Knowledge gaps that make it a challenge to provide evidence-based vector control recommendations to AMI partner countries

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Malaria vector control tools

Most common:

- Insecticide treated bednets (preferably LLINs)
- Indoor residual spraying (IRS)
- Larval source management

Less common:

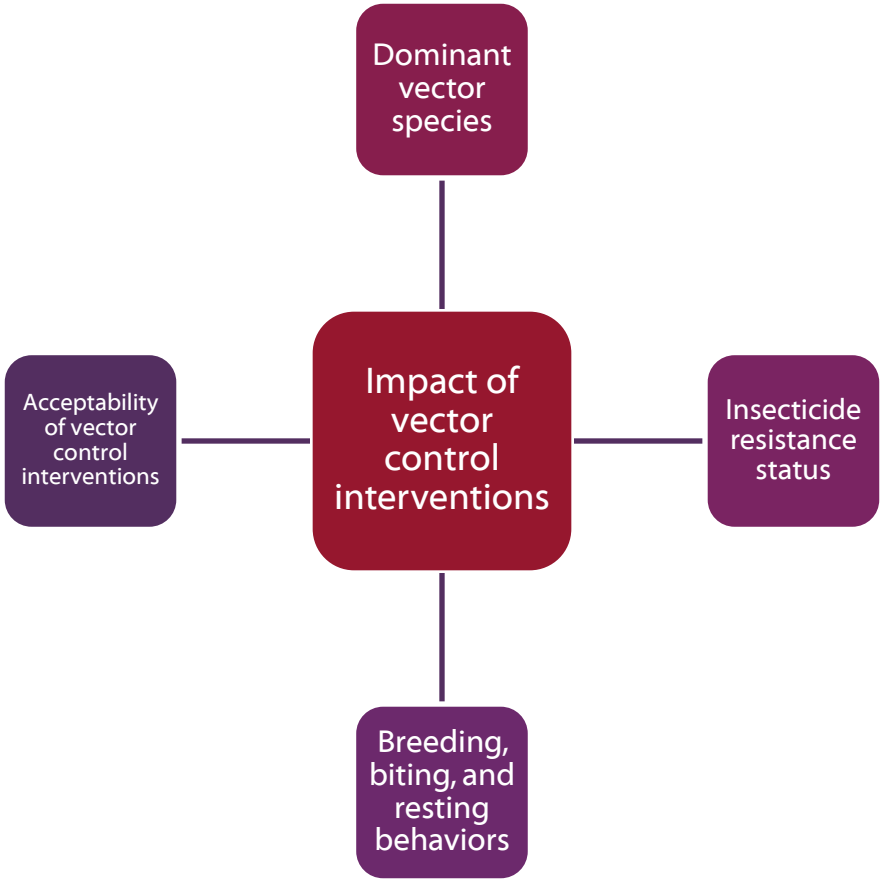
- Eave and window screens/curtains
- Spatial repellents
- Personal repellents
- Insecticide-treated clothing

Bottom line:

There are limited tools available for malaria vector control.

In the Americas, which tools are the most appropriate in which situations?

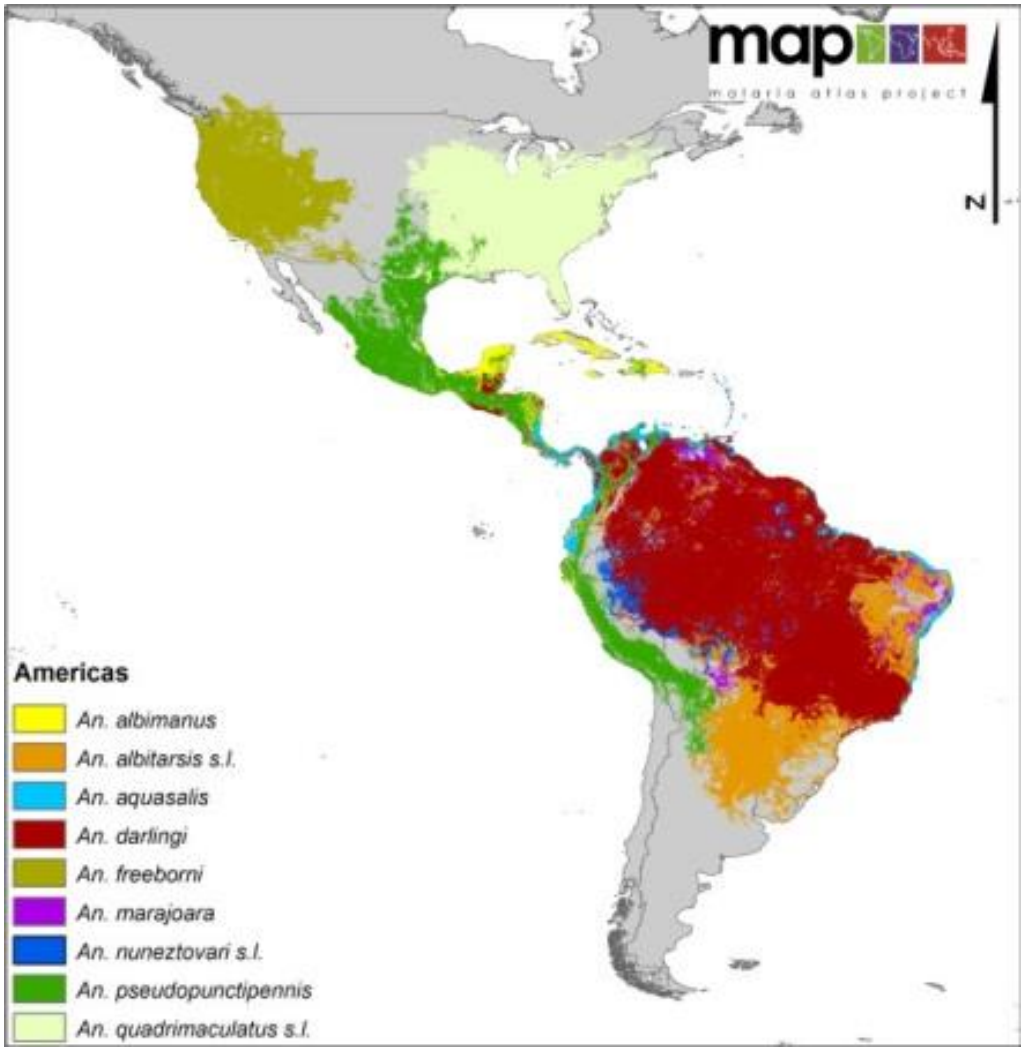
Determinants of vector control impact



Knowledge gaps

- Dominant vector species
- Breeding, biting and resting behaviors
- Insecticide resistance status
- Acceptability of vector control interventions
- Impact of vector control interventions

Dominant malaria vector species in the Americas



From Sinka et al. (2012) A global map of dominant malaria vectors. *Parasites & Vectors*, 5:69

Vector incrimination

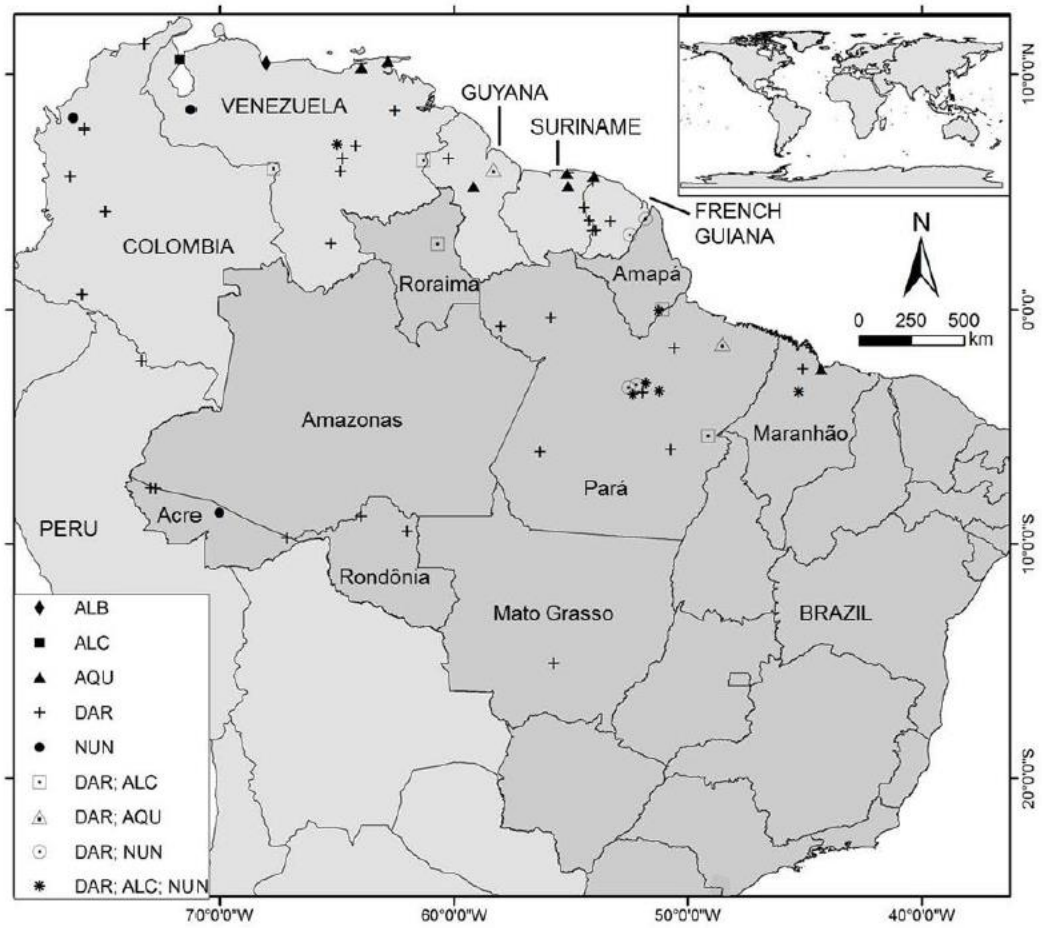


Figure 3. South American localities where malaria vectors have been incriminated by various methods since the year 2000. Species codes: ALB, *Anopheles albimanus*; ALC, Albitarsis Complex; AQU, *An. aquasalis*; DAR, *An. darlingi*; NUN, *An. nuneztovari*. The darker grey area is Brazil.

Jan E. Conn, Martha L. Quiñones and Marinete M. Póvoa. Chapter 5: Phylogeography, Vectors and Transmission in Latin America, *in* *Anopheles* mosquitoes - New insights into malaria vectors. 2013, InTech http://dx.doi.org/10.5772/55217

Knowledge gaps: Dominant vector species

- **Diversity of anophelines and species complexes**
  - Routine surveillance of species composition and relative abundance in malaria transmission and high risk areas
  - Analysis of *Plasmodium* infection (particularly sporozoites) in mosquitoes
- **Lack of fine scale data, particularly in remote areas**
- **To what degree do secondary vectors increase in importance when primary vectors are well-controlled?**

Summary of malaria vector behavior in the Americas

Table 6 Adult feeding and resting behaviour

Species	Source	Feeding habit		Biting habit		Biting time				Pre-feeding resting habit		Post-feeding resting habit	
		Anthro-pophilic	Zoo-philic	Exo-phagic	Endo-phagic	Day	Dusk	Night	Dawn	Exo-philic	Endo-philic	Exo-philic	Endo-philic
An. albimanus	Summary	2	2	9	2		7	9	0			1	3
An. albimanus	TAG	●	●	●	●		●	●		●		●	
An. albitarsis	Summary	2	2	4	3		7	3				2	
An. albitarsis	TAG	●	●	●	●		●	●		●		●	○
An. aquasalis	Summary	1	1	2	2	1	2	1		1		1	
An. aquasalis	TAG	●	●	●	●		●	●		●		●	
An. darlingi	Summary	12		9	6		15	23	3	1		2	
An. darlingi	TAG	●	○	●	●		●	●	●	●		●	
An. freeborni	Summary	1	1										
An. freeborni	TAG	●	●	●	●		●	●	●	●		●	
An. marajoara	Summary	2	2	3			4	1		1		2	
An. marajoara	TAG	●	●	●	●		●	●		●		●	
An. nuneztovari	Summary	2	4	5	1		3	1		1		2	
An. nuneztovari	TAG	●	●	●	●		●	●	●	●		●	
An. pseudopunctipennis	Summary	3	2	3				1			1	1	2
An. pseudopunctipennis	TAG	●	●	●	●			●		●		●	●
An. quadrimaculatus	Summary		3	2			1		1	2		2	
An. quadrimaculatus	TAG	●	●	●		○	●	●	●	●		●	

TAG: Rubio-Palis & Manguin (unpub. obs., 2009, 2010), ● = typical, ○ = examples exist. Numbers indicate the number of studies that found adults under each listed circumstance. *Anopheles albitarsis* refers to the *An. albitarsis* complex, which includes *An. albitarsis*, *An. albitarsis* sp. B, sp. E and *An. deaneorum*. *Anopheles marajoara* is listed separately.

From Sinka et al. (2010) The dominant *Anopheles* vectors of human malaria in the Americas: occurrence data, distribution maps and bionomic précis. *Parasites & Vectors*, 3:72

Knowledge gaps: Breeding, biting and resting behaviors

- **Data are highly focal/contextual; the same species can display distinct behaviors in distinct places**
- **Where multiple vector species overlap, what are the seasonal differences in species behavior that could impact vector control efficacy?**
- **Where (if anywhere) could larval source management be a viable vector control tool?**
  - Few, fixed, findable

Knowledge gaps: Insecticide resistance

- **Resistance frequency and intensity**
  - Resistance surveillance is often sporadic
  - Little or no information on resistance intensity
    - A vector that is resistant to only the diagnostic dose of insecticide vs. a vector that is resistant to 10X the diagnostic dose of insecticide have different control implications

- **Very limited data on resistance mechanisms**
  - Necessary to make sound decisions regarding vector control because of cross-resistance and shared metabolic or molecular mechanisms

Insecticide resistance surveillance as an opportunity to address multiple knowledge gaps

- **When a routine and systematic resistance monitoring system is in place, multiple types of information about vector populations can be collected simultaneously**
  - Presence of malaria vectors and species composition
  - Spatial and seasonal distribution of vectors
  - Relative abundance of malaria vector species
  - Feeding behavior: which malaria vector species are biting humans and at what level of intensity, including endophagy and exophagy

Knowledge gaps: Acceptability of vector control interventions

- **A vector control strategy may be highly efficient at killing mosquitoes, but unless the people like it and use it, it will never be effective**
  - More research is needed regarding the knowledge, attitudes, and practices of people and the underlying behaviors and perceptions that result in the adoption and maintenance of vector control tools/strategies

What information do we need to make evidence-based vector control decisions?

Examples: Peru and Guatemala

- **Loreto, Peru**
  - Previous research by multiple groups has investigated the knowledge attitudes, and practices of local populations regarding bednets
  - Evidence is lacking regarding which vector control tool(s) are likely to provide the greatest control efficacy
  - No time to conduct research—solutions are needed now
- **Guatemala**
  - A robust evidence base regarding LLINs is being developed, but how does that get translated into policy recommendations?

Priorities = operational challenges

- **Characterization of insecticide resistance mechanisms to support intelligent selection of insecticides**
  - New research suggests that resistance mechanisms are highly specific
  - Resistance management plans can prevent or delay the development of resistance
- **Understanding vector and human behavior to optimize the application of vector control interventions**
  - Where/when do vectors bite/rest? Which tools work best under which circumstances?

Muchas gracias por su atencion

Muito obrigada!