VECTOR SURVEILLANCE AND CONTROL: LESSONS FROM PMI IMPLEMENTATION IN AFRICA & ASIA

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www.rti.org

Outline

- PMI - outputs & outcomes
- Challenges to vector surveillance & control
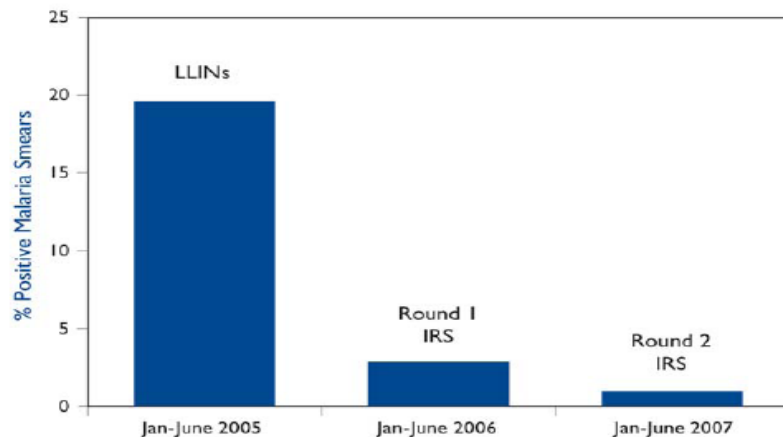- Strategic approach to address challenges

Indoor Residual Spraying

Spray inside walls of houses one time per year with long-lasting insecticide

Effective however requires more logistics than ITNs

Evidence of Early Impact:
Frequency of Positive Malaria Smears
in Children Under Age 2, Zanzibar, 2005–2007

Insecticide Treated Mosquito Nets

4

ITNs - Mixed Distribution Models

ITNs on Display in Shoprite Store

- Free distribution
  - Campaign
  - Routine distribution (clinics)

- Targeted subsidies (including vouchers)

- Facilitate commercial sector
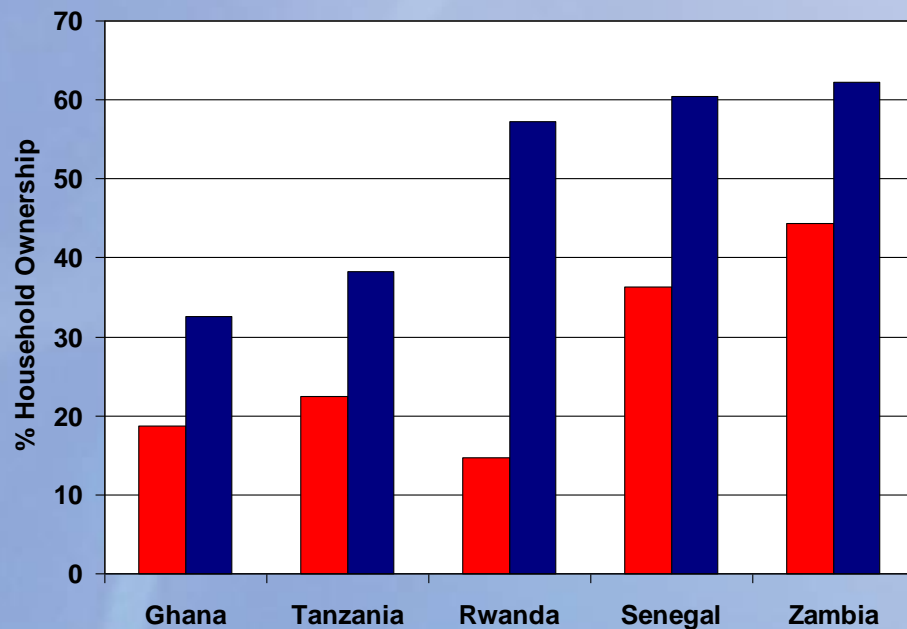
RTI
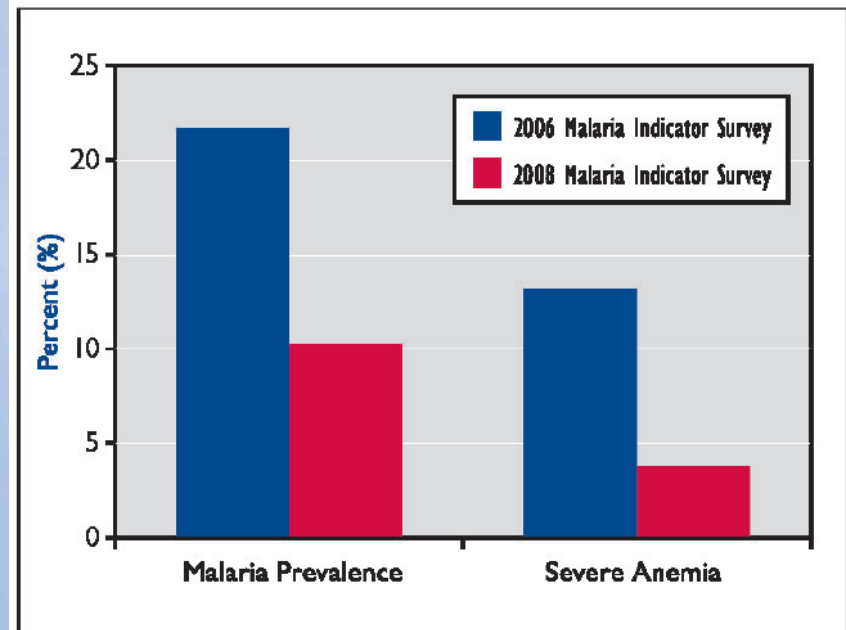INTERNATIONAL

PMI Progress as at Jan 2010 (year 4)

- IRS in 15 countries, 24.7m protected
- 27,8 million LLINs procured
- 57.8 million ACT
- 11.35 m RDTs procured
- 4m IPTp treatment procured
- Several thousands trained in IPTp and as CHW

Results

Change in LLIN ownership

Decline in Malaria Prevalence and Severe Anemia in Children Under Five Years of Age, Zambia, 2006–2008

SCOPE OF CHALLENGE

- Inadequate policy and institutional framework

  - ✓ persistent distortions due to decentralization

- Inadequate trained personnel and lack of critical specialties

- Absence/inadequate critical infrastructure

- Changing vector population dynamics and transmission profiles

- Politico-social disruptions

- High migration and atypical risk scenarios vis a vis major tools

Integrated Vector Management

"A rational decision-making process for the optimal use of resources for vector control" WHO 2008

Desired Outcomes:

Ecological soundness………. Cost-effectiveness…….. Sustainability

Characteristics

1. Advocacy, social mobilisation and legislation
2. Collaboration within health sector and with other sectors
3. Integrated approach (range of interventions, often in combination & synergistically)
4. Evidence-based decision-making (VC Methods based on knowledge of factors influencing local vector biology, disease transmission & morbidity)
5. Empowerment and involvement of local communities and other stakeholders
6. Capacity-building

Capacity consideration

1. Policies/strategies

2. Program management

## 3. Human resource priorities

- Staffing requirement by levels and competency area
- Geographical and structural distribution of competencies
- Training opportunities, major skill areas and numbers trained
- Efficiency in staff deployment and utilization success
- Staff retention and carrier pathways

4. Some major competency areas

Epidemiology	Vector ecology
Entomology	Anthropology
Program management	Health economy
Procurement & logistics	Communication & public education
Data management	pesticide management
Monitoring &Evaluation	Financial management
Capacity building	Tools specific field skills

5. Infrastructure (insectaries/ento labs)

Amazon and Mekong:
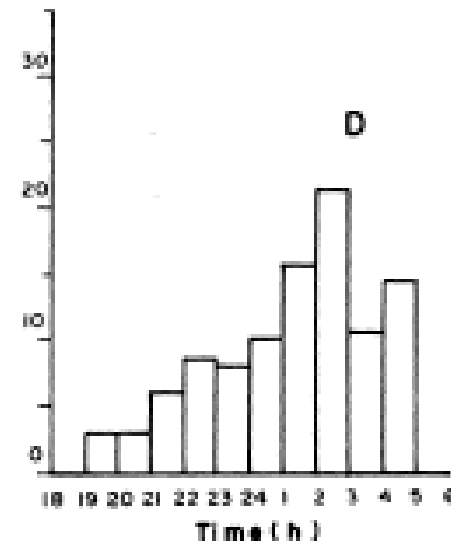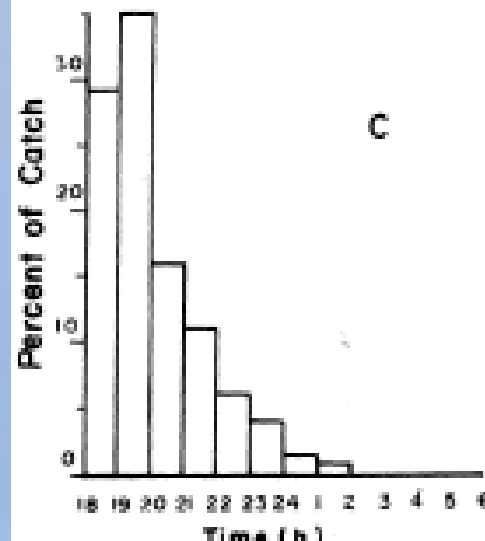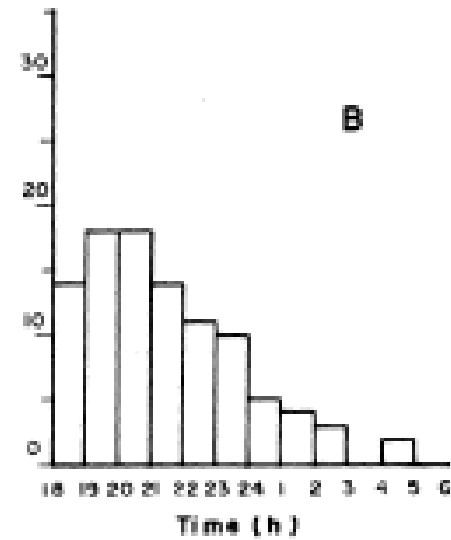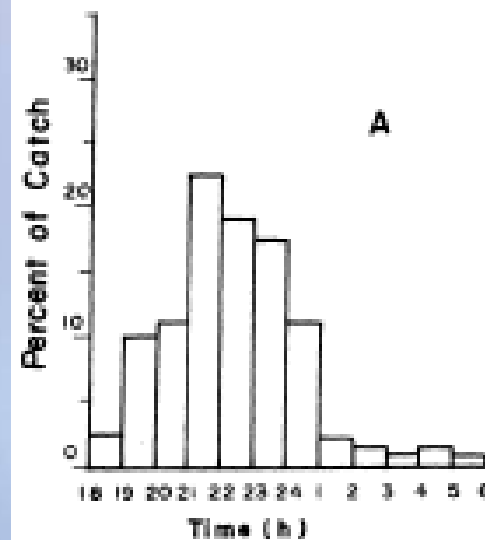## personal protection for mobile forest populations
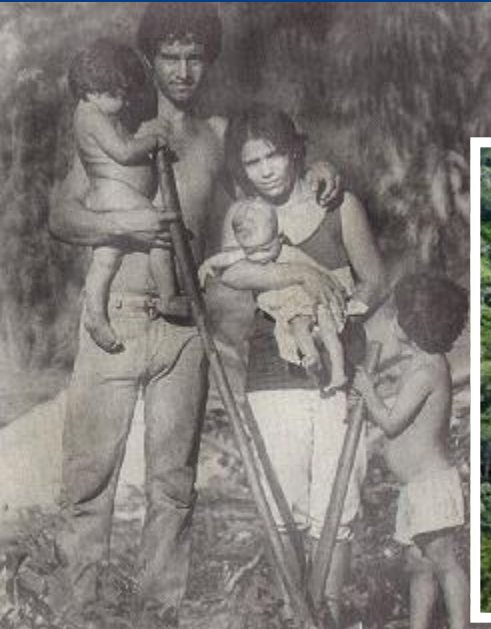
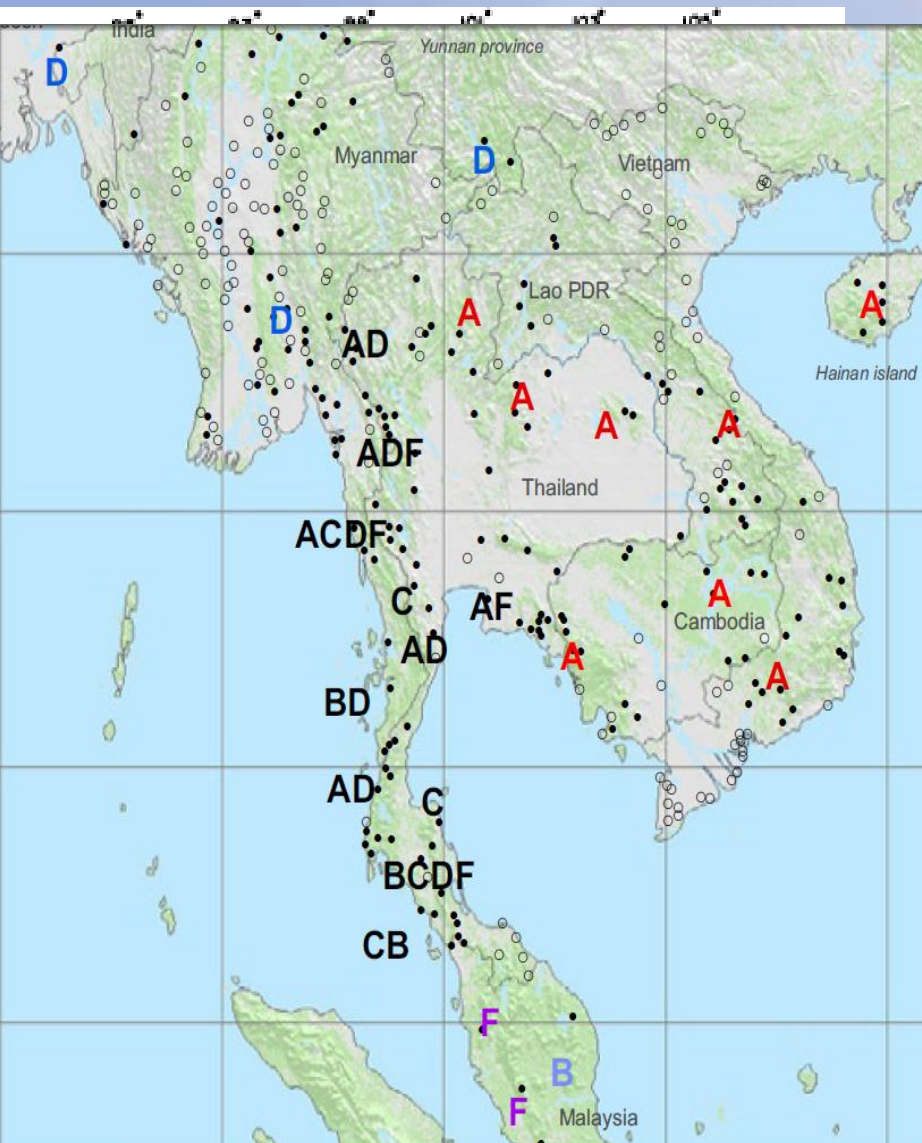# *The vectors*

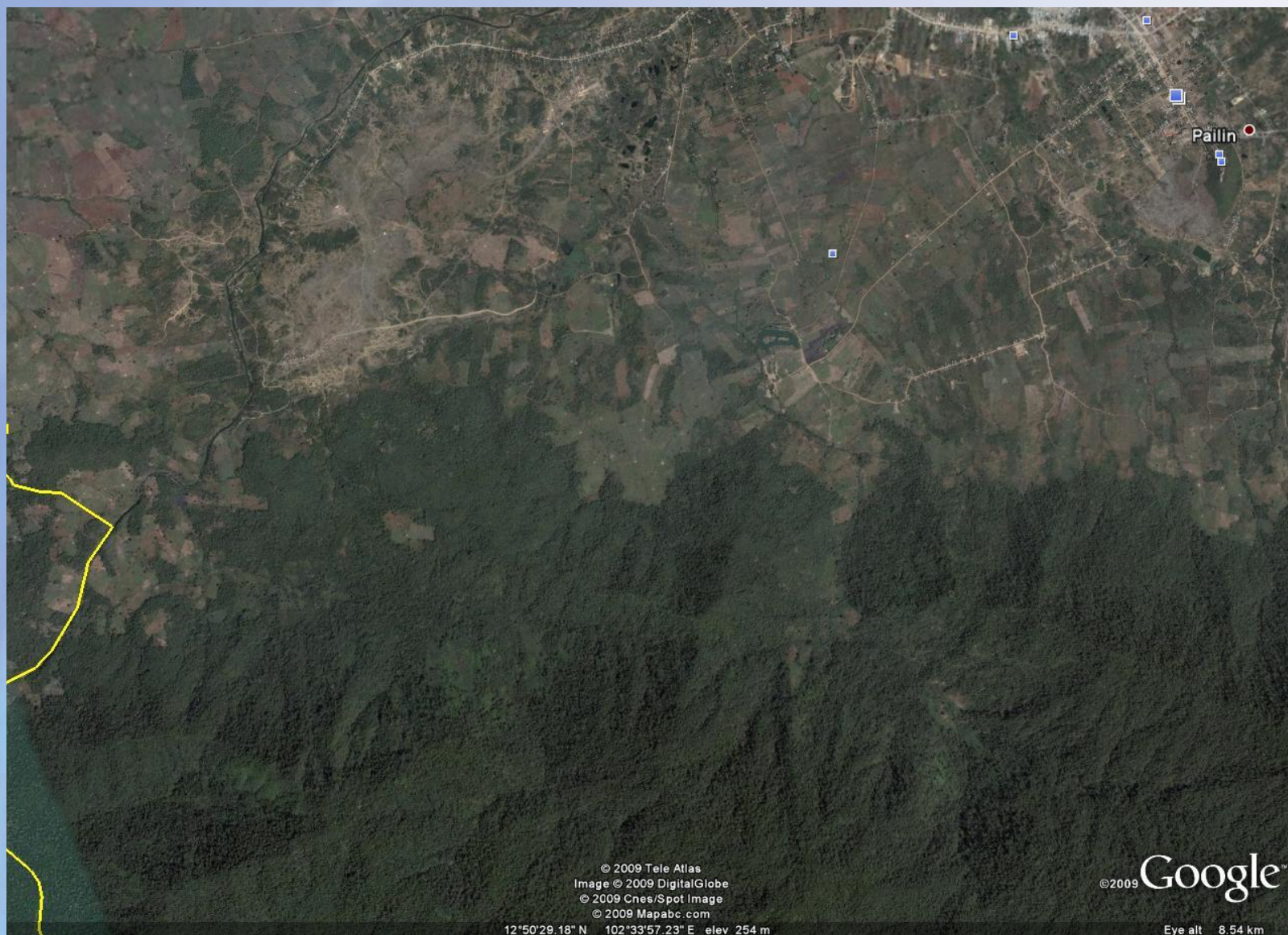## *An darlingi*   *An dirus*

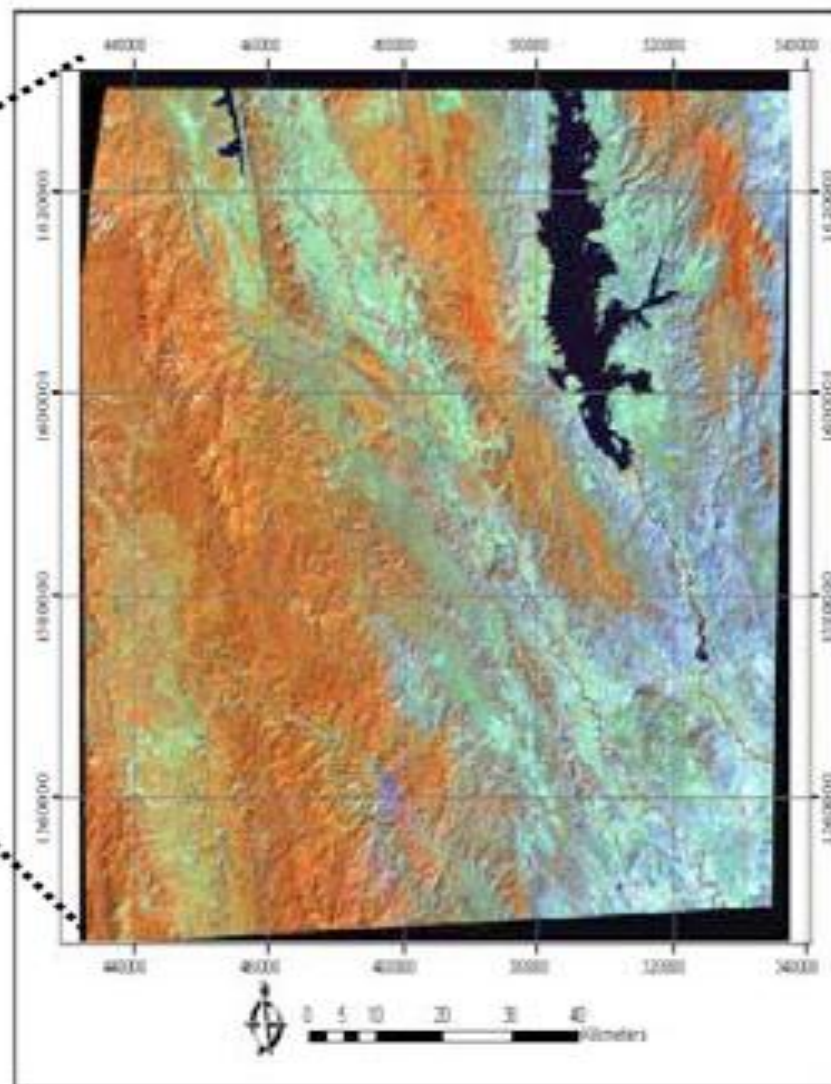# Biting times *An dirus* complex
Baimai et al 1988

Pailin, Cambodia

An minimus and *An dirus*

Charoenpanyanet 2008

Repellents: Para-methane-diol and Lemon grass oil vs DEET

Sarah Moore, Sam Darling et al (2007)

Table 2: Efficacy of 2 repellents tested 3 to 6 hours after application during study B in Peru.

Treatment		All mosquitoes Hours post application						Anopheles darlingi Hours post application					
		3	4	5	6	Mean	95 % C.I.	3	4	5	6	Mean	95 % C.I.
20 % oil control	AM	44.44	62.11	38.44	40.11	46.28	27.97 – 46.58	31.11	54.78	34.11	35.44	38.86	20.05 – 37.64
	WM	34.52	53.05	31.46	29.27	36.13[a]		22.10	44.60	23.05	24.79	27.52[a]	
	% P	-	-	-	-	-		-	-	-	-	-	
PMD/LG Repellent	AM	1.33	1.78	1.67	4.78	2.39	0.73 – 2.10	1.11	1.56	1.44	3.89	2.00	0.63 – 01.80
	WM	0.82	1.08	1.15	2.52	1.32[b]		0.66	0.93	1.05	2.17	1.14[b]	
	% P	97.01	97.13	95.66	88.08	94.84		96.43	97.15	95.78	89.02	94.85	
20% DEET	AM	15.22	19.78	13.89	18.44	16.83	10.17 – 17.25	13.56	18.33	12.89	17.22	15.50	9.13 – 15.76
	WM	10.59	16.12	11.68	15.28	13.28[c]		9.59	14.96	10.59	13.59	12.02[c]	
	% P	65.75	68.15	63.86	54.03	63.63		56.41	66.53	62.21	51.41	60.11	

AM = arithmetic mean mosquito landings per person hour.
WM = William's mean mosquito landings per person hour. Means followed by different letters are significantly different.
% P = Percentage protection i.e. 100 - ((mosquito landings on treatment ÷ mosquito landings on control) × 100).

Treated uniforms in the Americas

Soto et al.   CID 1995;21 (September)

Table 1. Efficacy of permethrin-impregnated uniforms in the prevention of malaria and leishmaniasis in Colombian soldiers.

Disease	Permethrin group	Control group	P value*
Malaria			
Total no. of subjects	86	86	
Total no. of cases (% infected)	3 (3)	12 (14)	.015
Leishmaniasis			
Total no. of subjects	143	143	
No. with indicated site of infection			
Face	1	1	
Ear	1	0	
Hand	1	4	
Arms	0	6	
Back	1	4	
Legs	0	3	
Total no. of cases (% infected)	4 (3)	18 (12)	.002

NOTE. There was a 79% reduction in disease in the malaria group and a 75% reduction in disease in the leishmaniasis group.
* Determined with use of the χ^2 test.

ITNs and forest workers Thailand

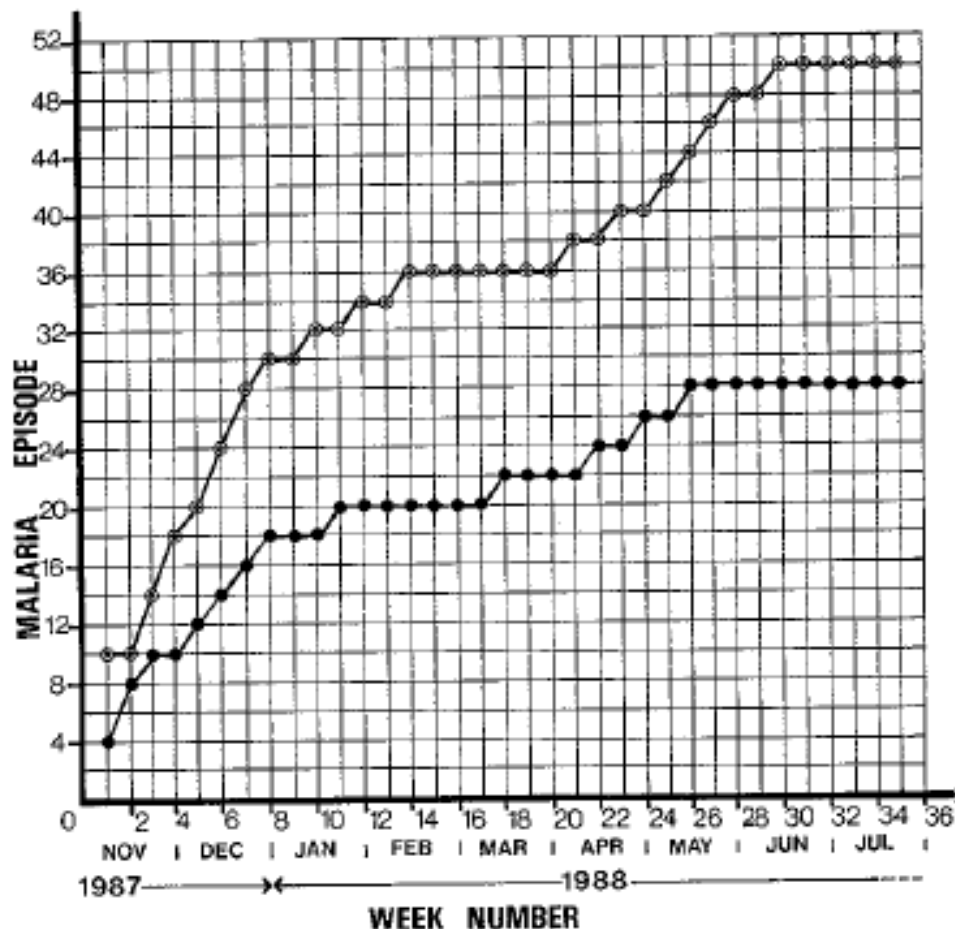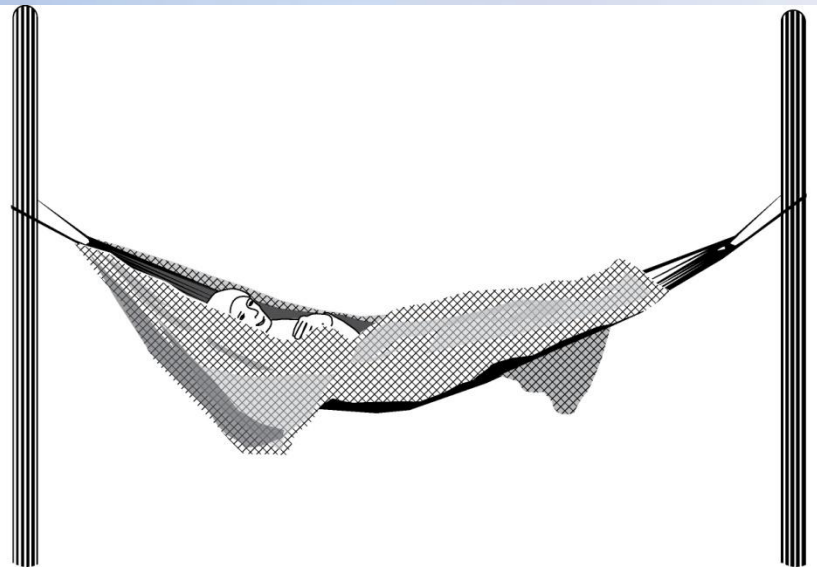308   KAMOL-RATANAKUL AND PRASITTISUK

FIGURE 1. Cumulative number of *Plasmodium falciparum* and *P. vivax* infections during the 35-week observation period of the study. ● — permethrin-treated nets; ⊘ — untreated nets.
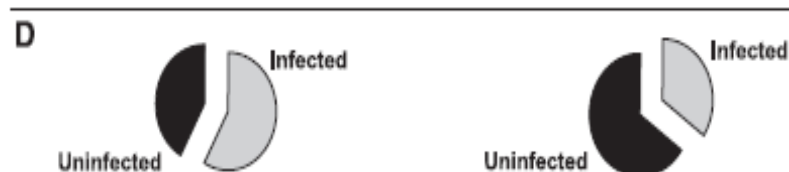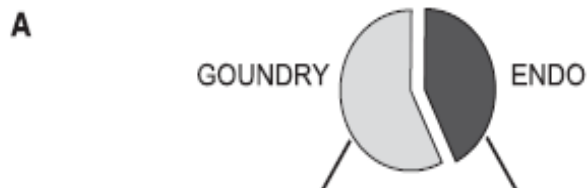
Hammock Nets

- Magris Yanomami Venezuela 2007 (84%)
- Thang Vietnam 2009 Prev 16.7-11.7%
- Sochantha Cambodia (in press) *An. dirus* (46%)

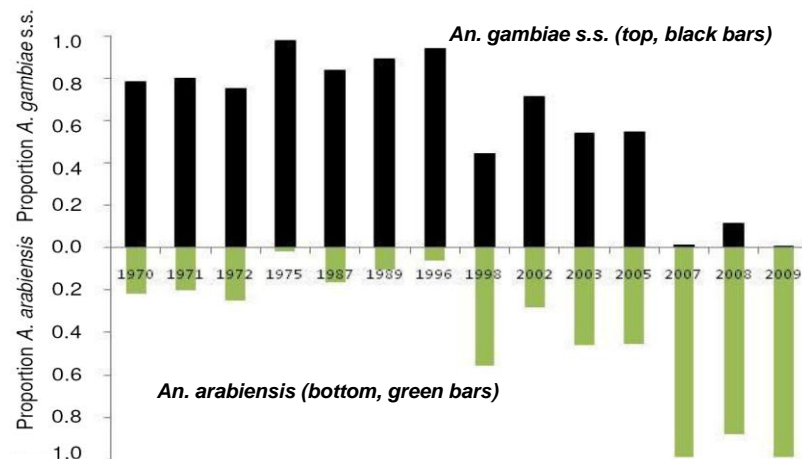# Outdoor Transmission in Africa

A Cryptic Subgroup of
Anopheles gambiae
Is Highly Susceptible to
Human Malaria Parasites

Michelle M. Riehle,et al

ITNs and IRS Programs can Change Vector Populations & Behaviour

An. gambiae s.s. (top, black bars)

An. arabiensis (bottom, green bars)

M Nabie Bayoh (2010) Malaria Journal 2010, 9:62

Shifting *A.gambiae to An. arabiensis*

STRATEGIC APPROACHES

Broad scope of challenges

- Inadequate policy and institutional framework

  - persistent distortions due to decentralization in terma

- Inadequate trained personnel and lack of critical specialties

- Absence/inadequate critical infrastructure

- Changing vector population dynamics and transmission profiles

- Politico-social disruptions

- High migration and atypical risk scenarios vis a vis major tools

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Strategic Approach : Mobilizing global resources

Partnership (global, regional and country level)

- mobilizing various constituencies for joint action.
- Work groups on "evidence generation", "capacity strengthening" & "advocacy and communication")

Concentrate initially on high impact small steps (low hanging fruits) for early successes, then on high impact major steps which may require some lead time

- Guidance, manuals and evaluation toolkits [*Handbooks Policy Documents, M&E for IVM*]
- Increased opportunities/access to training: *Training materials & institutionalize harmonized IVM training course*

Country Level Priorities

- Development of appropriate policy/institutional frameworks in endemic countries

- Establishment of critical competencies/capacities

  - Trained human resources
  - Critical infrastructure
  - Generation/management/utilization of local data

- Improving efficiencies and sustainability of ongoing programs

- Reorienting national vector borne disease control programming & management philosophies to enable full IVM

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Understand constraints/strengthens then orient Programs

Should be based on comprehensive national vector control needs assessment **(VCNA)**
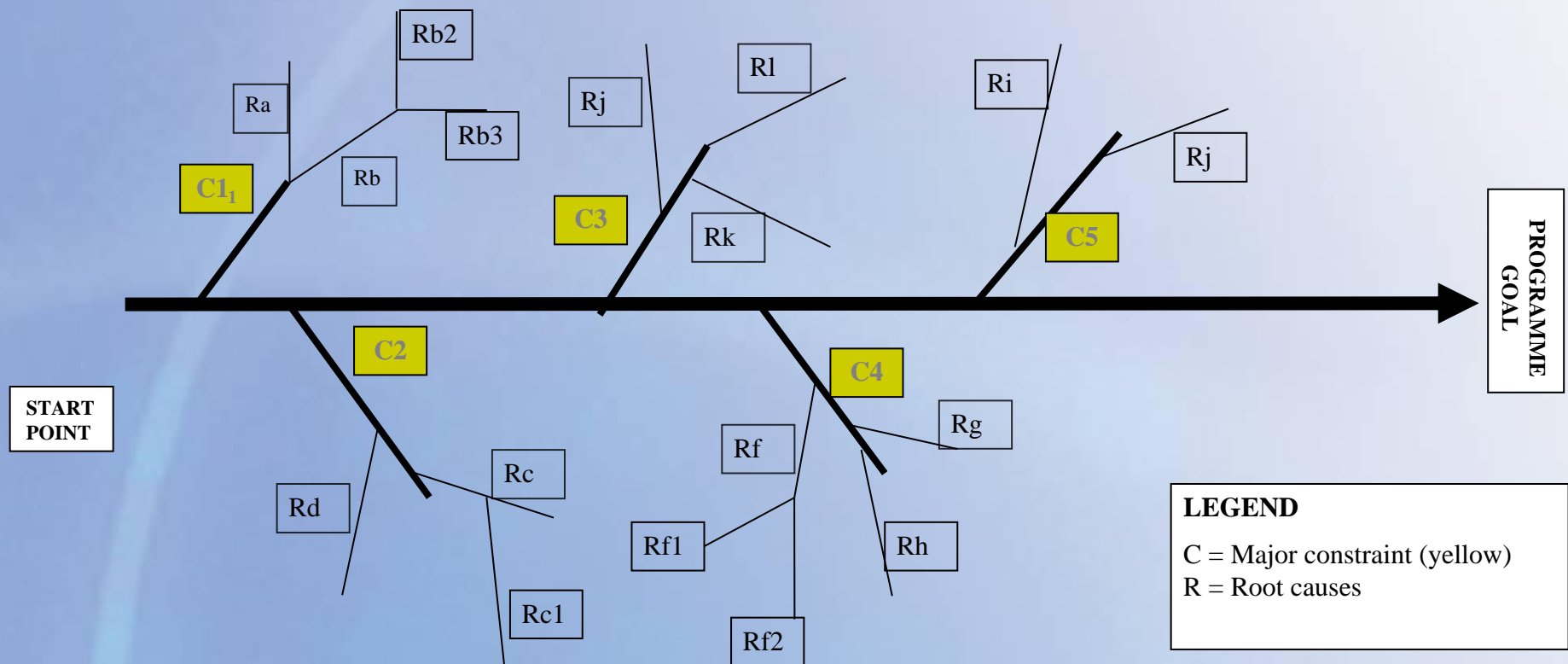
- What is working/not working and why
- National goals and relevant modification required
- needs for addressing problems and achieving set goals

Critical Steps in Implementation: Desirable M & E Attributes

Effective Monitoring:

- *Routine tracking of key elements of program performance (inputs, outputs)*

- *Ability to use findings to correct actions, improve program efficiency, quality, safety, performance*

Effective evaluation:

- *Assessment of attributable change in targeted results (outcome, impact)*

- *Ability to correctly evaluate assess changes in transmission risk, morbidity, mortality*

Facilitates transparency, accountability, resource mobilization, policy review/development

Comprehensive ento-monitoring scheme for vector control

Category 1 Basic Entomological Evaluation (monthly)
1. Species composition & morphological identification (monthly)
2. Vector density (adult: indoors/outdoors and larva)
3. Landing catches
4. WHO wall bioassay of IRS insecticide residual efficacy and cone assays for LLIN
5. Vector susceptibility tests 2x/year for WHOPES approved insecticides

Category 2: *Entomological Evaluation with enhanced capacity*

Year 1: monthly baseline followed by frequency indicated:

1. Vector identification (genetic) density & population structure (quarterly)
2. Sporozoite rate (quarterly)
3. Entomological inoculation rate (quarterly)
4. Blood meal analysis (quarterly)
5. Parity (quarterly)
6. PCR-based vector resistance (annual)
7. LLIN Effectiveness evaluation (annual)

Other: *Eco-epidemiological/Biological factors*

1. Meteorological: rainfall, humidity, temperature etc.
2. Larval productivity: water temp, transparency, nutrients, and other vector breeding place characterization
3. Utilization of LLINs or IRS coverage
4. Housing structure versus vector biting rate/EIR risks
5. Population based parasitemia
6. Socio-economic status

Country Capacity Strengthening for Vector Control

Entomology training
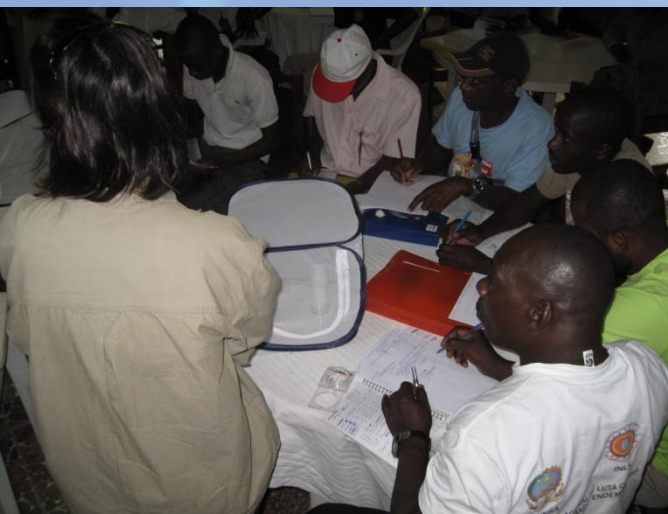
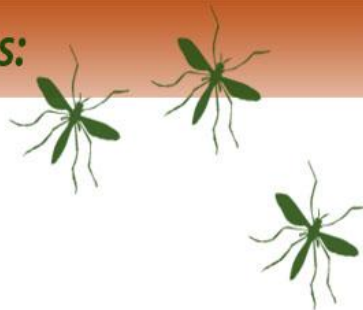# Supporting strengthening of country capacity: Providing critical products

Increase training opportunities

Focus on strengthening program management capacities

Focus on improving implementation techniques

IF MALARIA IS A SOCIAL PROBLEM THEN…..
VECTOR CONTROL MUST BE A WHOLE SOCIETY AFFAIR

Examples of Country Capacity Strengthening for Vector Control

Angola

- Insectary/ento lab complex in Vienna

- $50k equipment procured to support insectary and surveillance

Rwanda

- VCNA completed and IVM strategy in Q1-Q2 2011

- Support establishment of 12 station national sentinel system (GFATM)

- Sentinel staff training/mentoring

- Comprehensive monitoring scheme with monthly collections

- Insectary and wild and susceptible colonies established

- ELISA-based entomology lab with CDC

Liberia

- LIBR and entomology lab

- $64k equipment procured

- ELISA equipment in February-March 2011

Burundi

- VCNA under preparation

- IVM strategy/work plans:Q1 2011)

Mali (New FY11 addition)

- VCNA began in February 2011

- National IVM Strategy and work plans (Q3/4 2011)

DR Congo (FY11)

- Entomology baseline 2011

- SOW:Capacity strengthening (April '11)

- Increase use of remote sensing to enhance targeting of intervention

- Mainstream/improve use of niche control products
  - ✓ Repellents
  - ✓ Treated Hammocks / Nets
  - ✓ Treated clothing etc

- Monitor the impact (including transmission ecology) of niche products: Establish common protocols and communication on their implementation

- Confirm proof of principle and community acceptability on products

- Improve vector mapping and insecticide resistance monitoring in the Mekong

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Core Lessons on approaches

- Know what you wish to change: What is/not working and why?

- Identify critical low hanging fruits for improving surveillance and control

  - ✓ Policy & institutional arrangement to harness existing national capacities [**You are richer than you think!!**]
  - ✓ Technical competencies to build
  - ✓ Data generation, management and utilization scheme

- Inventory institutions working on personal protection