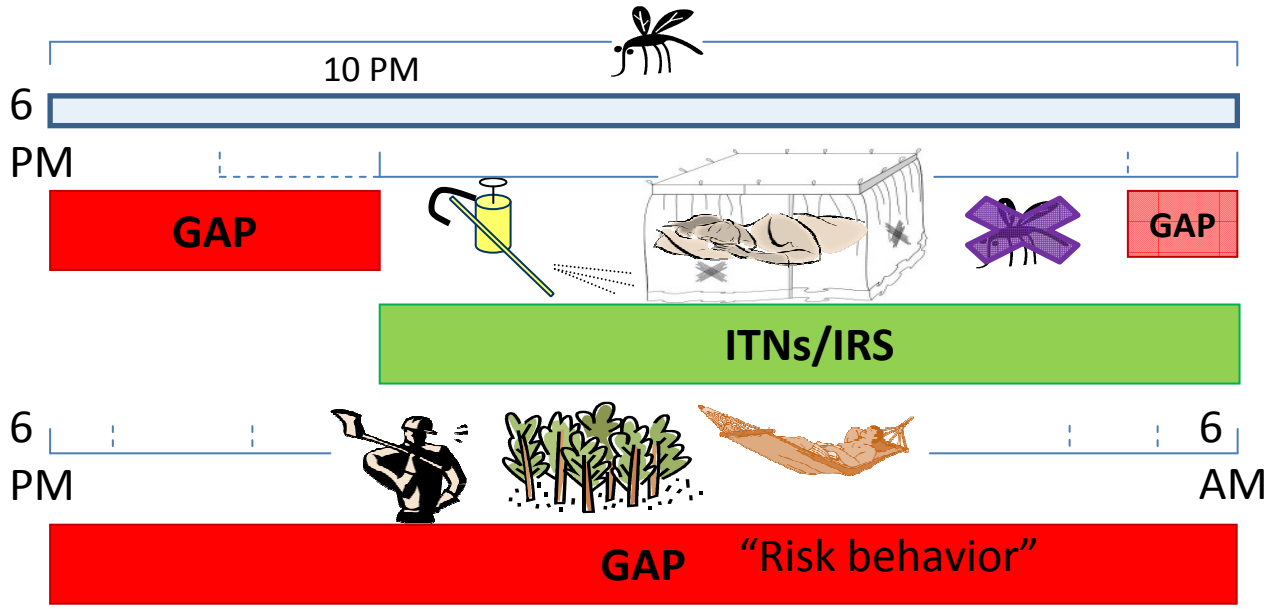
Outdoor Malaria Transmission Work Stream

Review of the current situation and magnitude of outdoor malaria transmission, and potential control tools

Marc Coosemans

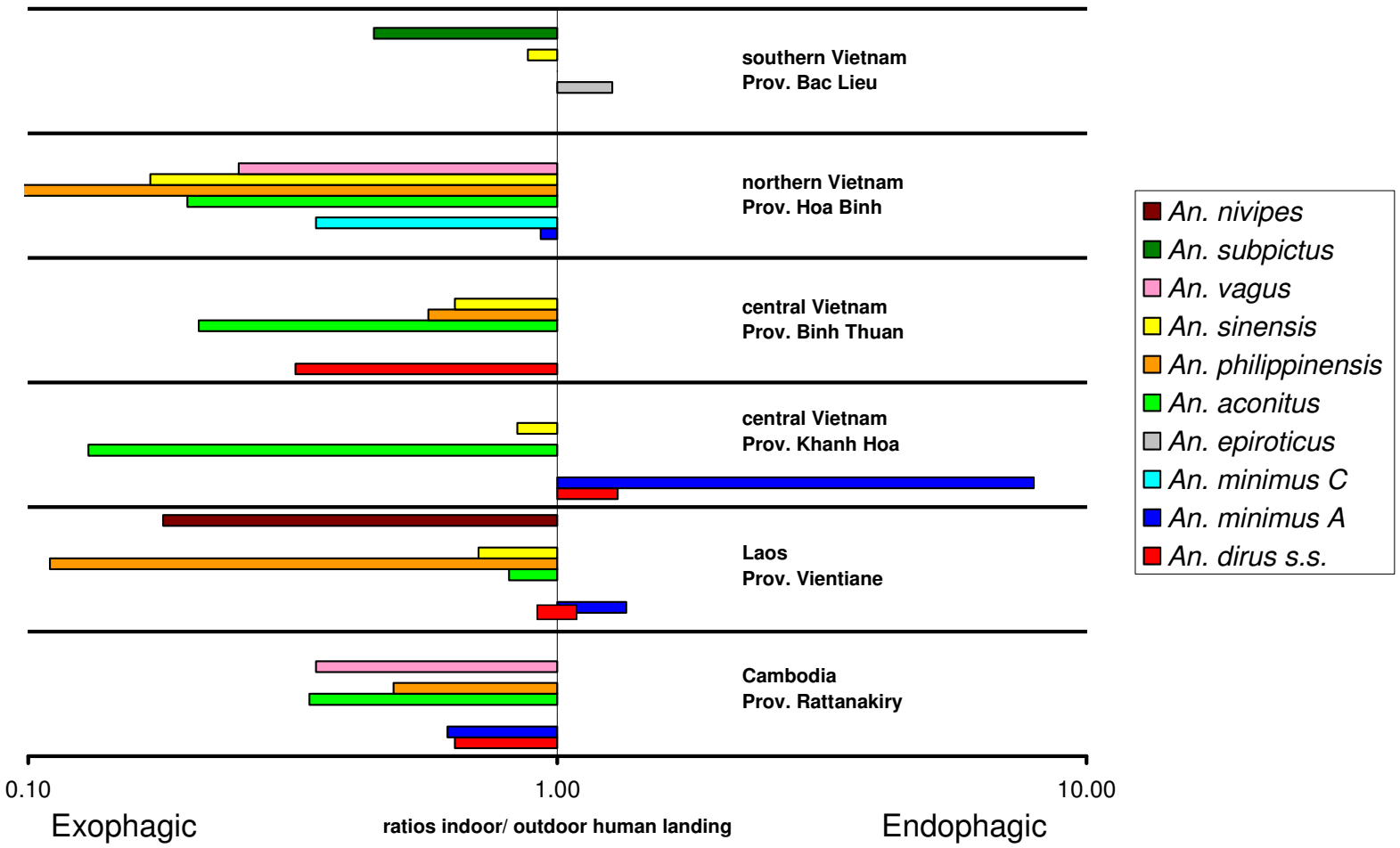
Introduction



Scaling up ITNs and IRS have contributed significantly to a worldwide decrease of malaria, but:

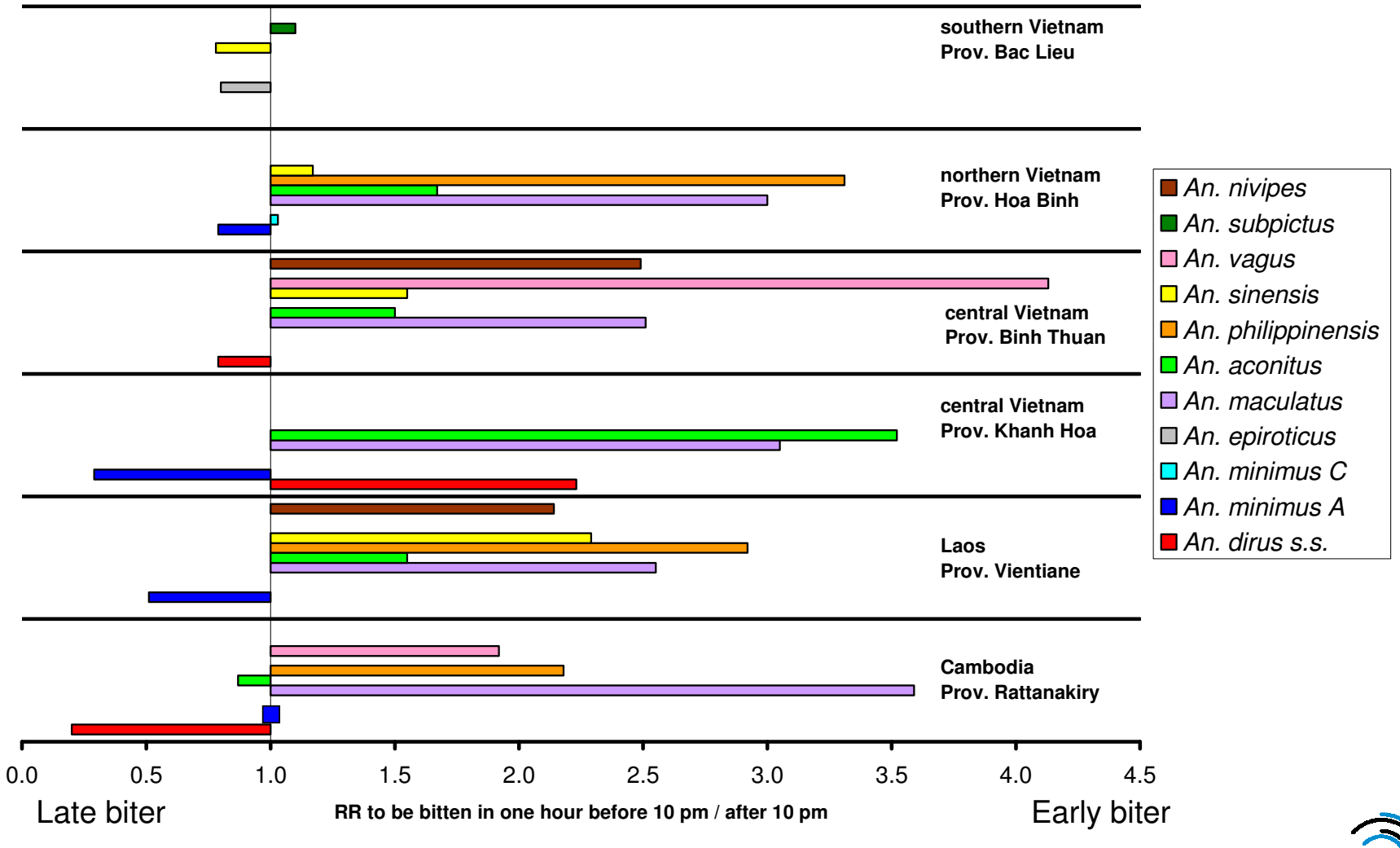
- IRS has little impact on **outdoor resting vectors**
- ITNs do not affect **outdoor and/or early biting vectors**

Indoor/outdoor biting behavior is species and location dependent



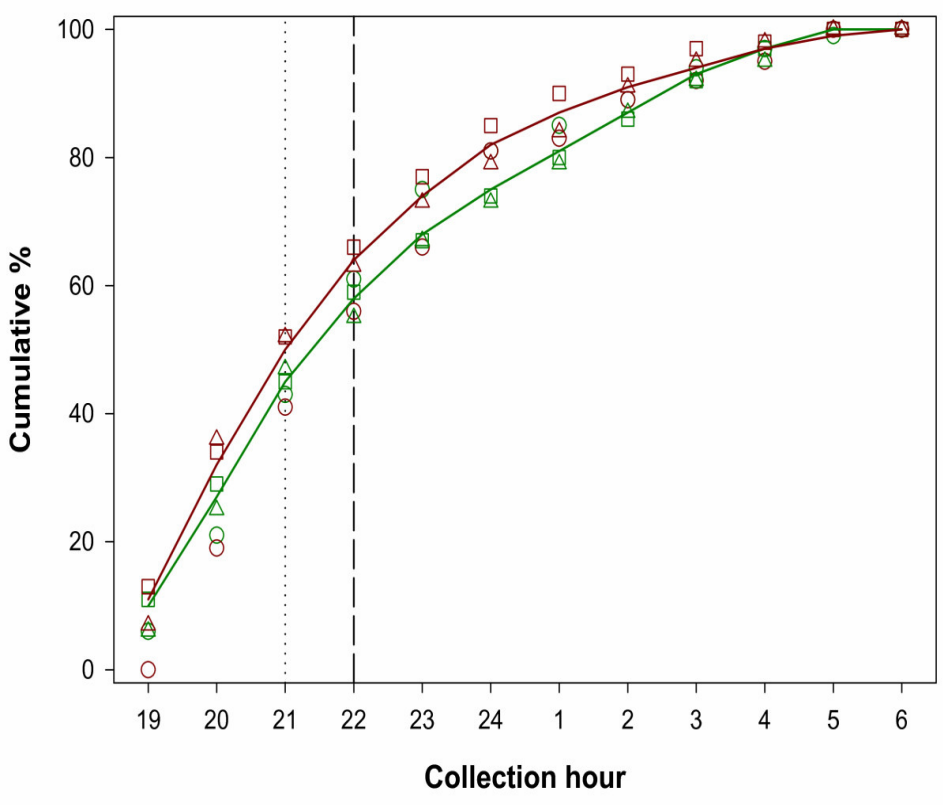
Trung et al, 2005, Trop Med Int Health, 10:251-62 ;
ıs & Van Bortel, 2006

Early biting behavior is species and location dependent



Trung et al. 2005

High early biting rate (up to 60% before 10 pm) in Ninh Thuan (Vietnam). Van Bortel et al. Malaria Journal 2010, 9:373



O *An. dirus*,

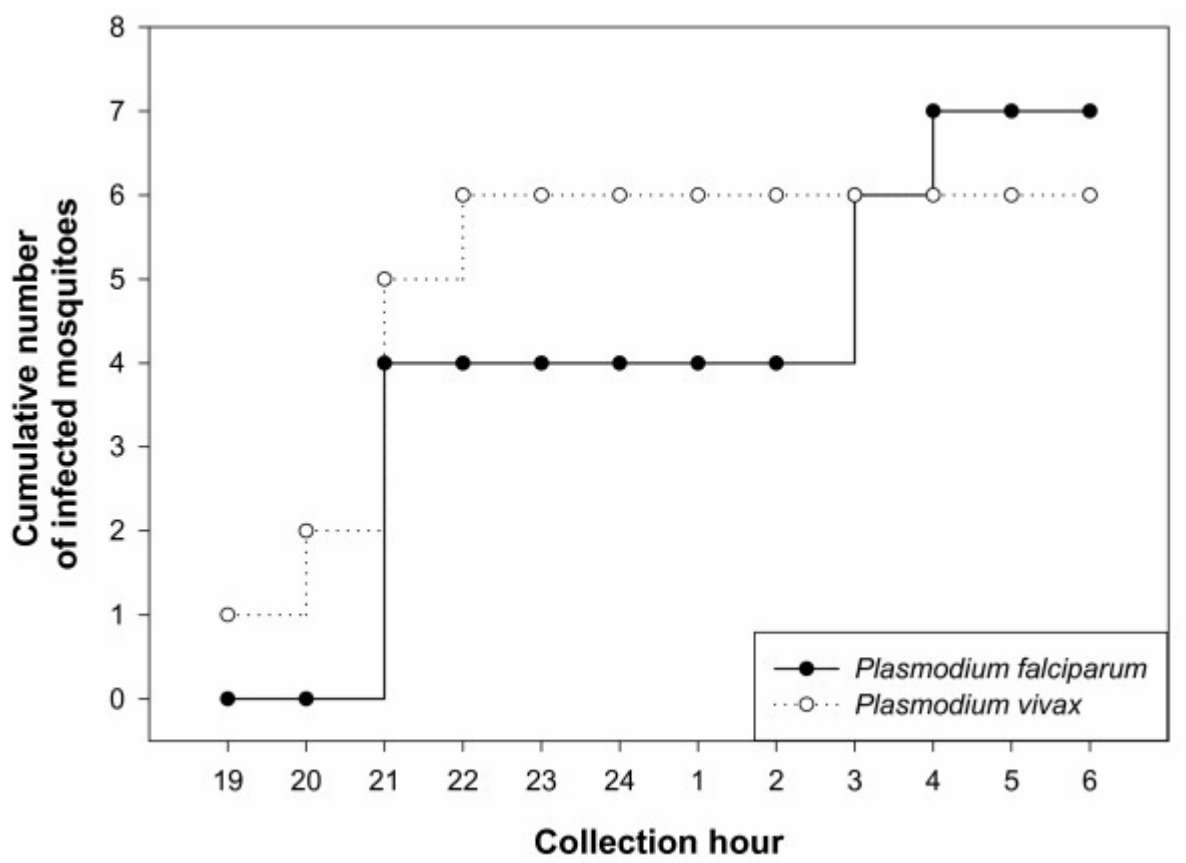
Δ *An. maculatus s.l.*

□ *An. minimus s.l.*

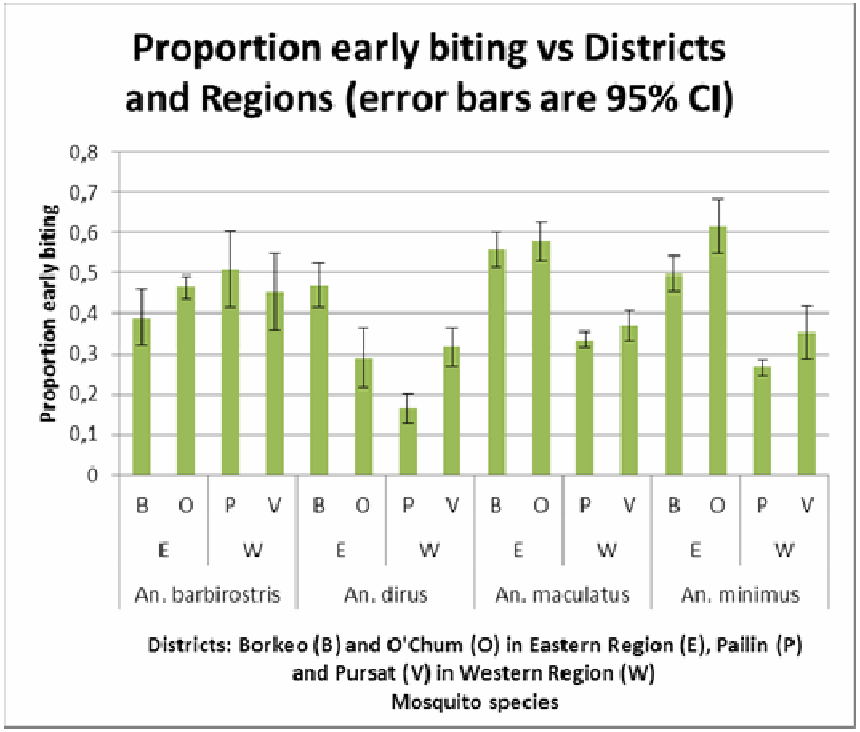
forest

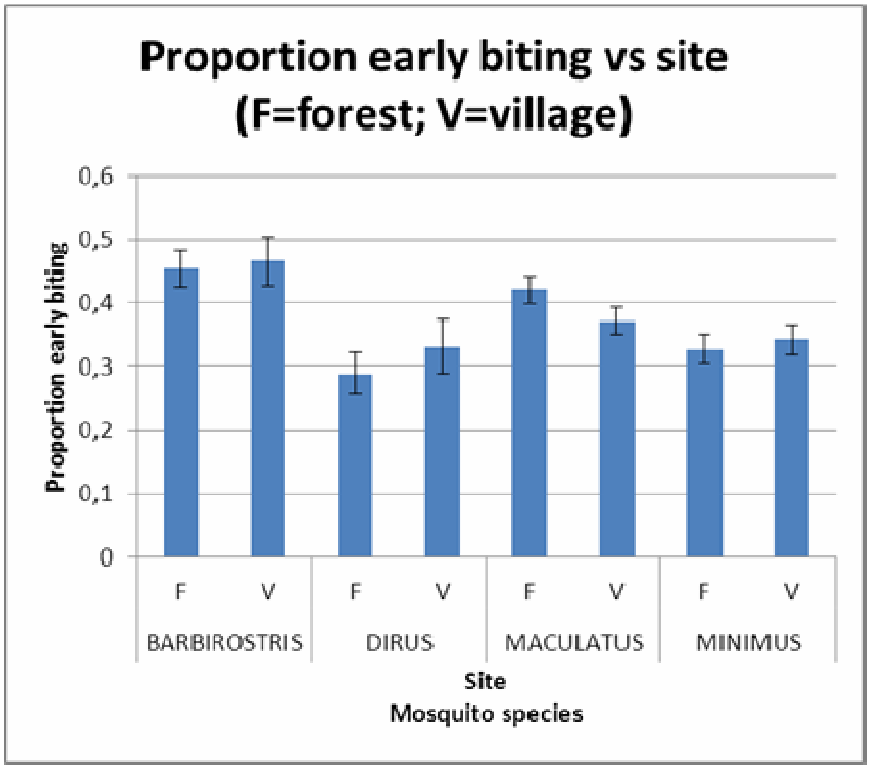
village

Most of the infected *Anopheles* are observed before 10 pm in Ninh Thuan Province, Vietnam (Van Bortel et al. Malaria Journal 2010, 9:373)



Early biting in Cambodia (collections in 2006)





Not only outdoor transmission, but also indoor transmission before sleeping time (Uganda)

Site	HLC	AEIR BST	Total indoor AEIR	% AEIR BST of total indoor AEIR	Species contribution to AEIR%		
					An. funestus	*An. gambiae* s.s.	*An. arabiensis*
Arua	Indoor	48.68	397	12.26	5.8	94.2	0
	Outdoor	12.44		3.13	42.9	57.1	0
Apac	Indoor	93.81	1586	5.91	95.02	4.98	0
	Outdoor	8.35		0.53	39.4	60.6	0
Tororo	Indoor	71.5	562	12.72	3.6	96.2	0.2
	Outdoor	31.66		5.63	4.6	95.4	0
Jinja	Indoor	2.18	6	36.33	0	82.8	17.2
	Outdoor	2.91		48.50	0	61.2	38.8
Kanungu	Indoor	0	6	0.00	-	-	-
	Outdoor	1.81		30.17	0	100	0

BST: Before Sleeping Time

Okello et al, 2006, Am J Trop Med Hyg, 75:219-25;

Pressure of ITNs and IRS might select outdoor and/or early biting vectors

- **Variation in foraging behavior exists between vector species without pressure of vector control measures (VC).**

- **Also within a vector species, e.g. in *An. arabiensis*, genetic variation is present between indoor and outdoor biting mosquitoes** (Coluzzi et al, 1979, Trans R Soc Trop Med Hyg, 73:483-97; Smits et al, 1996, J Med Entomol, 33:545-53).

=> VC can thus also result in selection of species and/or subpopulations of vector species more adapted to early and/or outdoor biting.

Tools to address residual transmission

- Topical Repellents (DEET, **Picaridine (KBR3023), P-Mentane-3,8-diol, IR3535)**
- Spatio-repellents **(metofluthrin fan vaporizer)**
- Insecticide treated hammocks, nets,
- Insecticide treated clothing
- Treated Plastic sheeting
- Mosquito Coils/ vaporizers
- Others?

Efficacy studies (entomological-epidemiological)?
Acceptability & feasibility studies?

Figure 1 A portable battery-powered blower that holds 0.6% transfluthrin or 0.6% metofluthrin granules in a cartridge (45 mm in diameter). (A) Vapor outlets, (B) cartridge.

Effect of topical repellents on malaria

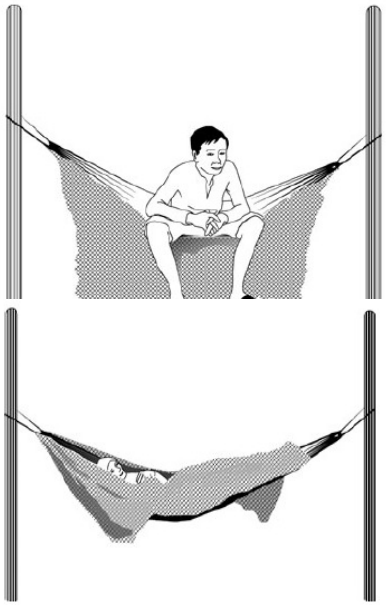
Limited number of studies.

House hold randomized trials (with placebo):

- aversion effect of mosquitoes from repellent users to non users
- Important spill over effect (exchange of products between the HH).
- In Bolivia: combined use of repellents and ITNs: reduced the incidence of malaria by 80% as compared to the use of ITNs alone. But lack of power for Pf.
  (Hill et al 2007, *BMJ* , **335**(7628):1023)
- In Pakistan use of soap 20% DEET + 0.5% permethrin => 56% protection for Pf (not for Pv).
  (Rowland et al 2004, *Trop Med Int Health* 2004, **9**(3):335-342).
- In Laos: 15% DEET vrs Placebo HH trial=> no effect. Confounding factors: spill over effect, adherence low, intensified follow up.
- In Tanzania: lack of power on clinical malaria (RDT)

Long lasting insecticidal hammocks (Olyset technology)

1. **Efficacy against mosquito bites** in Cambodia (Sochantha et al. 2010)



Species	Period	Interaction treatment w	% reduction
Culicines	• Whole night • Before 22h	Village Village	**28.7** (9.1-44) **36.5** (21.5-48.7)
A.maculatus	• Whole night • Before 22h	Village Village	**49.8** (30.9-63.5) **55.9** (35.9-69.7)
A.dirus	• Whole night • Before 22h	Survey Vil/Survey	**46.3** (25.3-61.5)
A.minimus	• Whole night • Before 22h	No no	**45.5** (34.7-54.5) **44.5** (25.0-58.9)

2. **Randomized community based trial in VN:** Thang et al. 2009

- malaria infection: 1.6 fold reduction
- incidence: 2 fold reduction