NAV News Letter

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RESEARCH PRIORITIES IN MALARIA CONTROL STRATEGY

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Insecticide spraying to control malaria has become unsustainable due to frequent upward revision in the cost of insecticides and need to introduce new and more effective insecticides to overcome the problem of vector resistance. Malaria control in large endemic areas is possible only through vector control, and residual insecticidal spraying strategy at one time leading towards malaria eradication has started producing diminishing returns. It is therefore imperative that chemical vector control is used selectively and integrated with other methods depending on the local determinants of malaria transmission.

IMPACT ORIENTED RESEARCH IN VECTOR BIOLOGY AND VECTOR CONTROL

The need of the malaria control programmes today is that vector control should be selective, cost effective, sustainable, eco-friendly and applied in an integrated fashion utilizing local technologies and resources. As far as possible community participation should be elicited, health education should be emphasized and intersectoral approaches should be utilized. These concepts should constitute the basic frame work in the planning of vector control. Given below are some research priorities in vector biology and control.

INSIDE

1. Vector Biology

This area of research was ignored in the past, to ensure good insecticidal coverage to achieve malaria control. Revised malaria control strategy requires a sound understanding of the bioecology of vectors in relation to available control tools and strategies. Studies in vector biology of direct relevance to control of vectors are :

1.1 Biology in Aquatic Stages

Larval ecology particularly breeding dynamics in relation to the ecological changes such as the geomorphological, hydrological, metereological, human settlements and development related.

1.2 Biology of Adults

Ecological Succession, adult vector behaviour particularly dispersal, biting activity, resting habits, preference, exophilic and exophagic behaviour.

1.3 Sibling Species Complex

Anopheline vectors of malaria comprise of species complexes which are indistinguishable morphologically but can be revealed by the application of cytological, biochemical, and molecular techniques. Biology of each sibling species may differ considerably and influence transmission dynamics. An area that is receiving emphasis is the development of DNA probes for the identification of species complexes in anopheline vectors, their distribution and biology for planning selective, sustainable and rational vector control.

1.4 Resistance to Pyrethroids

Mechanism of resistance particularly to synthetic pyrethroids, cross resistance, methods to delay the onset of resistance and rapid assessment of incipient resistance.

1.5 Vector incrimination

In recent years immunoradiometric assays (IRMA) and Elisa have become available for vector incrimination. It is important to study vector susceptibility and vectorial capacity of different vectors and their sibling species in endemic areas, and therefore this technique should be used extensively in vector incrimination. Knowledge on vector incrimination should be applied in : (i) understanding transmission

dynamics of malaria in various regions, (ii) determining malaria receptivity, (iii) planning revised malaria control strategy based on vectorial capacity and response to insecticides, and (iv) malariogenic stratification for selective and sustainable vector control.

1.6 Blood Meal Identification

Malaria vectors may have preference for the human blood or they may be zoophilic or indiscriminate feeders. It is therefore important to study man biting behaviour and the time of biting. To accurately determine the anthropophilic index, gel diffusion technique and micro-dot Elisa have been developed. These tests can detect source of blood meal in the gut of the mosquitoes even upto 30 - 40 hours, thus establishing man mosquito contact accurately. Simple studies in the biting rhythm of mosquitoes have shown that bed net programme may not produce desired results in areas where the vector bites early in the evening. This field research is particularly important for planning of insecticides impregnated bed net programme.

2. Vector Control

2.1 Slow release formulation

A new formulation to spray residual insecticides has been developed at the Rio de Janerio University known as the slow release emulsifiable suspension (SRES). This formulation is based on organic polymer polyvinyl acetate (PVA) and containing malathion as active ingredient. SRES has also been prepared for the synthetic pyrethroids like cyfluthrin, cypermethrin, deltamethrin, and permethrin, and it is possible to prepare SRES for DDT and HCH. The residual effectiveness of this formulation using malathion lasts for atleast 18 months as was demonstrated in the control of Triatoma bugs, the vectors of Chagas disease. Since 2 or 3 rounds of spraying with residual insecticides is the minimum requirement in the control of vectors, the SRES technology would be very useful in vector control as it would save several rounds of spraying. The new technology is environmentally acceptable as less insecticide is released into the environment, operationally advantageous as it eliminates 4 - 5 rounds in 2 year time period, and cost effective as compared to the spraying of residual insecticides as there is only marginal increase in cost of the SRES but enormous savings of insecticides and labour.

2.3 Insecticide impregnated bed nets

Mosquito bed nets or curtains treated with the synthetic pyrethroids can produce remarkable impact in lowering malaria transmission in areas where the vector is endophagic, biting rhythm coincides with the sleeping habits of the population and target vector species is sensitive to the insecticide. Insecticide impregnated bed nets have been tried in the control of endemic malaria in India against *An. minimus, An. fluviatilis,* and *An. culicifacies.* Results so far have been highly encouraging in terms of malaria control, and prevention from mosquito bites; but bed nets may not be suitable universally and requires the knowledge of the vector biting behavior, socio-cultural and sleeping habits of the target population, and a strong health education support. Applied field research is also indicated on the : (a) proportion of deterrent and killing action of SP compound used in the treatment of bed nets; (b) mechanism of resistance to SP compounds and cross resistance; (c) impact of bed nets in accelerating selection for exophilic vector behaviour; (d) role of curtains in malaria control; (e) counter-measures to overcome resistance and exophilic vector behaviour to SP compounds; and (f) sociology research to encourage bed net usage as an important method of malaria control. Studies are also required on the cost comparison with the residual application of insecticides and feasibility studies on the usefulness and practicability of bed nets in malaria control under the existing primary health care system.

2.4 Bioenvironmental control

Integration of biological and environmental management methods to control malaria has been demonstrated. In the application of this strategy it is important to select areas amenable to bioenvironmental interventions as large marshy areas, low population density areas, command areas and irrigation tracts with extensive seepages and misuse of water may not respond to these methods. Bioenvironmental technology is cost effective, ecologically sound, sustainable and can be linked with the income generating schemes. These methods control general mosquito breeding, thus addressing to the problem of mosquito nuisance as well as the transmission of vector borne diseases. Diffusion of this technology through field research and demonstrations is therefore indicated.

2.5 Biolarvicides

The two biolarvicides i.e., *Bacillus thuringiensis* H-14 and *Bacillus sphaericus* are now available in commercial quantities for application in malaria control. Studies so far were limited to laboratory investigations or small scale field trials. These formulations are highly effective in the control of Anophelines and Culicines in a variety of habitats except when the water pH is >10 or the temperatures fall <15 degree Celsius or so. In demonstration projects in India, the spraying of biolarvicides successfully controlled mosquito breeding and also interrupted malaria transmission. Recently it was demonstrated that mosquitoes rapidly develop resistance to Bs but not to Bt. Field studies are

indicated on the control of anopheline breeding in endemic areas (e.g., in the river bed pools) in the control of malaria.

2.6 Control of *An. stephensi*

A few technologies have emerged for the control of aquatic stages of *An. stephensi*. These are the mesocyclops, neem oil formulation, Insect growth regulators and biolarvicides. Depending on the location of breeding one of these formulation can provide long term control without harming the non-target species. *An. stephensi* type form and *An. stephensi mysorensis*, the vectors of rural and urban malaria respectively will respond to these methods. It will require good GR and health education to produce impact on transmission. *An. stephensi* control should rely on anti-larval methods e.g., in the 1994 epidemic in western Rajasthan (India). Field research on suitable anti-larval methods appropriate for communities and NGOs is indicated to fight malaria locally.

2.7 Expanded polystyrene (EPS) beads

EPS beads are very effective in the control of mosquito breeding in habitats which are not subject to wind current. Beads are very light, non-biodegradable, low cost and long term solution to the control of mosquito breeding. EPS beads can be applied alone or integrated with other anti-larval methods to control mosquito breeding in the pit latrines sluice valves, wells, water storage tanks. Research on the application of EPS beads along with other methods of control is indicated in the control of endemic malaria.

2.8 Larvivorous fishes

Guppy and Gambusia have been used extensively in the control of mosquito breeding in a variety of water habitats. Fishes are cost effective and environmentally sound methods of mosquito control. It is possible to produce larvivorous fishes by the billions and distribute these widely in endemic areas without any harmful effects on the ecology of the area or the indigenous fish fauna. Ponds and small lakes in the countryside can be used for the mass production of fishes at negligible cost. Larvivorous fish culture can be linked with edible fish and prawn culture without any loss of fish productivity. Unfortunately during the period of insecticidal control, larvivorous fishes as a method of vector control was completely forgotten. There is a need to revive the role of larvivorous fishes in malaria control. Research is also indicated on the search of new fishes and development of methods of transportation, packaging, release, maintenance of hatcheries, composite culture, ecological impact of the large scale use of fishes and methods of integration in malaria control.

2.9 Plant Products

Neem oil extracted from the seeds of *Azadirachta indica* is an excellent mosquito and sand fly repellent and a good larvicide. Application methods and formulations of Neem oil have been developed for use by the communities. This is a low cost, indigenous, safe and sustainable method to repel mosquitoes and control mosquito breeding.

3. Epidemiology

Malaria is entering into new areas due to environmental changes. A study on the impact of ecological changes, global warming and meteorological factors is important in the context of rapidly deteriorating malaria situation in some areas.

3.1 Epidemic forecasting

Entomological parameters for an early warning system should be developed and field tested in various eco-epidemiological zones. It may be noted that climate fluctuations have long been suspected to be the contributory factor in the transmission of malaria and other vector borne diseases. During El Nino southern oscillations (ENSO) or warm events the monsoon is lower than in the non-ENSO years. After ENSO, the cold or La Nina years, the monsoon is above average. A study of the rainfall in western Rajasthan showed that relation between ENSO and rainfall is particularly strong and coincided with malaria cases. The historic epidemics in Punjab were seen in years after the ENSO event. In 1983, major epidemics of malaria occurred in Ecuador, Peru, and Bolivia following a heavy rainfall which was again the same phenomenon. Since El Nino affects the rainfall and consequently the breeding potential of vectors. It is possible to forecast high and low risk to malaria and many other diseases transmitted by the vectors. This area is still unexplored and there is an urgent need to initiate some collaborative research with the meteorological experts in modeling and forecasting of malaria epidemics at the national and regional levels.

3.2 Malariogenic stratification

Malaria incidence is highly variable at village levels. Homogenous areas in a region could be separated using epidemiological indices. However, many parameters (e.g., epidemiological, entomological, intervention methods, human ecology) could be integrated to establish the cause and effect relationship in the chain of malaria transmission. Stratification is a dynamic process and should be directed in the planning of malaria control operations which are cost effective, sustainable and utilize local resources and talents.

3.3 Remote sensing

Satellite imageries have been used in the mapping and monitoring of vegetation, water bodies, buildings, terrain and in the forestry and agriculture to increase productivity. Scientists at the MRC applied RS in monitoring mosquito production in Sanjay lake in Delhi. It was possible to estimate total mosquito production from the lake and relate it with the resting mosquito populations. The

method however has the limitation that small water bodies which are the prolific mosquito production sites particularly for the anophelines are difficult to be mapped. However it is possible to relate mosquito production from the rice fields and this is now done routinely in the California, USA. Application of remote sensing is still in infancy and there are spectacular advances in the remote sensing technology in increasing the resolution. It is possible to predict mosquito production areas and seasons of high mosquito abundance. RS is now integrated with the geographical information system as an important parameter.

3.4 Geographical information system

GIS is being applied in a variety of development activities such as urban development, agriculture, industry, mining, forestry etc. GIS has been applied in health in the occurrence of river blindness and Chagas disease. GIS provides a range of powerful facilities for inputting, storing, retrieving, manipulating and displaying spatial information. In this technique relevant thematic maps are digitized and then overlaid. This is analysed using various computer software programmes. Resultant map brings out the cause and effect relationship. Recently GIS was taken up for the Kheda district and Car Nicobar island in India. Results brought out the diagnostic value of GIS in predicting malariogenic potential. This information can be used in planning situation specific interventions. Because of the ease with which GIS can provide malaria receptivity and vulnerability profile of a given area, this line of research is receiving increasing attention worldwide.

4. Applied Research

4.1 Problem of chloroquine resistance in *P. falciparum* is increasing. Urgent need is felt to investigate the transmission dynamics of drug resistance *P. falciparum* malaria through the local vectors.

4.2 Role of vector in diffusion and speed with which resistance strains are moving inwards from the international borders and development of control strategies.

4.3 Recent epidemics in India, Bangladesh, Bhutan have thrown up challenges in regard to vector control and management of disease.

4.4 Vector control along the international borders has always been problem. Studies are indicated on the precise role of vectors in malaria transmission. Arid zone ecology of malaria transmission is poorly understood particularly under the abnormal conditions of rainfall and irrigation. *An. stephensi* was a well known vector in Rajasthan but now there are vast stretches of water logged land due to Indira Gandhi canal where *An. culcifacies* has a strong foothold. It is important to investigate the vector biology of immatures and adult to develop new control tools.

4.5 There are very few studies on sociological factors affecting the success of malaria control programme. These studies have become all the more important in view of the change over to the integrated malaria control strategy envisaging active participation of communities and involvement of Panchayats in the prevention of malaria morbidity and mortality and in the sanitation programme. In this context it is important to understand the felt needs of the communities, how the communities perceive malaria, vector breeding sites, how these are being created, and what are the approaches to prevent environmental degradation to prevent creation of vector breeding habitats and improve the existing situation.

4.6 Success in insecticides impregnated bed nets will depend on the proper use and care of bed nets and therefore studies are indicated on the human factors that will interfere/encourage the proper bed net usages as a method of malaria control.

4.7 Studies are indicated on the precise role of vectors in malaria transmission. Studies are required to develop a package suitable for the Panchayat to prevent vector breeding and take remedial measures as may be required to interfere with the local transmission.

4.8 Cost effectiveness of malaria control requires continuous monitoring of the impact of interventions and a cost analysis directed to bring out the best combination of methods applicable under a given epidemiological situation. Therefore, practical methods of cost analysis under a decentralized malaria control programme would have to be developed, and field tested before these are incorporated into the training modules on the implementation of integrated malaria control strategy.

4.9 Health impact assessment (HIA) in the environment impact assessment (EIA) is being introduced as an important component of the malaria control strategy. In many areas of growing economy projects in the field of agriculture, industry, human settlements etc. have created enormous mosquito breeding potential. Research is indicated on the magnitude of this problem, mitigating measures which are cost effective and sustainable, and future planning to prevent malariologic conditions.

4.10 Vector control in relation to agricultural policies is an important area of research. Irrigation, land utilization, deforestation, cropping pattern, use of insecticides etc. all profoundly affect the abundance of vectors. There is a need to study vector biology in relation to these developments for sustainable vector control.

VECTOR RESISTANCE TO INSECTICIDES

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Rapid development of resistance to insecticides by insect vectors of human diseases during the past 50 years has jeopardised vector control programmes. More than 160 species of vectors have now become resistant to major groups of insecticides.

Massive repeated applications of insecticides to control vector-borne diseases have resulted in accelerated development of insecticide resistance in vectors at a time when the need to control them has become more urgent. Scientists have failed to appreciate the fact that insecticide resistance, an instance of micro-evolution, is indeed nature's subtle, rational and effective way to ensure survival of insects from the onslaughts of pesticide abuse. The appalling rate at which vectors are developing multiresistance and broad spectrum cross resistance has further eroded the efficacy of many useful insecticides. Also recent report of resistance to biocides in mosquitoes is a severe blow to substitute conventional insecticides with bioharmonious biocides. There is an increasing concern that extensive use of highly potent and safe pyrethroids in agriculture may precipitate selection for resistance in public health species and deprive their benefit in vector control. The future of chemical control looks bleak because on the one hand the pesticide armoury is depleting fast and on the other the prospects of new insecticides entering markets are dim due to the exhorbitant cost involved in developing new insecticides.

Many of the current approaches for managing resistance will provide only temporary mitigation as they are conceived without fully understanding the genetical, biological and ecological diversity that exist in vector populations. In fact these are dynamic and evolving natural populations which can easily adapt themselves to overcome the onslaughts of inimical environment. A reductionist approach to resistance management may not lead to success. This is exemplified by the fact that development of transgenic plants with *Bti* endotoxin gene failed to alleviate development of resistance to *Bti* in noxious plant pests. Insecticide resistance offers many opportunities for multidisciplinary basic research. A better understanding of the multidimensional resistance phenomenon will pave the way for a holistic, bioharmonious approach to managing resistance and to ensuring the continued use of insecticides in a scientific way. The motto should be to minimise its use while at the same time maximising its effect. It is abundantly clear from past experience that resistance management must be an ecofriendly approach in any integrated vector control programme where insecticide has an important role and it should not be an attempt to renew unrestrained use of insecticides in vector control.

ABOUT THE ACADEMY

The National Academy of Vector Borne Diseases is a nonprofit scientific/academic organisation established in 1994 in India with nearly 60 eminent senior scientists from 17 different States of the country. The Academy itself came into existence as a spin off from the recommendations made by a panel of experts from both India and abroad during the proceedings of the "**First International Symposium on Vectors and Vector Borne Diseases**" held at the Regional Medical Research Centre, Bhubaneswar in November, 1994.

The National Academy of Vector Borne Diseases (Academy) is a registered professional organisation dealing with vectors and vector borne diseases. The Academy published the proceedings of the International Symposium on Vectors and Vector Borne Diseases in September, 1995. The Academy also publishes a "**News Letter**" in every July which disseminates timely news of the Academy. The Academy also organises national/international symposia on Vectors and Vector Borne Diseases in alternate years.

Membership is open to any individual interested in any aspect(s) of Vectors and Vector Borne Diseases (i.e., epidemiological, control, clinical, entomological, parasitological, sociological, economics and cost-benefits and cost-effectiveness of control methods, etc.).

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The proceedings volume of the International Symposium on Vectors and Vector Borne Diseases held at Bhubaneswar in November, 1994 containing around 40 selected research papers (246 pages) is now available. Interested persons/institutions (not life members) are requested to send Rs. 550 (inclusive of postal charges) by M.O. or bank draft drawn in favour of the "Treasurer, National Academy of Vector Borne Diseases" to Sri R. K. Hazra (Treasurer of the Academy), Regional Medical Research Centre, Bhubaneswar 751 016, India. Limited copies are available.

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ANNOUNCEMENTS

Second Symposium on Vectors and Vector Borne Diseases

27 – 29th January, 1997 • GOA

The Second Symposium on Vectors and Vector Borne Diseases (Sponsored by Bayer India Limited) is proposed to be held at Goa from **27 th to 29th Jan., 1997.** The first circular has already been despatched. The abstracts may be sent to Dr. A. P. Dash, Regional Medical Research Centre, Chandrasekharpur, Bhubaneswar- 751 016, India before **15.11.1996.**

Registration fee : Students ... Rs. 200 (certificates from guides/institutions to be produced)
Others ... Rs. 500

The registration fee along with name, address, telephone and fax numbers, institutional affiliation etc may be sent to R. K. Hazra, Treasurer, National Academy of Vector Borne Diseases, Regional Medical Research Centre, Bhubaneswar-751016 before **30.11.1996** through bank draft (drawn in favour of the National Academy of Vector Borne Diseases, BHUBANESWAR) or by M.O.

The scientific programme will cover all aspects of malaria, filariasis, leishmaniasis, arboviral diseases and other vector borne diseases of man and animals. Fur further information, please contact : ***Dr. V. P. Sharma,*** *Director, Malaria Research Centre, 20 Madhuban, Vikas Marg, Delhi 110 092 OR* ***Dr. A. P. Dash,*** *Regional Medical Research Centre, Bhubaneswar 751 016, India.*

It has been decided to give the following awards by the Academy during the second symposium:

1. One for outstanding contributions in the field of Environmental Aspects of Vectors/Vector Borne Diseases.
2. One for outstanding contributions in the field of molecular aspects of Vectors/Vector Borne Diseases.

Applications/nominations (from head of the institutions) are invited from interested Life members along with biodata, list of publications and copies of five important publications in the field so as to reach **Dr. V. P. Sharma,** President of the Academy & Director, Malaria Research Centre, 20 Madhuban, Vikas Marg, Delhi 110 092, before 15th November, 1996. The awardee shall deliver a lecture on the subject of his work either during the symposium/annual meetings or at any other place as agreed by the Academy.

★ The Life Members of the Academy are requested to send their important achievements, if any, from time to time to Dr. A. P. Dash, Regional Medical Research Centre, Bhubaneswar 751 016, Orissa, India for possible inclusion in the Newsletter.

★ Members are also requested to intimate about their change of address, if any.

★ Mini review articles (2-4 typed pages) of good quality on any aspects of Vector Borne Diseases are invited from members of the Academy for possible use in the Newsletter.

★ Annual Members are requested to renew their membership before 31.12.1996.

NATIONAL ACADEMY OF VECTOR BORNE DISEASES

(Regn. No. 19767/199 of 1994-95 under Societies Registration Act XXI of 1860)

(Regional Medical Research Centre, Bhubaneswar - 751 016, India)

MEMBERSHIP FORM

(Kindly fill in the form and send it to **Dr. A.P. Dash**, Regional Medical Research Centre, Bhubaneswar-751 016, Orissa, India.
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Student Member	Annually	50	10
Ordinary Member	Annually	100	20
Life Member	Life time	500	50
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Patron	Life time	By donating more than 20,000	By donating more than US $2000

Members upto 31.3.1995 will be treated as founder members. The membership fees are likely to be enhanced from 1st April, 1995. The membership fee may be sent by bank draft (**drawn in favour of Treasurer, National Academy of Vector Borne Diseases, Bhubaneswar**) or M.O. to R.K. Hazra, Treasurer, National Academy of Vector Borne Diseases, Regional Medical Research Centre, Bhubaneswar-751 016, Orissa, India.

- Sl. No. 2,3,4 and 6 are not applicable for institutions.

Place :
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