
Pandu Wijeyaratne

Malaria Prevention

Lessons Learned

Environmental Health Project

May 1999

An estimated 300 to 500 million cases of malaria occur each year worldwide. In sub-Saharan Africa, malaria is the most important tropical disease, with 1.5 to 2.5 million deaths per year, most of them among children under five. One of four childhood deaths in Africa is caused by malaria, and Africa accounts for 80% of malarial morbidity and 90% of mortality. The World Bank estimates that in 1990 malaria was responsible for the loss of close to 32 million disability-adjusted life years (DALYs—a measure that combines mortality and morbidity). Reducing the burden of this disease is a high priority for Child Survival programs.

More difficult than assessing its toll of mortality and morbidity is assessing malaria's economic toll. In Africa alone the estimated direct and indirect costs of malaria were $800 million in 1987, the last year for which reliable figures are available. These costs were expected to reach $1.8 billion in 1995.

In the past, malaria control was addressed through large-scale programs in Asia and Latin America, principally house spraying. Many of these programs were allowed to lapse because the malaria problem was considered solved or because they were too expensive to continue. Now such programs are unsustainable, given the budgets and institutional capacities of many countries. Few African countries were ever able to support such programs. USAID is now taking a fundamentally different approach with the Africa Integrated Malaria Initiative (AIMI), which combines malaria control with existing maternal / child health services, and the 1998 Infectious Diseases Strategy.

The experience of the Environmental Health Project (EHP) in malaria prevention consists of support to AIMI and the Infectious Disease Strategy, development of tools and techniques, and technical assistance assignments in both Africa and Latin America.

Support to AIMI and the Infectious Diseases Strategy. EHP has supported AIMI programs in Malawi, Kenya, and Zambia in collaboration with other organizations: the U.S. Centers for Disease Control and Prevention (CDC) and the African Medical and Research Foundation (AMREF) and with USAID's Child Survival project, BASICS. Activities have included collection of baseline information, intervention design, workshop planning and facilitation, production of brochures and newsletters, and facilitation of the 1997 International Conference on Insecticide-Impregnated Bednets and Other Materials organized by USAID. EHP has also developed tools and techniques specifically for AIMI: an assessment tool (discussed below) for judging the feasibility of insecticide-treated materials (ITMs)—bednets and curtains—for malaria control in a given locale, and a framework for monitoring and evaluating AIMI programs.

EHP Goal: Develop and test approaches for the prevention of malaria and integrate them into ongoing programs.

EHP is currently playing an active role in implementation of two of the four emphasis areas of the 1998 USAID Infectious Diseases Strategy: the control and prevention of malaria

Malaria Prevention is part of a series of leaflets produced in 1999 by the Environmental Health Project (EHP) to document lessons learned in eight results areas. EHP is a project of USAID's Office of Health and Nutrition, Bureau for Global Programs, Field Support and Research. This series was produced by EHP under the management of Camp Dresser & McKee International Inc. with funds from USAID (Contract No. HRN-C-00-93-00036-11). Other leaflets cover *Diarrhea Prevention, Environmental Sanitation Policies, Behavior Change, Services for the Urban Poor, Community Involvement, Risk Assessment,* and *Institutional Strengthening.*

and surveillance. Activities underway include

- assessments of the surveillance systems in Malawi and Mozambique, followed by development of action plans for improving them,
- technical assistance to the USAID missions in Bolivia and Honduras to plan infectious disease programs, including vector-borne disease control, and
- strengthening the surveillance capacities of the Vector-Borne Disease Research and Training Center in Hetauda, Nepal.

Development of Tools and Techniques. EHP has developed approaches for knowledge-attitudes-and practices surveys and rapid assessment methods for identifying malaria risk factors in urban areas and has expanded the use of geographic information systems (GIS) for malaria prevention and control programs. In Zambia, GIS has supported district-level planning for malaria control. In Nepal, GIS is assisting the initial planning of epidemiological studies and local surveillance. In Lagos, Nigeria, GIS played a role in a rapid assessment conducted by EHP with BASICS to examine the prevalence and distribution of malaria. A large number of persons with fevers and associated clinical conditions were being treated for malaria; but the assessment revealed that malaria was not the problem.

Integrating Malaria Prevention in Child Health Programs. In partnership with BASICS, EHP helped develop community-based district-level approaches for malaria prevention to complement case management at the health facility level for the Zambian Child Health Project.

These activities included community-and-clinic-based development and implementation of education / behavior change approaches and materials for treatment and prevention of malaria; defining urban malaria transmission patterns; and pilot-testing of environmental control strategies in Kitwe, Zambia.

EHP has also worked in malaria activities in Latin America. In Bolivia, EHP presented to the Ministry of Health a reorganization plan for the vector-borne disease control program. In Peru, EHP worked in partnership with CDC to reach a better understanding of malaria transmission in the tropical Amazon, including the status of antimalarial drug and insecticide resistance.

LESSONS LEARNED

The following lessons are based on EHP experience in ten countries in Africa and Latin America.

Lesson One: *In sub-Saharan Africa, malaria appears to be increasing in urban areas, requiring alternative assessment and control strategies.*

Urbanization is proceeding rapidly in sub-Saharan Africa. It is estimated that 43% of the population will live in urban areas by the year 2000, and evidence indicates that urbanization is having a significant impact on malaria epidemiology.

Formal urban development can typically reduce anopheline mosquito vector densities, but the informal, peri-urban settlements found at the edge of many major urban centers in sub-Saharan Africa create conditions favorable to anopheline vector breeding. During the initial stages of their development, these suburban slum areas are frequently nothing more than expanded rural areas with mosquito breeding sites essentially unchanged.

Conventional thinking has generally held that formal urban areas do not support significant levels of malaria transmission. The concentration of human populations in a city is normally accompanied by pollution and the destruction of clean water sources required by the *Anopheles* vectors. However, in South Asia, *An. stephensi* has successfully adapted to breeding in water sources even with a high organic content. A recent report on the adaptability of *An. gambiae* to breed in household water containers in Accra, Ghana, documents similar vector adaptability. If this level of biologic responsiveness is found in other species of the vector, the way of thinking about malaria in urban centers in sub-Saharan Africa may have to change dramatically.

An EHP assessment of factors influencing malaria in the city of Kitwe, Zambia, and its environs confirmed that malaria in Kitwe is mostly of local origin and not transmitted from rural areas. The assessment recommended three inter-related interventions: standardizing malaria management at health centers, destruction of mosquito breeding sites, and mass promotional campaigns for ITMs. Many Kitwe neighborhoods are taking action to improve drainage, plant trees, and remove solid waste from swampy areas to reduce vector breeding.

In urban areas, larval control methods can often be quite effective because breeding sites are relatively easy to identify and control. However, consideration of biologic control approaches, source reduction, and larvicides clearly depends on the specific local circumstances. Each situation must

"Malaria control is everybody's business and everyone should contribute to it, including community members and people working in education, environment, water supply, sanitation, and community development. It must be an integral part of national health development, and community action for control must be sustained and supported by intersectoral collaboration at all levels and by monitoring, training and evaluation, and operational and basic research."

— WHO Fact Sheet on Malaria (No. 94), October 1998

be carefully evaluated before an intervention method is adopted.

Lesson Two: *Methodological approaches for assessing malaria transmission and risk factors need to be simple and rapid but scientifically acceptable.*

A major constraint to developing rational malaria prevention plans is the lack of a simple but scientifically acceptable method for assessing malaria risk factors and transmission patterns in a localized area. Most assessment methods now in use are expensive, time consuming, and complicated. For lack of adequate assessment tools, health authorities often base their decisions for control / prevention on malaria data routinely collected from health centers. These data are often unreliable because they are based mostly on clinical diagnoses not confirmed in the laboratory. Political pressure or anecdotal information may be the deciding factor in program design. In most cases, neither epidemiological nor community information is considered.

EHP has developed and tested an approach for the rapid assessment of local malaria transmission patterns and risk factors to generate data for immediate planning of cost-effective control measures. The approach, which was successfully applied by EHP in Zambia and Nigeria, was designed for urban situations but can be readily adapted for rural.

The assessment is conducted in two phases. The first, *very rapid* (seven to ten days) phase answers two questions through a weight-of-evidence assessment: Is malaria present? Is it of local origin? If malaria is present, the assessment moves to phase two (an additional two months) for the identification of local transmission factors.

Phase two combines three types of assessment: (1) environmental and entomological, (2) disease prevalence, diagnosis, case management, and treatment, and (3) sociological. Methods include on-site inspection of neighborhoods and homes, sampling of mosquito larvae and adults, blood sampling for parasitemia, focus group discussions with health facility personnel, examination of health records, and surveys of residents. The assessment can be completed by a small local team composed of persons with training in laboratory diagnostics, entomology, health, and the social sciences. This rapid approach was reviewed and critiqued in a multi-agency meeting hosted by EHP in February 1999 and is described in "Urban Malaria in Sub-Saharan Africa," an EHP Activity Report.

Resources spent on malaria prevention and control, without an adequate assessment of local conditions, may be wasted. Malaria epidemiology is not the same everywhere; numerous anopheline mosquitoes with different breeding and biting patterns carry the disease, and there are several varieties of malaria. Other factors also must be considered: variations in health care systems, residents' education, socio-economic conditions, drug and insecticide resistance, availability of commodities such as bednets, and so on.

Lesson Three: *Risk area mapping can play a leading role in planning and surveillance for malaria prevention and control.*

Decades of experience confirm that successful malaria control programs depend on accurate identification and geographical reconnaissance of high risk areas in order to target control measures. Modern mapping approaches, such as computerized geographic information systems (GIS), are economical, efficient, supportive of other health systems, and rapidly becoming user-friendly. They far exceed the capabilities of manual approaches in terms of amount of data that can be included and ease of updating, correlating, and manipulating the data. Planners can get new insights into the nature of the malaria problem and potential solutions by bringing together a variety of data on a single map. Community members can assist in gathering and verifying local information.

Mapping malaria endemic locations and risk areas based on eco-geographic and demographic data helps health authorities understand the human and environmental factors that determine malaria transmission patterns. Such an understanding is critical for effective allocation of resources to malaria prevention.

GIS Mapping

GIS maps prepared for Lusaka have the potential to display the following type of information as overlays:

- district and township boundaries
- health facilities
- schools and churches
- market places
- population distribution
- industrial, commercial, and residential areas
- roads and railroads
- water wells and boreholes
- water and sewage distribution and treatment facilities
- solid waste dump sites
- malaria vector breeding sites
- reported malaria cases

Existing health data alone may not be reliable enough to guide malaria programming, but if they are combined with good environmental, population, and geographic data through GIS, a picture of malaria risk areas and possible options may emerge.

For example, in Zambia, until EHP introduced GIS, the Lusaka District Public Health Office and Lusaka City Council had no systematic approach to tracking the geographic spread of malaria (and cholera); nor did they have any accurate environmental health maps of a scale that could be used for planning of prevention and control. The GIS maps enabled the District Health Management Team to identify malaria-prone areas where preventive activities will be accelerated.

GIS mapping has not been extensively used by the health sector, but other sectors have used it widely. They can share their data and resources with the health sector and train health-sector personnel. The costs of computer facilities and software for GIS are modest, given the high utility and the potential impact of this tool for malaria prevention.

The intersectoral collaboration involved in gathering, sharing, and coordinating data can serve as a model for other cross-sectoral programs.

Lesson Four: *It is important to identify and carefully plan for essential operational research prior to implementing ITM programs.*

Although ITMs have proven efficacy in controlled field trials, they are not effective in all situations. Before an ITM program is launched, a number of issues need to be considered to assess feasibility and to guide design:

- Current use, practices, and attitudes towards normal bednets and ITMs and costs in relation to household income,
- Current malaria prevalence and transmission, including seasonality,
- Essentials of malaria vector ecology as related to ITMs, e.g., biting behavior and times,
- Susceptibility of the vector to the chemical of choice for impregnation of nets,
- The potential role of the health system and other relevant community organizations, both public and private, and
- Government policies, regulations, and available resources.

Reaching an understanding of these issues may involve feasibility assessments and pilot projects.

EHP has developed a practical approach for arriving at a "go" or "no-go" decision on the feasibility of ITMs in a particular area. Feasibility is based on five types of criteria: epidemiological, cultural, infrastructural, economic and sustainability, and central government policy. The guide contains forms for collecting data and steps for analyzing the data and making a decision about feasibility.

In situations where ITMs are feasible, and the decision is "go," the program should be shaped by local conditions concerning demand, accessibility, affordability, and appropriate use.

Careful planning for obtaining reliable information on these topics is a must. For example, EHP established an entomological database, including vector susceptibility to Cyfluthrin (the insecticide of choice for the ITM program in Malawi). This work was carried out with Population Services International (PSI) as part of operations research for social marketing of ITMs.

OUTSTANDING ISSUES

Prevention and control of malaria cannot be achieved by the health sector alone. In the majority of countries, as well as among donor agencies, there is a great opportunity to expand malaria control activities beyond disease management. Malaria transmission is strongly influenced by land clearing, irrigation and other agricultural practices, exploitation of natural resources, local effects of home building, as well as changing demographic patterns. Because of the diversity of these associated problems, malaria control requires a cross-sectoral vision and a nonconventional operational strategy open to the active participation of governmental and nongovernmental organizations, the private sector, and the local community.

Increased capacity-building for full involvement of communities is needed to sustain malaria prevention. Aside from efforts to develop a malaria vaccine, current malaria prevention activities focus primarily on promoting the use of ITMs and secondarily on reducing vector breeding sites and larviciding, where indicated. These activities are effective but not sustainable without community involvement. The absence of vector-control programs—for nearly a generation in some areas—has resulted in reduced awareness and knowledge of breeding sites. This knowledge should be reintroduced as a way to mobilize communities for reduction of breeding areas. As mentioned, EHP has helped define community-based strategies for ITMs and, where appropriate, for vector control, but there is still much to be learned.

—Panduka Wijeyaratne, EHP Program Director for Tropical Disease Prevention, and Andrew Arata, EHP Senior Tropical Disease Specialist

Reports Available from EHP

"An Annotated Bibliography on Malaria." (EHP)
"Chloroquine Efficacy Study in Zambia, 1995-1996" (EHP A.R. 15).
"Community and Household Assessment of Malaria Prevention in Eastern Province, Zambia: Summary of Findings on Knowledge, Attitudes, Behaviors, and Practices" (EHP A.R. 51).
"Indicators for Programs to Prevent Diarrheal Disease, Malaria, and Acute Respiratory Infections: Report of a Meeting of an EHP Technical Advisory Group" (EHP A.R. 46).
"Urban Malaria in Sub-Saharan Africa" (EHP - forthcoming)

To request technical assistance or to find out more about EHP, contact:
Dr. John Borrazzo, Environmental Health Advisor, Office of Health and Nutrition, RRB 3.07-026, Bureau for Global Programs, Field Support and Research, U.S. Agency for International Development, Washington, D.C. 20523-3700
Tel: (202) 712-4816 • Fax: (202) 216-3702 • E-mail: jborrazzo@usaid.gov