SPATIAL REPELLENTS FOR CONTROL OF VECTOR-BORNE DISEASE

AN UPDATE

Neil F. Lobo / Nicole L. Achee
University of Notre Dame
Department of Biological Sciences
Eck Institute for Global Health

ROLL BACK MALARIA

What are Spatial Repellents?
Product Description and Paradigm Claim

•Spatial repellents are products designed to release volatile chemicals into the air and prevent human-vector contact within the treated space.

Deployment of spatial repellent products in enclosed and semi-enclosed spaces will reduce pathogen transmission.

PROTOTYPES

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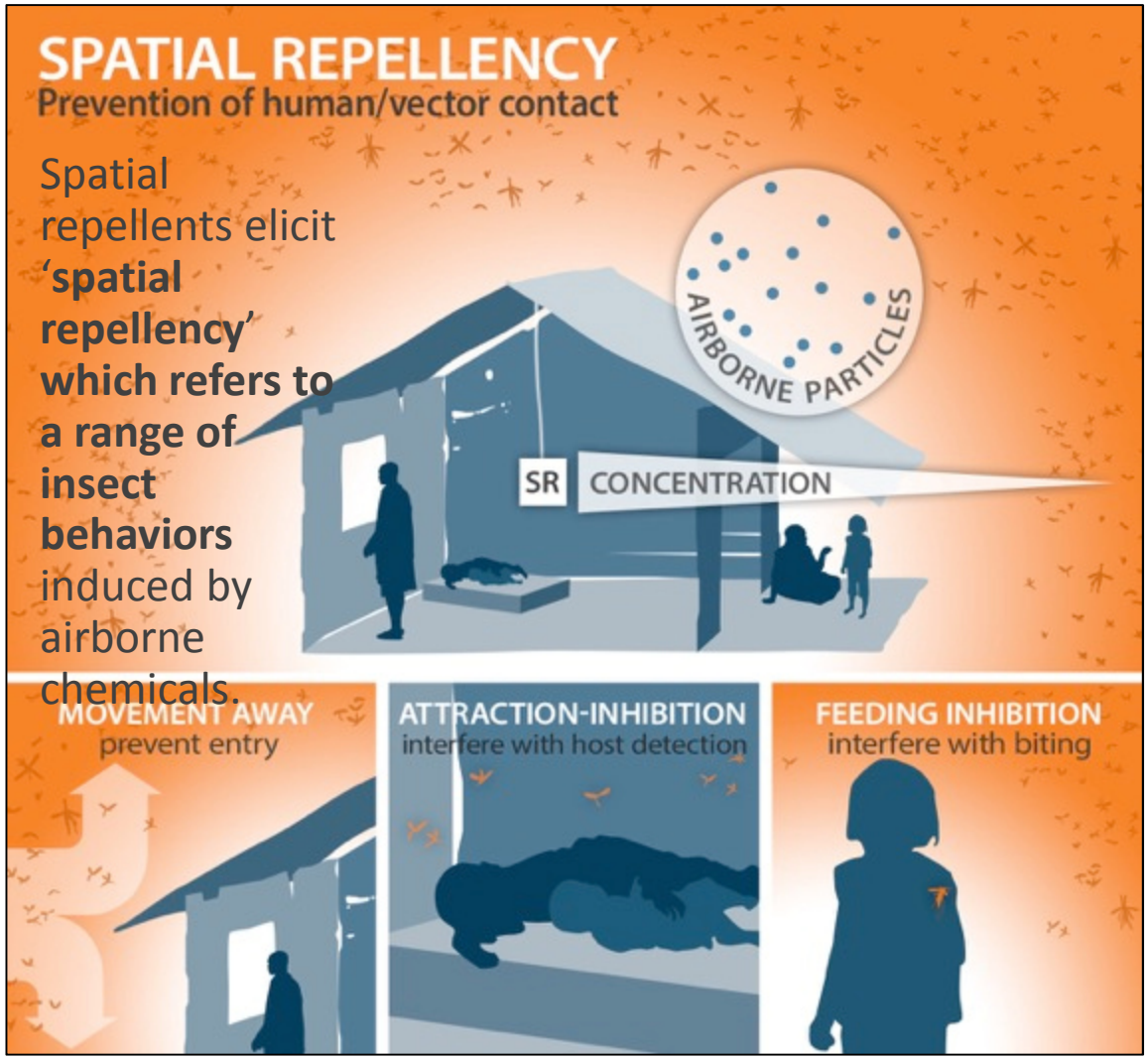
How Spatial Repellents are Expected to Function
Mechanism of Action



Continual Release

Chemical Exploitation

Graphic by Kristina Davis

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Role of Spatial Repellents in Vector Control
Filling Gaps

- Addresses vector behavior variability
  - day-time, early evening and/or outdoor biting
- Facilitate coverage and reduce delivery challenges
  - adding a consumer product distribution model (uptake enhancement)
  - top-down delivery during epidemics (dengue) and/or routinely (malaria)
  - less bulky than LLINs, IRS and/or space-spraying
- Tools for insecticide resistance mitigation
  - additional target sites, mode of action & functional doses beyond toxicity
- ***New paradigm to drive R&D for novel chemical actives /products***

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Evidence –
Entomology and Epidemiology

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Evidence of Spatial Repellents to Prevent Disease

Hill et al. Malaria Journal 2014, 13:208
http://www.malariajournal.com/content/13/1/208

MALARIA JOURNAL

RESEARCH Open Access

A household randomized, controlled trial of the efficacy of 0.03% transfluthrin coils alone and in combination with long-lasting insecticidal nets on the incidence of *Plasmodium falciparum* and *Plasmodium vivax* malaria in Western Yunnan Province, China

Nigel Hill[1*], Hong Ning Zhou[1,2], Piyu Wang[2], Xiaofang Guo[2], Ilona Carneiro[1] and Sarah J Moore[3,4,5*]

Coils alone : 77% PE
LLINs alone: 91% PE
Coils + LLIN: 94% PE

Am. J. Trop. Med. Hyg., 91(6), 2014, pp. 1079–1087
doi:10.4269/ajtmh.13-0725

Impact of a Spatial Repellent on Malaria Incidence in Two Villages in Sumba, Indonesia

Din Syafruddin,* Michael J. Bangs, Dian Sidik, Iqbal Elyazar, Puji BS Asih, Krisin Chan, Siti Nurleila, Christian Nixon, Joko Hendarto, Isra Wahid, Hasanuddin Ishak, Claus Bøgh, John P. Grieco, Nicole L. Achee, and J. Kevin Baird

Eijkman Institute for Molecular Biology, Jakarta, Indonesia; Department of Parasitology, Faculty of Medicine, Hasanuddin University, Makassar, Indonesia; Public Health and Malaria Control, International SOS, Kuala Kencana, Papua Indonesia; Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand; Department of Epidemiology, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia; Eijkman-Oxford Clinical Research Unit, Jakarta, Indonesia; The Sumba Foundation, Bali, Indonesia; Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, Bethesda, Maryland; Department of Biological Sciences, Eck Institute for Global Health, University of Notre Dame, Notre Dame, Indiana; Centre for Tropical Medicine, Nuffield Department of Medicine, University of Oxford, Oxford, United Kingdom

Coils alone : 52% PE

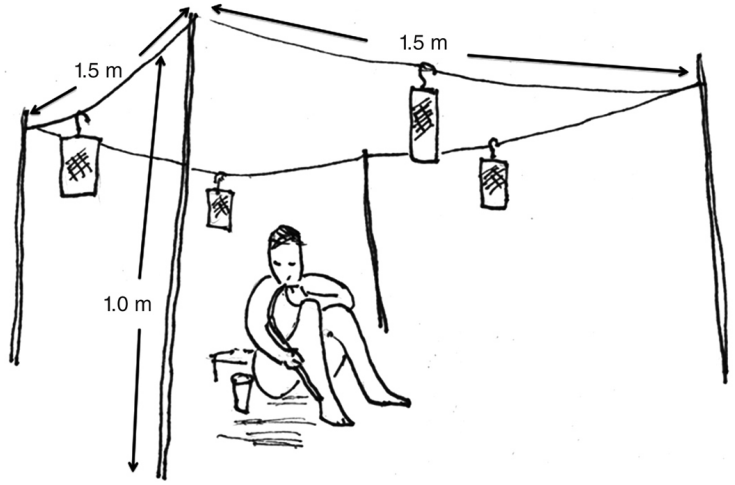
32% lower outdoor landing in houses with SR

Effects of the spatial repellent metofluthrin on landing rates of outdoor biting anophelines in Cambodia, Southeast Asia

J. D. CHARLWOOD ✉, S. NENHEP, N. PROTOPOPOFF, S. SOVANNAROTH, J. C. MORGAN, J. HEMINGWAY

First published: 15 March 2016 Full publication history

DOI: 10.1111/mve.12168 View/save citation



- Metofluthrin
- Landing rates reduced by
  - 48% - 1 emanator
  - 67% - 4 emanators

- Similar results with tent traps and CDC-LTS

- Different results in Pailin, Pursat versus Koh Kong (no difference)

Modified mosquito landing boxes dispensing transfluthrin provide effective protection against *Anopheles arabiensis* mosquitoes under simulated outdoor conditions in a semi-field system

Marta Andrés[1,2], Lena M Lorenz[2,3], Edgar Mbeleya[3] and Sarah J Moore[3,4,5*]

- Modified odor baited trap used with repellant
- Transfluthrin
- 69% protection against bites / landing

A crossover study to evaluate the diversion of malaria vectors in a community with incomplete coverage of spatial repellents in the Kilombero Valley, Tanzania

Marta Ferreira Maia[1,2,3*], Katharina Kreppel[3,4], Edgar Mbeyela[3], Deogratius Roman[3], Valeriana Mayagaya[3], Neil F. Lobo[5], Amanda Ross[1,2] and Sarah Jane Moore[1,2,3]

Several studies to demonstrate Push-pull strategies might be useful
Chareonviriyaphap, Achee, Greico, Takken, Moore, Maia, etc

Guidance on Operational Implementation
Primary VCAG Questions

- What is the product **coverage required** for protection?
- **How does efficacy vary** with geography or vector bionomics?
- Do repellents have either a **diversion or a community-wide protection effect**?
- Are current pyrethroid-based repellents **effective against resistant vector populations**?

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Newly Funded Research Program (2014-2018)

Generating an Evidence Base

UNIVERSITY OF NOTRE DAME

BILL & MELINDA GATES foundation

- **GOAL:**
- Evaluate the public health impact of one spatial repellent product to reduce and prevent transmission of *Plasmodium* spp. and dengue viruses.
- **OBJECTIVES:**
  - Provide a quantitative estimate of protective efficacy (PE)
  - Provide inputs into program-relevant questions of optimization/application
  - Confirm and measure the entomological correlates of reduced infection
  - Drive efforts to acquire full recommendation of spatial repellent products

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Scale-back of Study from Africa sites (Indonesia and Peru only)

Present status of Primary VCAG Questions

- What is the product **coverage required** for protection?
  - Indonesia (malaria) and Peru (Dengue) only
- **How does efficacy vary** with geography or vector bionomics?
  - Indonesia (malaria) and Peru (Dengue) only. Not possible in Africa
- Do repellents have either a **diversion or a community-wide protection effect**?
  - Not possible (was planned as part of the Kenya study)
- Are current pyrethroid-based repellents **effective against resistant vector populations**?
  - Not possible at present (possible if insecticide resistance appears)

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Program updates

- **Scale back from Africa sites (Zambia, Tanzania, Kenya)**
  - Team notified (March 2016) – funder directed
  - African sites closed down Dec 2016
- **Indonesia (malaria)**
  - Follow-up of 1240 subjects (from ~2,719 enrolled households) began May 2016. Intervention placed.
  - 12,449 Bloodspots collected (19x active + passive collections) since December 2016 (Intervention)
  - 19x HLC collections (at 4 sentinal sites in 12 clusters) have occurred following intervention.
- **Peru (Dengue)**
  - Weekly febrile surveillance in 13,994 persons for active virus infection has occurred as of Oct 2016
  - Baseline samples from ~1800 subjects for longitudinal sero-conversion have been collected as of Oct 2016

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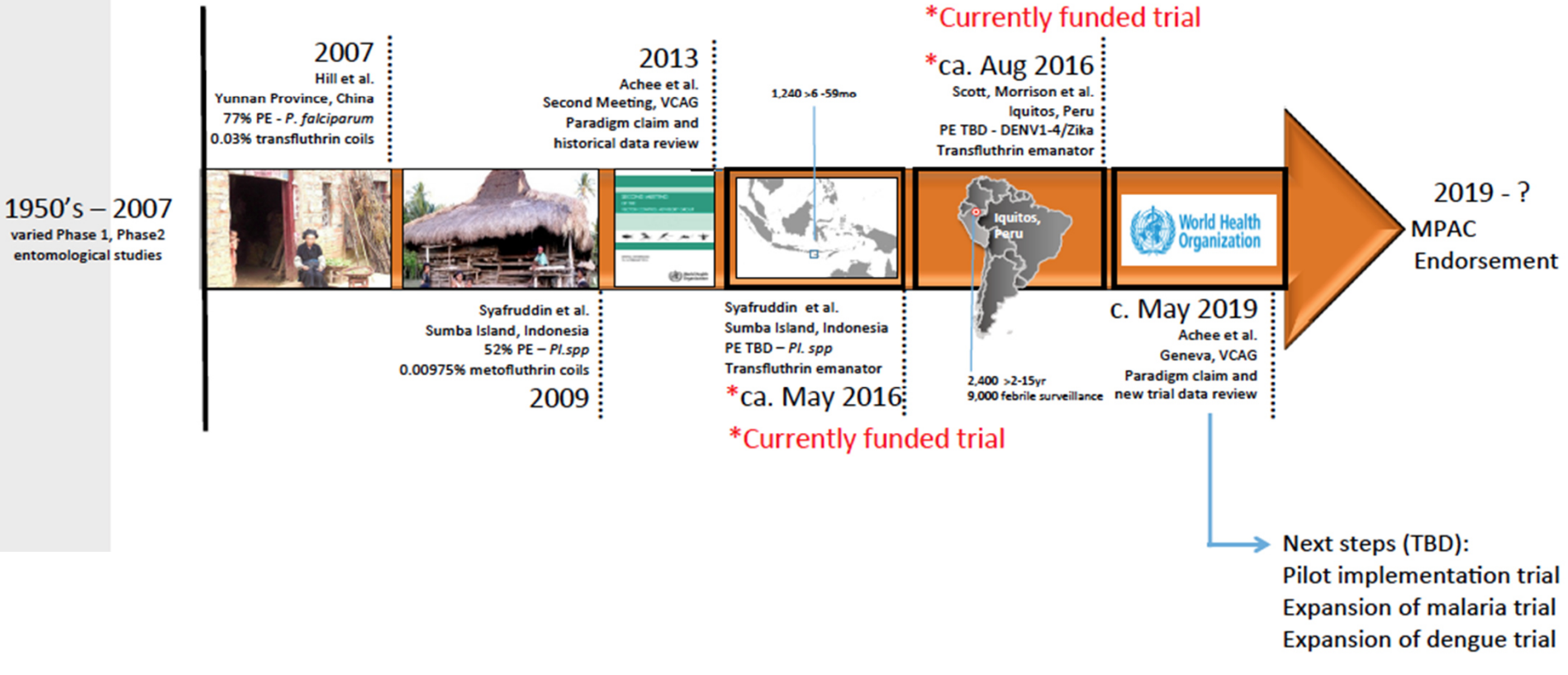
FOR CONTROL OF VECTOR-BORNE DISEASE

Thank you

nlobo@nd.edu (Neil Lobo)
nachee@nd.edu (Nicole Achee)

ROLL BACK MALARIA

Progress on Public Health Value



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