

Integrated Disease Vector Control Project

A Profile



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Integrated Disease Vector Control Project: A Profile

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Contents

Messages	v
Preface	xi
Acronyms	xiii
Executive Summary	xv
Major Achievements of the IDVC Project	xvi
1. Introduction	1
2. Eco-epidemiological Settings	4
3. Nadiad (Gujarat)	7
4. Panaji (Goa)	16
5. Hardwar (Uttaranchal)	31
6. Jabalpur (Madhya Pradesh)	42
7. Rourkela (Orissa)	56
8. Sonapur (Assam)	76
9. Bangalore (Karnataka)	82
10. Chennai (Tamil Nadu)	91
11. Raipur (Chhattisgarh)	100
12. Ranchi (Jharkhand)	102
13. Haldwani (Uttaranchal)	104
14. Car Nicobar (Andaman & Nicobar Islands)	113
15. Shahjahanpur (Uttar Pradesh)	119
16. Shankargarh (Uttar Pradesh)	130
17. Delhi	134
18. Support Provided to the Programme	140
19. List of Ph.D Awardees	142
20. Research Papers Published	144

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MESSAGE

I am delighted to know that National Institute of Malaria Research has brought out a profile of research activities undertaken under the aegis of Integrated Disease Vector Control Project since its inception, i.e. 1986. The 13 field stations located in different eco-epidemiological paradigms of malaria have generated invaluable data on basic transmission dynamics of malaria, evaluated many new insecticides, diagnostic kits, drugs, development of human resource, IEC material, demonstrated malaria control using non-insecticidal methods and are providing support to National Vector Borne Disease Control Programme. Many technologies have been adopted by National programme.

The achievements of the IDVC project emphasise the importance of field-based research for continued support for vector borne diseases control. I am sure the experiences, findings and outcome of the project would help the vector control operations in different parts of the country.

I congratulate Prof. A.P. Dash, Director, National Institute of Malaria Research and his team for bringing out such a useful document. I also wish them a success in their future endeavours.

(N.K. Ganguly)
Director General



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MESSAGE

I am pleased to learn that the National Institute of Malaria Research (NIMR) is bringing out a Profile of IDVC project. The IDVC under NIMR is continuing for almost two decades and the field units are now reorganised. In the process, two new field units have been created in this year in Chhattisgarh and Jharkhand where the incidence of malaria is very high. The IDVC project has been operational in various epidemiological paradigms to support the national programme. The bioenvironmental strategy of malaria control; use of long-lasting nets, biolarvicides, larvivorous fish, diagnostic kits, the new drugs and insecticides have gone to the programme. The achievements of the IDVC project emphasised the importance of operational research for continued support to the programme. I am confident that the outcome would be of immense help to the programme and to others who have interest in malaria research. National Institute of Malaria Research is at the fore-front of malaria research in the country and provides critical support to malaria control activities in India. The IDVC field stations are pillars of NIMR and serving as a research backup for National Vector Borne Disease Control Programme. I congratulate Professor A.P. Dash and staff of NIMR and IDVC for their outstanding contributions and commendable efforts in progress of NIMR & IDVC project activities.

(Dr. Shiv Lal)

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MESSAGE

I am extremely happy to note that the National Institute of Malaria Research (NIMR) is bringing out a Profile of IDVC Project which has been running for almost two decades. The IDVC Project has been giving enough technical inputs to the programme. Many control measures have been included in the national programme basing on the findings of NIMR and IDVC Project. The IDVC Project located in ten different places in India works as a good networking system for the programme. The application of larvivorous fish, insecticide treated bed nets and various new formulations have been included in the programme basing on research carried out by different IDVC projects in the country. I congratulate the Director NIMR & staff for their significant inputs. I hope, in course of time, the IDVC Field Units will be an intramural activity of the ICMR under the Ministry of Health & Family Welfare, Govt. of India, which will continue to give support to the programme.

(P.L. Joshi)



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Preface

Malaria is a local and focal disease and its transmission is a dynamic process influenced by the changes in ecological conditions, agricultural practices, urbanisation, socio-economical factors, cultural practices, meteorological conditions, etc. Control strategy developed for one type of setting may not be applicable to or sustainable in other eco-epidemiological settings. It necessitates the need for constant research in different paradigms. A major public health programme like the National Vector Borne Disease Control Programme requires field research support for evaluating and updating its control strategies. The need for field based research was realised in the early 1980s, and the Integrated Disease Vector Control Project started under Science and Technology Mission mode. The project was assigned to be implemented by the Malaria Research Centre, now renamed as the National Institute of Malaria Research (NIMR).

In the course of time, NIMR set up 13 field units in different parts of the country as per the programme needs. Each unit was assigned to study local dynamics of malaria transmission and demonstrate feasible and effective methods of control so as to provide inputs to the local health department and the national programme.

Over the years, the field units have undertaken studies on the epidemiology, various aspects of vector biology, susceptibility status of vector species to the insecticides being used for indoor residual spraying, therapeutic efficacy of antimalarials against *Plasmodium falciparum* and *P. vivax* and demonstration of bioenvironmental methods or alternative methods such as insecticide-treated nets for control of malaria and other vector borne diseases. Other important activities included clinical trials of antimalarial drugs, evaluation of rapid diagnostic kits, new insecticides, larvicides and repellents, and health impact assessment of development projects. The project has immensely contributed in the development of human resources by imparting training to health professionals and non-health sectors as well as development of health education materials.

Various technologies have been transferred to the national programme, such as bioenvironmental methods of malaria control; insecticide-treated nets; use of pyrethroids for indoor residual spraying; biolarvicides, larvivorous fishes and expanded polystyrene beads for larval control; artemisinin-based combination therapy for treatment of malaria; use of rapid diagnostic tests; etc. The field units located in industrial, rural plains, urban, tribal forested and island ecosystems have further enhanced our knowledge on malaria transmission dynamics and suitable methods of disease vector control in different paradigms. The achievements of the project have been commendable as the project has provided direct technical support to the programme and helped in developing human resource in vector borne disease control cutting across health and non-health sectors in various parts of the country. In 2005, the project was approved by the Standing Finance Committee of the Government of India and as per its recommendations, the field units of the project have been reorganised. As a result, now there are 10 field units located at Nadiad (Gujarat), Hardwar (Uttaranchal), Sonapur (Assam), Jabalpur (Madhya Pradesh), Rourkela (Orissa), Bangalore (Karnataka), Panaji (Goa), Chennai (Tamil Nadu), Raipur (Chhattisgarh) and Ranchi (Jharkhand).

With a view to disseminate the experiences and conclusions drawn from the activities of these units, it was thought prudent to document the findings of the project so that the tools and technologies can be emulated by others for control of malaria and other vector borne diseases. I hope this profile would benefit all the stakeholders.

I take this opportunity to express my sincere thanks to Dr. V.P. Sharma and Dr. S.K. Subbarao, former Directors of Malaria Research Centre for their continued support. My special thanks go to Dr. V.P. Sharma for his technical inputs. I also wish to acknowledge the sincere efforts of all the Officers Incharge of the field units in generating valuable field data and compiling achievements of their respective field units. Dr. R.S. Yadav, Deputy Director (SG) & Officer Incharge, Nadiad field unit, Dr. R.C. Dhiman, Deputy Director (SG), NIMR, Delhi, Dr. N. Valecha, Deputy Director (SG), NIMR, Delhi and Dr. N. Nanda, Assistant Director, NIMR, Delhi deserve special appreciation for technical editing of the profile. The efforts of Publication Division, particularly of Mr. U. Sreehari, Assistant Editor, NIMR, Delhi are also acknowledged. I express my sincere thanks to the Director General, Indian Council of Medical Research for his constant support to this project.



A.P. Dash
Director

Acronyms

ABER	Annual blood examination rate	HRP	Histidine rich protein
ACD	Active case detection	ICGEB	International Centre for Genetic Engineering and Biotechnology
ACPR	Adequate clinical and parasitological response	ICMR	Indian Council of Medical Research
API	Annual Parasite incidence	ICT	Immuno-chromatographic test
BHEL	Bharat Heavy Electricals Limited	IDPL	Indian Drugs and Pharmaceuticals Pvt. Ltd
<i>Bs</i>	<i>Bacillus sphaericus</i>	IDVC	Integrated disease vector control
BSC	Blood slides collected	IEC	Information, education and communication
BSE	Blood slides examined	IGR	Insect growth regulator
<i>Bti</i>	<i>Bacillus thuringiensis israelensis</i>	IOC	Indian Oil Corporation
CDC	Centres for Disease Control & Prevention	IRCS	Indian Red Cross Society
CDRI	Central Drug Research Institute	IRS	Indoor residual spraying
CFR	Child falciparum rate	ITN	Insecticide-treated nets
CHC	Community health centre	JE	Japanese encephalitis
CMO	Chief Medical Officer	LLIN	Long-lasting insecticide treated nets
CPR	Child parasite rate	LPF	Late parasitological failure
CQ	Chloroquine	LTF	Late treatment failure
CSIR	Council of Scientific and Industrial Research	MCRP	Malaria control and research project
CV	Coefficient of variation	MHD	Man hour density
CVC	Comprehensive vector control	MLO	Malaria larvicidal oil
DDC	Drug distribution centre	MPI	Malaria parasite incidence
DDT	Dichloro diethyl trichloro ethane	MPO	Modified plan of operation
DMO	District Malaria Officer	MRC	Malaria Research Centre
DRDO	Defense Research and Development Organization	NAMP	National Anti Malaria Programme
EC	Emulsified concentration	NEDA	Non-conventional Energy Development Authority
EDPT	Early case detection and prompt treatment	NGO	Non governmental organization
EI	Inhibition of emergence	NICD	National Institute of Communicable Diseases
EIR	Entomological inoculation rate	NIMR	National Institute of Malaria Research
ELISA	Enzyme-linked immunosorbent assay	NMEP	National Malaria Eradication Programme
EMCP	Enhanced malaria control project	NTPC	National Thermal Power Corporation
EPS	Expanded polystyrene	NVBDCP	National Vector Borne Disease Control Programme
ETF	Early treatment failure	OD	Optical density
EVBDCP	Enhanced vector borne disease control project	OHT	Overhead tanks
FTD	Fever treatment depot	<i>Pf</i>	<i>Plasmodium falciparum</i>
G-6-PD	Glucose-6-Phosphate dehydrogenase	PHC	Primary health centre
GIS	Geographical information system	<i>Pv</i>	<i>Plasmodium vivax</i>
GLC	Gas liquid chromatography	PWD	Public Works Department
GR	Geographical reconnaissance	RMRC	Regional Medical Research Centre
HBI	Human blood index	RS	Remote sensing
HCH	Hexa-chloro-cyclo-hexane	RWH	Rainwater harvesting
HEC	Heavy Engineering Corporation	SC	Suspension concentrate
HIA	Health impact assessment	SFR	Slide falciparum rate
HPLC	High performance liquid chromatography	SPR	Slide positivity rate

UGT	Underground tanks	WDG	Wettable dispersible granules
UMS	Urban malaria scheme	WHO	World Health Organization
UV	Ultra violet	WHOPES	World Health Organization Pesticide Evaluation Scheme
VCRC	Vector Control Research Centre	WP	Wettable powder
VSP	Visakhapatnam Steel Plant		

Executive Summary

Return of malaria in the late 1970s, from near eradication, to all previously endemic regions superimposed by frequent outbreaks was an insurmountable challenge to the public health in India. Malaria Research Centre (MRC) now National Institute of Malaria Research (NIMR) addressed this problem and conceptualised an innovative approach to control malaria. This new approach to malaria control known as the “Bioenvironmental Malaria Control” was initially launched in 1983 in Nadiad Taluka, District Kheda, Gujarat. Villages in this area were experiencing high malaria transmission and deaths despite of indoor residual insecticide spraying of DDT/HCH and malathion. Within two years, active malaria transmission was eliminated from the experimental villages as monitored by epidemiological indices. The successful demonstration of malaria control attracted the attention of the government and international agencies. By 1992, 12 more feasibility-cum-demonstration projects on Integrated Disease Vector Control (IDVC) were launched in high malaria endemic areas. These field units were opened in various ecotypes throughout the country. Successful malaria control was demonstrated in rural, urban, industrial, forest and coastal areas. Bioenvironmental malaria control interventions successfully controlled malaria and simultaneously produced many collateral benefits of direct relevance to the welfare of the communities. Field research produced a number of new technologies and most of these were eventually absorbed by the National Vector Borne Disease Control Programme.

Currently malaria control heavily relies on the integrated methods. This switchover to integrated control has resulted in more cost-effective and sustainable malaria control, free from environmental contamination, and provides an opportunity for community participation. *Inter alia* these technologies are: mass production and distribution of larvivorous fishes in a variety of ecotypes, insecticide-treated bed nets, biolarvicides, repellents, health impact assessment in development projects to prevent vector/mosquito breeding, malaria teaching in schools, management of malaria in pregnancy, clinical trial of new drugs and combinations, in-depth epidemiology of malaria in various ecotypes, vector biology of immatures and adults, site preparation for malaria vaccine trials, mosquito proofing of water storage and water harvesting structures, economics and sustainability of malaria control interventions, amendment of urban by-laws, health education programmes for Doordarshan, etc. Several in-depth reviews by national and international experts have highly appreciated the field research outcome. The IDVC project created a large pool of technical manpower, provided training and consultancy services to the states, participated in various evaluations, and provided consultancy services to WHO and other organizations.

Malaria epidemiology is dynamic and has undergone a dramatic change during the last half a century. In addition, the country has witnessed emergence of arboviral diseases like dengue and chikungunya. Many new techniques are being developed by various laboratories throughout the world. Water harvesting, global warming, climate change, soil change, changing profile of agriculture are adding new dimensions to the vector borne diseases. In view of these changes, NIMR has reorganised its field units. Some field units were discontinued and two new units were opened. These field units have new mandate as per the need of the local situation. The field units will also actively participate in the planning and monitoring of the ongoing disease vector control interventions in the states.

Major Achievements of IDVC Project

Beginning in 1958, the national malaria eradication programme (NMEP) relied heavily on indoor residual spraying of insecticides for vector control during the eradication era until the early 1980s when the IDVC project was initiated. Since then the project has demonstrated feasibility of integrated disease vector control methods in various ecosystems such as rural plains, industrial units, urban areas, and forest areas, as well as an island. Important technologies demonstrated by the project and later transferred to NMEP (now renamed as the National Vector Borne Disease Control Programme, NVBDCP) are mentioned below.

Larvivorous Fish

The *Kheda Project* initiated in Nadiad taluka, Gujarat in 1983 to test alternative methods of control revived interest on use of larvivorous fish in malaria control including their mass production along with food fish by involvement of village *Panchayats*. Feasibility of use of larvivorous fish was demonstrated at various sites in rural, industrial and urban areas. Thereafter, the technology was adopted by the national programme in different states. The method is currently being used in 100 malaria endemic districts, entire states of Maharashtra and Karnataka, parts of Gujarat and many other states with World Bank support. It has been found a cost-effective technology. In several cities such as Chennai, Panaji, Ahmedabad, Surat and Mangalore, extensive use of larvivorous fish is being made. An independent assessment of the larvivorous fish programme in the country has reported that the technology has been fully imbibed in the malaria control strategy and is being scaled-up in new areas. Training manuals have been developed and programme personnel have been trained in different states. Taking inspiration from India's larvivorous fish programme, WHO Eastern Mediterranean Region has taken technical support from MRC (now NIMR) for a similar initiative.



Gambusia affinis



Poecilia reticulata

Environmental Management

The environmental management methods were shown to be cost-effective in Kheda and industrial complexes in Uttaranchal. These methods, which include safe storage of household waters, periodic cleaning of receptacles, improvement of drainage, earthwork for filling puddles and pools, solid waste management, use of expanded polystyrene beads, repair of water supply leakages, etc, now have become a component of the vector control strategy in urban areas of Chennai, Ahmedabad, Surat and Bangalore, several industrial complexes, seaport areas in Goa state and Konkan railways. As a result of the advocacy efforts of the project, urban by-laws have been modified in Chennai and Goa and a similar move has been made in Gujarat.



Filling of mosquito breeding habitats

Insecticide-treated Mosquito Nets

Field evaluation of insecticide-treated mosquito nets (ITNs) for malaria control was conducted for the first time in India in Kamrup district, Assam. The ITN programme was expanded to high malaria transmission areas in Sundargarh district, Orissa, Jabalpur, Madhya Pradesh and the Car Nicobar Island. ITN technology feasibility trials led to their acceptance as an effective tool for malaria control by the NVBDCP in malaria endemic areas of the country. A major programme is now underway for (re)treatment of nets owned by people. More recently, effectiveness of long-lasting insecticidal nets (LLINs) against malaria has also been demonstrated. ITNs and LLINs have therefore become an innovative technology to fight malaria in the country.



Distribution and insecticidal treatment of bednets

Biolarvicides

Large-scale, multi-centre trials of various formulations of biolarvicides such as *Bacillus thuringiensis israelensis* and *B. sphaericus* were conducted for the first time in the country at 13 field units of NIMR. For the first time, larval control alone led to the control of malaria and filariasis in endemic Primary Health Centres (PHCs) of Shahjahanpur district, Uttar Pradesh. These trials have led to the use of biolarvicides by the NVBDCP in urban and peri-urban areas for control of malaria and filariasis.



Spraying of biolarvicides in curing waters and storm drains

Health Impact Assessment

Major advances have been made in the use of health impact assessment (HIA) in environmental impact assessment at several locations in the country. For example, 760 km railway track of Konkan Railway was made mosquito free jointly by Railways and NIMR Goa unit. The work at the Sardar Sarovar Water Resources Development Project in Gujarat has received wide appreciation. Mitigating measures have been undertaken to prevent any outbreak of diseases in the command area. Currently, HIA is being done of the Bargi Dam and Narmada Sagar Dam in Madhya Pradesh state.



Filling up of breeding places along the Konkan railway track



Sardar Sarovar Water Resources Development Project in Gujarat where health impact assessment was undertaken

Therapeutic Efficacy Studies

Field units monitored the *in vitro* and *in vivo* sensitivity of *P. falciparum* to antimalarial drugs. A 7-day simplified *in vivo* test for the detection of R II and R III levels of resistance in *P. falciparum* to chloroquine was developed, that facilitated detection of several drug resistant foci in a short period of time in the country. Since 2001, using WHO standard protocols, therapeutic efficacy of chloroquine in vivax malaria was evaluated in Tamil Nadu, Navi Mumbai and Uttar Pradesh. Therapeutic efficacy of chloroquine and/or sulphadoxine-pyrimethamine (SP) in the treatment of falciparum malaria was evaluated in Assam, Gujarat, Tamil Nadu, Orissa, Karnataka, Uttar Pradesh, Goa, Madhya Pradesh, West Bengal and Jharkhand states. Similarly, artesunate and SP combination was evaluated for treatment of falciparum malaria in Assam, Orissa and Madhya Pradesh. Wherever treatment failure with chloroquine was found more than the accepted cut off levels, the drug policy was changed by the National Vector Borne Disease Control Programme.



Screening of patients for therapeutic efficacy studies at Chennai



Screening of patients for therapeutic efficacy studies in Uttar Pradesh

Information, Education and Communication

The audio-visual unit produced nearly 50 films and 15 brochures. Training modules were developed for engineers and architects for safe designs. IDVC project developed a demonstration-based approach to health education. For the first time, each year 50,000 students study elementary epidemiology of malaria and its control. They pass a special paper on malaria and take the benefit of grace marks for admission in professional courses. Goa's school health programme is an example to emulate in other states. IEC has now come to the centre stage of the National Vector Borne Disease Control Programme.



Exhibition on malaria



Demonstration of malaria parasites

Other Research Activities

Other major contributions of the project are given below:

- Several malaria rapid diagnostic tests namely Paracheck[®], Parasight[®], ICT, OptiMal[®], etc. were evaluated in Delhi, Gujarat, Tamil Nadu, Goa, Orissa, Assam and Karnataka. The programme and the private health sectors are now using many of these tests for the diagnosis of *P. falciparum* and *P. vivax* malaria.
- Phase III clinical trials of α - β arteether against uncomplicated *P. falciparum* malaria have led to the inclusion of the use of this drug into the National Drug Policy for the treatment of malaria. Further, new drugs and new artemisinin-based combination therapies are being evaluated for introduction into the programme.
- Comprehensive vector control strategies for malaria and dengue control in arid areas of north Gujarat and malaria, and dengue and Japanese encephalitis control in Karnataka have been developed.
- Following a retrospective study to measure the burden of malaria in Ahmedabad City, the malaria information system has been improved.
- Use of indoor residual spraying with insecticides in high risk areas remains an important tool against malaria. In view of the need of more effective insecticides following the development of resistance in vectors to conventional insecticides, several new insecticides namely deltamethrin, lambda-cyhalothrin, cyfluthrin, bifenthrin, chlorpyrifos methyl and alphacypermethrin evaluated with project support are now being used in the national programme for malaria control.
- A number of new larvicides have been evaluated at various field units.

Technical Support to Programme and other Agencies

- IDVC project has provided support in implementing various activities of the National Vector Borne Disease Control Programme such as for training, epidemiological investigations, malaria situation analysis, programme planning and evaluation, etc. More detailed information has been given in Chapter 18 : Support Provided to the Programme.