Residual Malaria Transmission: a hindrance for vector control

Ousmane NDIATH, PhD
RIIP Entomo Group
Institut Pasteur International Network
Malaria situation

• Despite many efforts in basic and applied research, malaria remains one of the major tropical challenges in the world.
• Among the different strategies used, vector control is an important component of malaria control.
• Long-lasting insecticidal nets (LLIN) and indoor residual spraying (IRS) represent the front-line for vector control.
The efficacy of these strategy for preventing malaria is well established and they are known to provide substantial protection to both individuals and communities that use them.

Many studies demonstrate the reduction of mortality in the target populations: **Pre-elimination**

Unfortunately the efficacy of vector control to control malaria is endangered by:

- **insecticide resistance**
- **Behavioural resistance (RMT)**
As a real arms race, Anopheles develop more and more Resistance.
Vector’s diversity
RMT: Myth or Reality?

Fontenille et al. 1997

Ndiath et al. 2008

Fig. 3. Number of female Anopheles feeding on humans from 19:00 to 07:00, N'Diaye, Senegal, 1993–1996.

Fontenille et al. 1997
RMT: Myth or Reality?
Dielmo–Ndiop: A Case Study
Dielmo project

- 2 Senegalese villages selected in 1990
- Dielmo and Ndiop, only 5 Km apart but with different malaria patterns, were selected for a longitudinal study of vectorial transmission, parasitaemia,
- Mosquitoes were collected weekly or monthly by HLC from April 1990 to today (2014).
- Additional studies were conducted on the bionomics of anophelines before and after LLINs
Relation between HBR, Infection and Interventions

Number of infected bites/person/year (EIR)

Number of Anopheles bites/person/night (HBR)

A. gambiae  A. funestus  EIR

LLIN's

8th RMT Work Stream Meeting
mosquitoes that remained susceptible to insecticide had a marked decreased lifespan.

In the following years, they tended to adapt by shifting to outdoors host seeking, by biting earlier.

insecticide-treated nets quickly selected resistant mosquitoes with long lifespan and unchanged feeding behaviour.
Exophagous behaviour in *An. gambiae* populations before and after LLINs

- From January 2006 to July 2008
- In a total of 2345 *Anopheles gambiae*.
- No difference between indoor and outdoor
- No preference hour biting time
Exophagous behaviour in *An. gambiae* populations before and after LLINs

- A shift from indoor to outdoor: *An. coluzzii* & *An arabiensis*.
- A shift from outdoor to indoor: *An gambiae S form*.
The Change of hour biting in *An. gambiae* before and after LLINs

The graph shows the percent of bites from 7:30 PM to 6:07 AM, with a peak around 11:00 PM before LLIN's and a peak around 01:00 AM after LLIN's.
The Change of hour biting in *An. funestus* after LLIN’s
Tactical Versus Strategic Residual Malaria Management Strategies for Disease Vectors

Strategy  Tactics
Deployment in Senegal

PEDACOM

How should control interventions be used to minimize the impact of RMT?
Challenges

• Requires deeper understanding of vector biology
• Coordination between National Control Programmes
• Budget and authority to broadly implement
Surveillance-Response Tactics

1. Establish baselines
2. Periodic vector populations investigation: New Catching methods!
3. Correlate change with intervention
4. Survey insecticide resistance.
Each Residual Malaria Transmission is Potentially Unique
Every Solution May Be Unique

What we must do?

8th RMT Work Stream Meeting
Acknowledgments

Dielmo-Ndiop Population’s

Dr. JF Trape

Dr. V Richard & Dr. K Vernick
and Pr. C. Rogier

Pr. O Faye

Dr. Fatou Ba

Dr. Sambou

Dr. E. Dotson & Dr. B. Brogdon, CDC Atlanta

PMI Saving Lives in Africa
Thank you for your attention