in certain villages in Maharashtra state. Indian J Med Res 93: 174, 1991.
11. Joshi, V., Mathur, M.L., Dixit, A.K. and Singhi, M. Entomological studies in a dengue endemic area, Jalore, Rajasthan. Indian J Med Res 104: 161,1996.
12. Mahadev, P.V.M., Fulmali, P.V. and Mishra, A.C. A preliminary study of multi level geographic distribution and prevalence of Aedes aegypti (Diptera: culicidae) in the state of Goa. Indian J Med Res 120: 173, 2004.
13. Joshi, V., Sharma, R.C., Sharma, Y., Adha, S., Sharma, K., Singh, H., Purohit, A. and Singhi, M. Importance of socio-economic status and tree holes in distribution of Aedes mosquitoes (Diptera: Culicidae) in Jodhpur, Rajasthan, India. J Med Entomol 43: 339, 2006.
14. Rosen, L. and Gubler, D. The use of mosquitoes to detect and propagate dengue viruses. Am J Trop Med Hyg 23: 1153, 1974.
15. Lee, H.L. and Rohani, A.Transovarial transmission of dengue virus in Aedes albopictus in relation to dengue outbreak in an urban area in Malaysia. Deng Bull 29: 106, 2005.
16. Mendez ,F., Barreto, M., Juan, F., Rangifo, G., Munoz, J. Burbano, M. and Parra, B. Human and mosquito infections by dengue viruses during and after epdemics in a dengue endemic region of Columbia. Am J trop Med Hyg 74: 678, 2006.
17. Joshi, V., Singhi, M. and Chaudhary, R.C. Transovarial transmission of dengue 3 virus by Aedes aegypti. Trans R Soc Trop Med Hyg 90: 643, 1996.
18. Joshi, V., Mourya, D.T. and Sharma, R.C. Persistence of dengue 3 virus through transovarial passage in successive generations of Aedes aegypti mosquitoes. Am J Trop Med Hyg 67: 158, 2002.
19. Padbidri, V.S., Adhikari, P., Thakare, J.P., Ilkal, M.A., Joshi, G.D., Pereira, P., Guttikar, S.N., Walhekar, B.D., Chowta N. and Hegde, B.M. The 1993 epidemic of dengue fever in Mangalore, Karnataka state, India. Southeast Asian J Trop Med Pub Hlth 26: 699, 1995.
20. Thakare, J.P., Walhekar, B.D. and Banerjee, K. Hemorrhagic manifestations and encephalopathy in cases of dengue in India. Southeast Asian J Trop Med Pub Hlth 27: 471, 1996.
21. Risbud, A.R., Mehendale, S.M., Joshi, G.D. and Banerjee, K. Recurrent outbreak of dengue fever in rural areas of Maharashtra (an experience from Parbhani district). Indian J Virol 7: 120, 1992.
22. Mahadev, P.V.M., Mehendale, S.M. and Banerjee, K. Dengue in villages in India from 1981 to 1990. Arthropod-borne Virus Inform Exch (June): 6, 1991.
23. Bohra, A. and Andrianasolo, H. Application of GIS in monitoring of dengue risk based on socio-cultural data: Case of Jalore, Rajasthan, India. Deng Bull 25: 92, 1992.
24. Khin, M.M. and Khin, A.T. Transovarial transmission of dengue-2 virus by Aedes aegypti in nature. Am J Trop Med Hyg 32: 590, 1983.
25. Joshi, V. and Sharma, R.C. Impact of vertically transmitted dengue virus on viability of eggs of virus inoculated Aedes aegypti. Deng Bull 25: 103, 2001.
26. Sabin, A.B. and Schlesinger, R.W. Production of immunity to dengue with virus modified by propagation in mice. Science 101: 640, 1945.
27. Hase, T., Summers, P.L. and Ecles, K.H. Flavivirus entry into cultured mosquito cells and human peripheral blood monocytes. Arch Virol 104: 143, 1989.
28. Salas-Beineto, J.S. and Angel, R.M. Identification of two surface protein from c6/c36 cells that bind dengue type virus. J Virol 71: 7246, 1997.
29. Barth, O.M. Replication of dengue viruses in mosquito cell cultures - a model from ultra-structural observations. Memm Inst Oswaldo Cruz 87: 565, 1992.
30. Chen, L.H. and Wilson, M.E.Transmission of dengue virus without a mosquito vector: nosocomial mucocutaneous transmission and other routs of transmission. Clin Infect Dis 39: 56, 2004.

This write-up has been contributed by Dr. Vinod Joshi, Scientist F, Desert Medicine Research Centre, Jodhpur.

ICMR NEWS

The following meetings of various technical committees/ groups of the Council were held

Meeting of Scientific Advisory Group (SAG) held at New Delhi

SAG of Division of Non-Communicable Diseases	May 27-28, 2008

Meetings of Task Forces (TFs)/Steering Committees/And Other Meetings

Brain Storming Meeting on Gene Therapy in Cancer	March 3, 2008 (at New Delhi)
Steering Committee on National Cancer Registry Programme	April 4, 2008 (at New Delhi)
Training Workshop for Data Entry Operators	April 24-25, 2008 (at New Delhi)
Meeting of Stroke Registry	April 29, 2008 (at New Delhi)
TF Sub Committee on Review of Guidelines for Management of Stomach Cancer	May 5, 2008 (at Mumbai)
TF on Genetic Basis of Resistance to Diabetes in Raica Community of Rajasthan	May 9, 2008 (at New Delhi)
Steering Committee of ICMR Centre for Advanced Research on Genomics of Type 2 Diabetes Mellitus	May 21, 2008 (at Chennai)

Meetings of Project Review Committees (PRCs)/Expert Groups (EGs) held at New Delhi

PRC on Oncology	March 3, 2008
PRC on Otorhinolaryngology	March 11, 2008
PRC on Environmental Hygiene and Occupational Health	March 20, 2008
Joint PRC on Human Genetics, Haematology and Anthropology	March 30, 2008
EG on Safety Assessment of G.M. Foods	March 31, 2008
PRC on Experimental Medicine and Surgery	April 8, 2008
PRC on Oral Health	April 11, 2008
EG on Stem Cell Research	May 25, 2008

Participation of ICMR Scientists in Scientific Events

Dr.Veena Shatrugna, Scientist E, National Institute of Nutrition (NIN), Hyderabad, participated in the UNSCN Satellite Meeting on India and Acute Malnutrition in Children under Three at Hanoi (March 1-5, 2008).

Dr. A.P. Dash, Director, National Institute of Malaria Research (NIMR), Delhi, participated in a discussion on Ongoing Collaboration between NIMR and CDC at Atlanta (March 2-5, 2008). He also participated in the WHO Coordination Meeting on the Impact of Vector Resistance on the Efficacy of Malaria Vector Control Interventions in Areas Where Vectors are Resistant to Insecticides at Geneva (March 25-28, 2008).

Dr. Tapas Chakma, Scientist E, Regional Medical Research Centre (RMRC) for Tribals, Jabalpur, participated in a Workshop on Role of Nutrition in Fluorosis Control at Ethiopia (March 2-6, 2008).

Dr. S.P. Tripathy, Scientist F and Dr. Smita Kulkarni, Scientist D, National AIDS Research Institute (NARI), Pune, participated in the AIDS Clinical Trials Group Leadership Retreat at Colorado (March 3-6, 2008).

Mr.T. Longvah, Scientist F, NIN, Hyderabad, participated in the International Symposium on Underutilized Plant Species for Nutrition, Income and Sustainable Development at Arusha, Tanzania (March 3-7, 2008).

Dr. B.K.Tyagi, Scientist F and Officer-in-Charge, Centre for Research in Medical Entomology, Madurai, participated in XLIV Annual Scientific Seminar of the Malysian Society for Parasitology and Tropical Medicine at Kuala Lumpur (March 4-5, 2008).

Dr. Neeru Singh, Director, RMRC for Tribals, Jabalpur, participated in a Meeting of Project on Malaria in Pregnancy: Review and Progress at Boston (March 4-8, 2008).

Dr. P.R. Narayanan, Director, Tuberculosis Research Centre (TRC), Chennai, participated in the Meeting on AIDS Vaccine Initiative at New York (March 12-14, 2008).

Dr. M.S. Chadha, Scientist E, National Institute of Virology (NIV), Pune, participated in the International Conference

on Emerging Infectious Diseases at CDC, Atlanta (March 13-19, 2008).

Dr. Anjali Nag, Scientist D, National Institute of Occupational Health (NIOH), Ahmedabad, participated in the IX World Conference on Injury Prevention and Safety Promotion at Merida (March 15-18, 2008).

Dr. G.B. Nair, Director, National Institute of Cholera and Enteric Diseases (NICED), Kolkata, participated in the Annual Meeting of Japanese Society of Bacteriology at Kyoto (March 24-26, 2008).

Dr.A.C. Mishra, Director, NIV, Pune, participated in the IV International Symposium on Filoviruses: Cellular System and Ecosystem Study towards Outbreak Assessment at Libreville (March 26-28, 2008).

Dr.K.Polasa, Scientist F, NIN, Hyderabad, participated in the Indo-Australian Workshop on Nutraceuticals and Functional Foods at New Wales (March 27-28, 2008).

Prof.A.P. Dash, Director, NIMR, Delhi, participated in the (i) I Meeting of the Investigators of the TDR Business Line on Innovative Vector Control Interventions; and (ii) II Meeting of the Scientific Advisory Committee on Innovative Vector Control Interventions at Geneva (March 31 - April 1 and April 2-4, 2008).

Dr. G.B. Nair, Director and Dr. Dipika Sur, Scientist E, NICED, Kolkata, participated in the International Vaccines Institute (IVI) X Anniversary International Symposium on Vaccine for the 21st Century and Annual Meeting of the IVI Board of Trustees at Seoul (April 2-4, 2008). Dr.Nair and Dr. Dipika Sur along with Dr. Byomkesh Manna, Scientist E and Dr. Suman Kanungo, Scientist B, NICED, Kolkata, participated in the Meeting on Impact Evaluation of Cholera Vaccine Introduction at Dhaka (April 30 -May 1, 2008).

Dr.P.R. Narayanan, Director, TRC, Chennai, participated in the Joint WHO/TDR/TGF Consultative Technical Meeting at Geneva (April 3-5, 2008).

Dr.Poonam Salotra, Scientist E, Institute of Pathology (IOP), New Delhi, participated in the IFoLeish 2008 - An Interdisciplinary Forum on Leishmaniasis at Heidelberg (April 3-5, 2008).

Dr. Seema Sahay, Scientist D, NARI, Pune, participated in the Meeting of Community Partners Group in HIV/AIDS at Virginia (April 3-6, 2008).

Dr. M.V. Ghate, Scientist D and Dr. Sheela Godbole, Scientist C, NARI, Pune, participated in the DAIDS Regional Training at Virginia (April 4-6, 2008).

Dr. S.M. Mehendale, Scientist F, NARI, Pune, participated in the meeting of Executive Committee of HPTN at Virginia (April 6, 2008). He along with Dr.A.R. Risbud, Scientist F, and Dr. Seema Sahay, Dr. M.V. Ghate and Dr. Sheela Godbole, participated in the Annual Meeting of the HPTN/IMPACT at Virginia (April 7-9, 2008).

Dr.D.S. Chauhan, and Dr. Raj Kamal, Scientist C, National JALMA Institute for Leprosy and Other Mycobacterial Diseases (NJIL&OMD), Agra, participated in the II International Conference on Tuberculosis Vaccines for the World at Atlanta (April 9-11, 2008).

Dr. Rajeshwari Ramachandran and Dr. Aleyamma Thomas, Scientist F, TRC, Chennai, participated in the TMC207-C208 Investigators Meeting at Philadelphia (April 9-11, 2008).

Dr. Soumya Swaminathan, Scientist F, TRC, Chennai, participated in the Biovision Alexandria 2008 Conference at Alexandria (April 12-16, 2008).

Dr. Neena Valecha, Scientist F, NIMR, Delhi, participated in the (i) World Antimalarial Resistance Network Meeting at Paris; (ii) DNDi FACT Advisory Group Meeting and WHO Technical Expert Group Meeting at Geneva; and (ii) Meeting Focused on the \Choice of the Best Drug(s) to be combined with Tafenoquine at Oxford (April 16-19, 22 & 23-25 and 29, 2008 respectively).

Mr. R.S. Zaidi, Scientist C, NIV, Pune, participated in the 2008 International Conference on Biocontainment Facilities at Washington D.C. (April 21-22, 2008).

Dr. Neeru Singh, Director, RMRC for Tribals, Jabalpur, participated in the Seminar on Iron and Malaria Interactions and Interventions at Rockville (April 24-25. 2008).

Dr. Alok Kumar Deb, Scientist C, NICED, Kolkata, participated in the D-SAB Meeting with Diarrhoeal Disease Programme at London (April 28-29, 2008).

Dr. Sekhar Chakraborti, Scientist F, NICED, Kolkata, participated in the (i) PDVI Field Site Consortium Investigators Meeting, and (ii) VIII International Advanced Course on Vaccinology at Seoul (May 2-3 and 5-8, 2008 respectively).

Dr.A. Roy Chowdhury, Scientist F, NIOH, Ahmedabad, participated in the X World Congress on Environmental Health at Brisbane (Mary 11-16, 2008).

Dr. Vrinda V. Khole, Scientist F, National Instiltute for Research In Reproductive Health (NIRRH), Mumbai, visited the Laboratory of Prof. John C. Herr, Department of Cell Biology, University of Virginia (May 12-25, 2008). She and Dr. Geeta Vanage, Scientist D, NIRRH, Mumbai, also participated in the XLI Meeting of the Society for the Study of Reproduction at Kailua, Kona, Hawaii (May 27-30, 2008).

Dr. Pradeep Das, Director, Rajendra Memorial Research Institute of Medical Sciences (RMRIMS), Patna, participated in the Kalanet Consortium Meeting at Dharan, Nepal (May 13-15, 2008). He also participated in the WHO Visceral Leishmaniasis Workshop at Kathmandu (Mary 29 - June 3, 2008).

Dr. T. Adak, Scientist F, NIMR, Delhi, participated in the Meeting on Cryo Preservation Practices of Different Biological Materials used in Various Research and Uses of Liquid Nitrogen Plants for the Same at the Netherlands (may 19-23, 2008).

Dr. M. Ikram Khatkhatay, Scientist D, NIRRH, Mumbai, participated in the XXXV European Symposium on Calcified Tissues at Barcelona (May 24-28, 2008).

Dr. Narendra Kumar, Scientist E and Dr. Vijay Kumar, Scientist C, RMRIMS, Patna, participated in the Data Analysis Workshop on Kala-Azar Research in Indian Subcontinent at Kathmandu (may 26-28, 2008).

Dr. Sandipan Ganguly, Scientist C, NICED, Kolkata, participated in the DMID International Research in Infectious Diseases Annual Meeting at Betheseda (May 28-30, 2008).

Dr. L. Satyanarayana, Scientist E, Institute of Cytology and Preventive Oncology, NOIDA, participated in the AOGIN 2008 Conference at Seoul (May 29-31, 2008).

Training Programmes/ Courses/ Fellowships/ Associateships

Dr. Aparup Das, Scientist D, NIMR, Delhi, proceeded to avail DBT Overseas Associate at the Department of Evolutionary Biology, Ludwig Maximilians University, Germany for 6 months (w.e.f. March 26, 2008).

Dr. Amit Pal, Scientist D, NICED, Kolkata, proceeded to avail Visiting Research Scientist Fellowship at the Department of Molecular Biology, University of Umea, Sweden for a period of 14 months (w.e.f. April 1, 2008).

Dr. Deepa Bhartiya, Scientist D, NIRRH, Mumbai, proceeded to avail Biotechnology Overseas Associateship at Buck Institute, USA for 3 months (w.e.f. April 25, 2008).

Dr. Byomkesh Manna, Scientist E, NICED, Kolkata, participated in the IX Advanced Vaccinology Course at Annecy (May 19-30, 2008).

Dr. B.N. Murthy, Scientist F, Dr. M.V. Murhekar, Scientist E, Dr. R. Ramakrishnan, Scientist E and Dr.P. Manickam, Scientist B, National Institute of Epidemiology, Chennai, participated in the T5 Training Programme at Boston (May 27 - June 13, 2008).

Dr.A. Sheik Iliyas, Scientist B, TRC, Chennai, proceeded to avail Short-term Training on Design and Conduct of Clinical Trials at the University of Alabama, Birmingham for 6 weeks (w.e.f. May 30, 2008).

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