
RBM
Partnership
To End Malaria

RBM Partnership To End Malaria

30th January, 2019

VBD and the Built Environment

Co-chairs: Steve Lindsay and Lucy Tusting

Agenda

Time	Title	Speaker
14:30 – 14:45	Welcome & review of 2018-2019	Lucy Tusting
14:45 – 15:00	BOVA Network update (Building Out Vector-Borne Diseases in Africa)	Steve Lindsay
15:00 – 15:45	Research updates (10 minutes each): 1. House entry of *Anopheles gambiae* changes according to building design 2. Repellent ribbons along open eaves 3. New designs for poor communities – the CUBO house	Steve Lindsay Arnold Mmbando Earl Forlales
15:45 – 16:15	Afternoon break / coffee, tea, fruit juices, sweet snack	
16:15 – 18:00	Discussion – All • House design recommendations for vector control: what do and don't we know? • The view from the countries. How do the health and building sectors link at local level? How can protective house designs be incorporated into local architecture?	• Led by Steve Lindsay, Lucy Tusting • Led by Steve Lindsay, Fredros Okumu
18:00	End of meeting	

RBM Partnership To End Malaria

30th January, 2019

Review of 2018-2019

Lucy Tusting

A new name…

from

Housing and Malaria

to

Vector-Borne Diseases and the Built Environment

Link between insect-borne diseases & the built environment

Poorly screened houses

Open water containers

Polluted still water

Solid waste accumulation

Our objectives

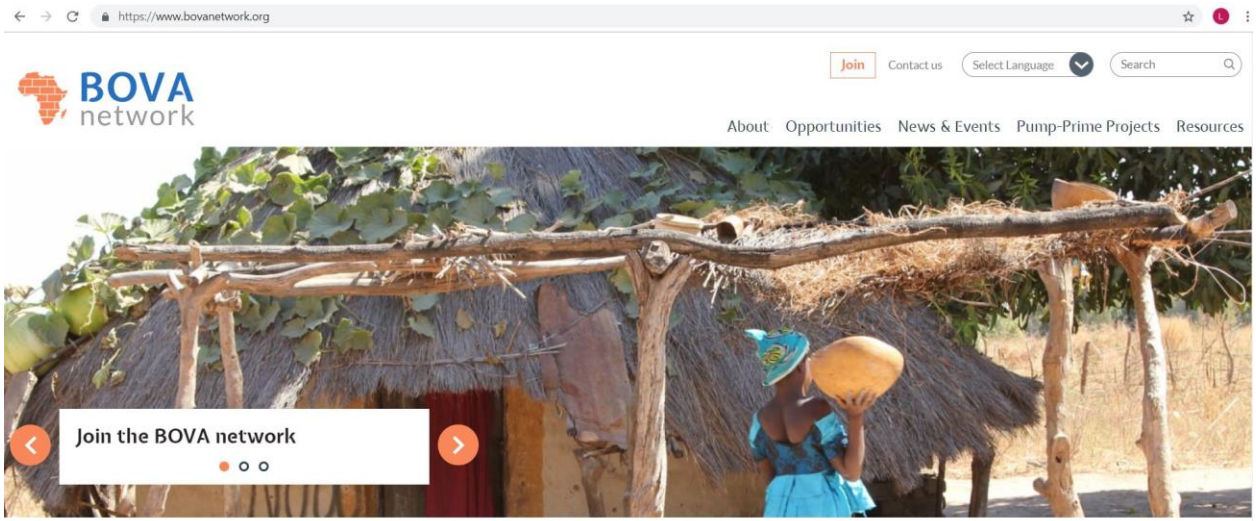
1. To bring together VBD and housing specialists

2. Identify the best approaches for reducing house entry and indoor resting by mosquitoes and keeping the home comfortable and healthy for residents.

3. Develop methods for scaling-up housing interventions against VBD

The BOVA network: our core activity

- **BOVA** stands for '**B**uilding **O**ut **V**ector-borne diseases in sub-Saharan **A**frica
- Funded by the UK Global Challenges Research Fund
- Supports two areas of work:
    1. Bringing together VBD and housing specialists
    2. Funding research



Building out vector-borne diseases in sub-Saharan Africa: an interdisciplinary network focusing on preventing vector-borne diseases through improving the built environment

Including the built environment within RBM's new Multisectoral Working Group…

Kick-off meeting in Basel, October 2018

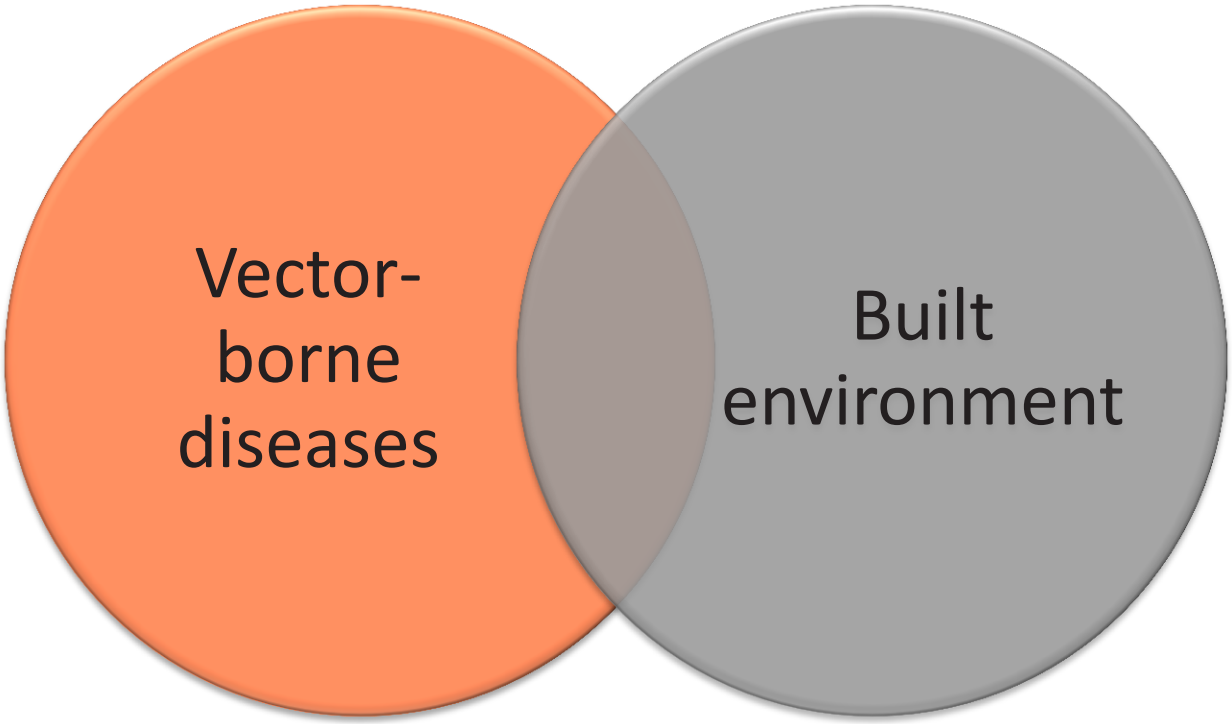
BOVA Network - Building Out Vector-borne diseases in sub-Saharan Africa

Steve Lindsay

BOVA network

What is the BOVA Network?

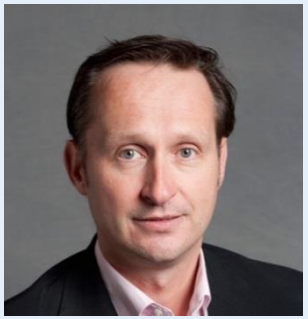
- Interdisciplinary network of researchers and practitioners working on insect-borne diseases and the built environment
- Aims to establish a new research discipline



Who are we?

Network directors

Prof. Steve Lindsay
Durham University



Prof. Mike Davies
UCL

Co-directors:

Dr Lucy Tusting (LSHTM) and Dr Cassidy Johnson (UCL)

Network Manager:

Dr Fiona Shenton (Durham), formerly Dr Anne Wilson (LSTM)

Network Management Board

(architects, economists, policy makers, urban planners, development practitioners, product developers AND entomologists/epidemiologists)

BOVA Network activities

1. Pump-prime funding
2. Global advocacy
3. Yearly open network meetings for information exchange
4. Grant writing workshops

BOVA network

BOVA-funded studies

PI	Study
Addissee	A transdisciplinary study on the distribution of aquatic habitats of malaria vectors and exploring potential social & cultural measures for reducing transmission in Jimma town, Ethiopia
Fillinger	Designing hard floors for tungiasis control in Kenya
Knudsen	Computer Fluid Dynamics modelling of indoor climate in rural sub-Saharan African houses.
Lindsay	Investigating whether the height of a house affects malaria mosquito indoor entry
Mutuku	Identifying methods for collecting trash for profit to reduce vector breeding sites in Kwale County, Kenya
Okumu	Using low-cost mosquito-repellent chairs to provide day and night protection against mosquito-borne illness
Phiri	Filming the unseen: understanding mosquito flight into houses
Saute	Screening mosquito entry points into houses with novel long-lasting insecticidal netting to reduce indoor vector densities and mitigate pyrethroid-resistance

Bringing together VBD and housing specialists

- First annual meeting in London, March 2018
- In partnership with RSTMH
- Speakers included WHO, UN-HABITAT, MRC The Gambia, Royal Danish Academy of Fine Arts, Centre for Affordable Housing Finance in Africa, Habitat for Humanity International, ARCHIVE Global

BOVA network

Bringing together VBD and housing specialists

- BOVA at the MIM conference in Dakar, April 2018…

BOVA network

News

- We're having our **second network meeting** on 4th April 2019 in Nairobi! All welcome!
- We have **funds for students** to attend providing they provide a statement of interest on their vision for moving the field forward
- You can follow our **tweets** @bovanetwork

What we need you to do is:

- Let us know of any **relevant information** on VBDs and the built environment
- E.g. news, comments, research papers, meetings, symposiums, funding - **particularly in the built environment**

BOVA network

Thanks for listening

RBM Partnership To End Malaria

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Research Updates

RBM Partnership To End Malaria

Wednesday 30th January 2019

How house design affects mosquito house entry in The Gambia

Professor Steve Lindsay, Durham University, UK

UNAIDS NothingButNets.net SEND A NET. SAVE A LIFE. World Health Organization END MALARIA COUNCIL aplma ASIA PACIFIC LEADERS MALARIA ALLIANCE

80-100% malaria transmission in sub-Saharan Africa occurs indoors

Huho *et al*. *Int J Epidemiol* 2013; **43**: 235-47.

How do we keep out mosquitoes from a house and keep it cool indoors at night so people will sleep under a mosquito net?

How do different typologies of housing affect mosquito house entry?

Roofs (& gaps)

Experimental houses

Jatta et al. (2018) *Lancet Planetary Health*, **2** e498

Housing typology 1

Thatched-roof, open eaves, poorly-fitting doors

Housing typology 2

Thatched-roof, closed eaves, poorly-fitting doors

Housing typology 3

Thatched-roof, closed eaves, screened doors

Housing typology 4

Metal-roof, closed eaves, poorly-fitting doors

Housing typology 5

Metal-roof, closed eaves, screened doors & eaves

Outcome measurements

CDC light trap

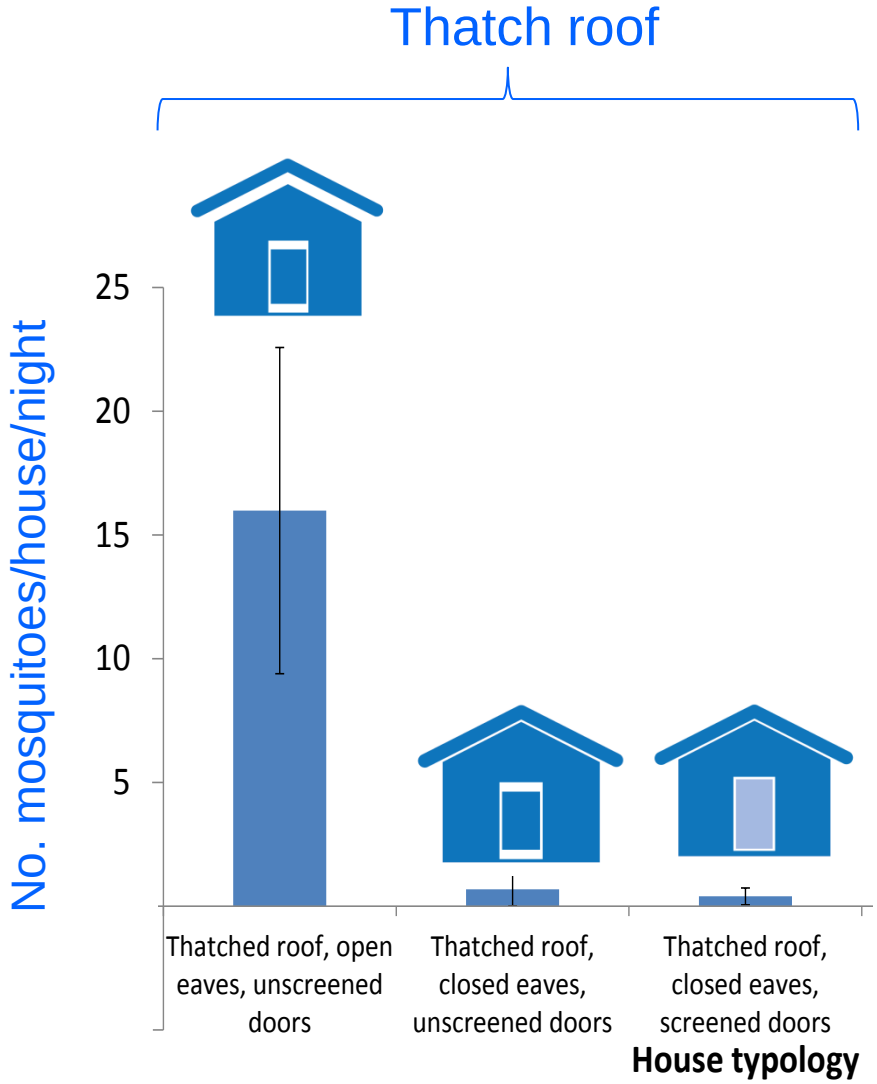
Temperature & relative humidity logger

Latin Square design

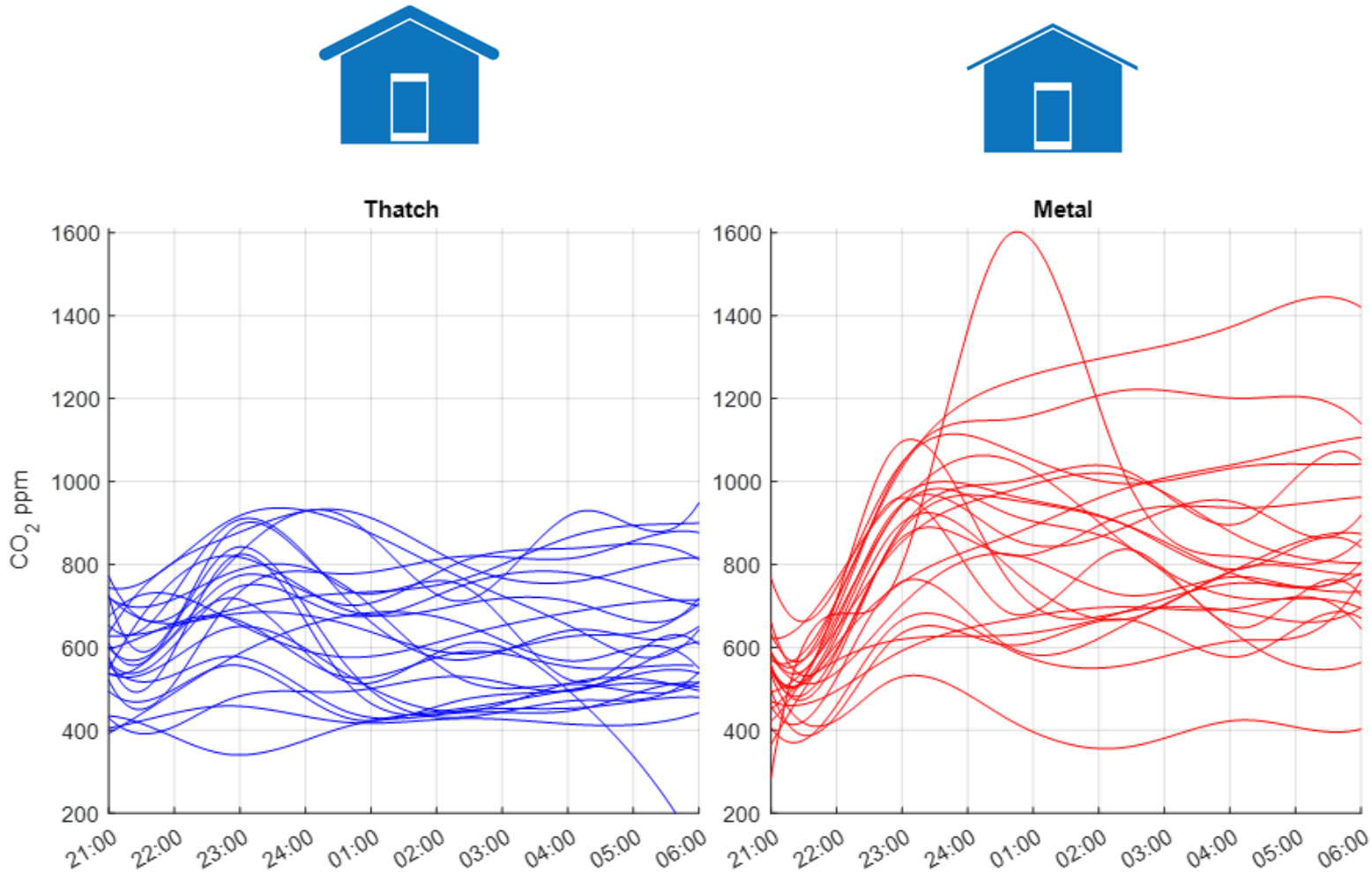
Week	**House position**				
	1	2	3	4	5
1	Metal roof	Thatched, closed eaves, screened doors	Thatched, open eaves	Thatched roof, closed eaves	Roo*Pf*s

Moving roofs

Small changes to rural houses can be protective against malaria vectors



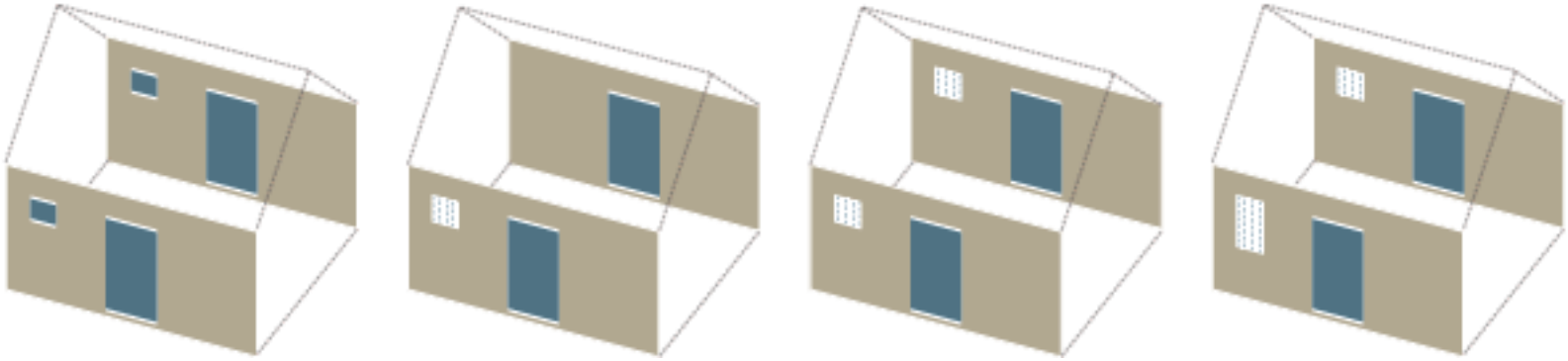
Indoor carbon dioxide concentrations



Windows

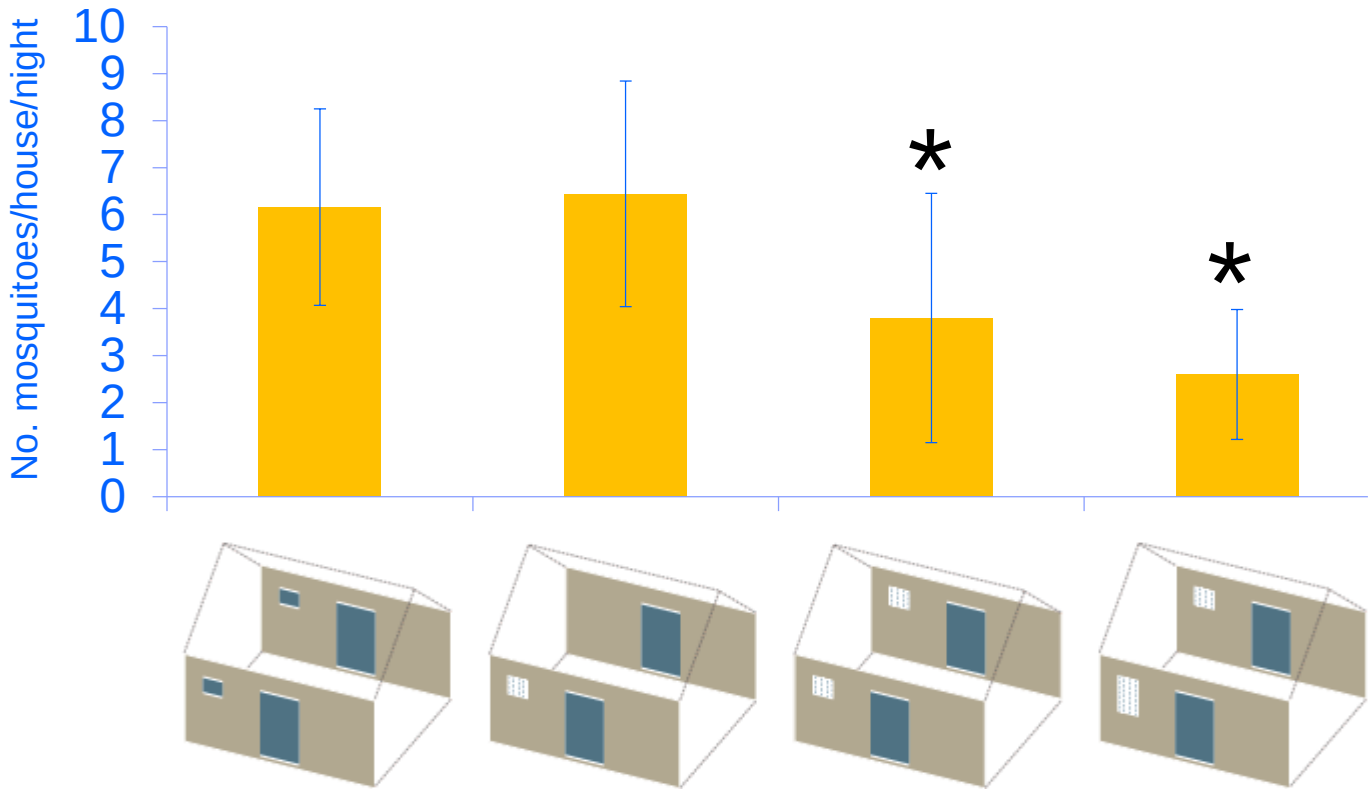
Small windows

Reference



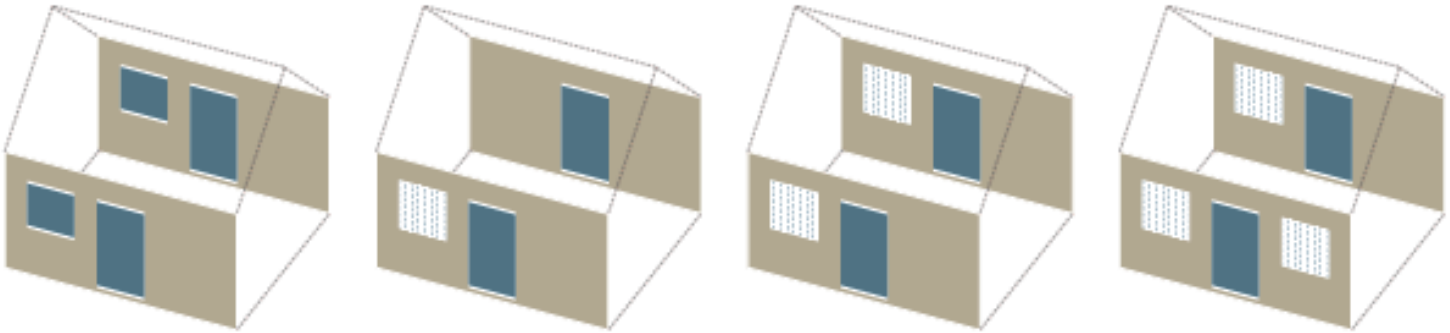
Small windows

Effect of small windows on *An. gambiae* house entry



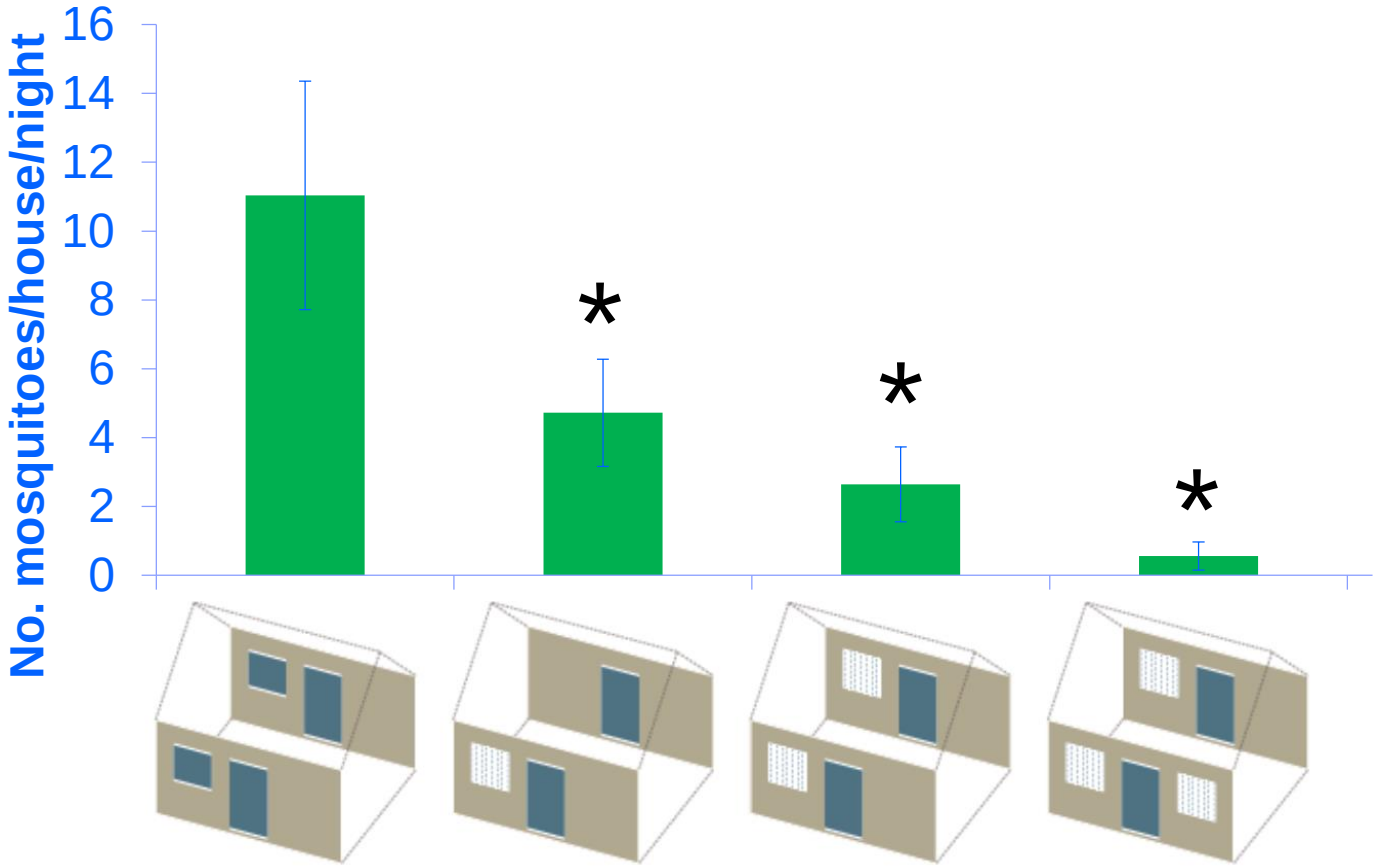
Large windows

Reference

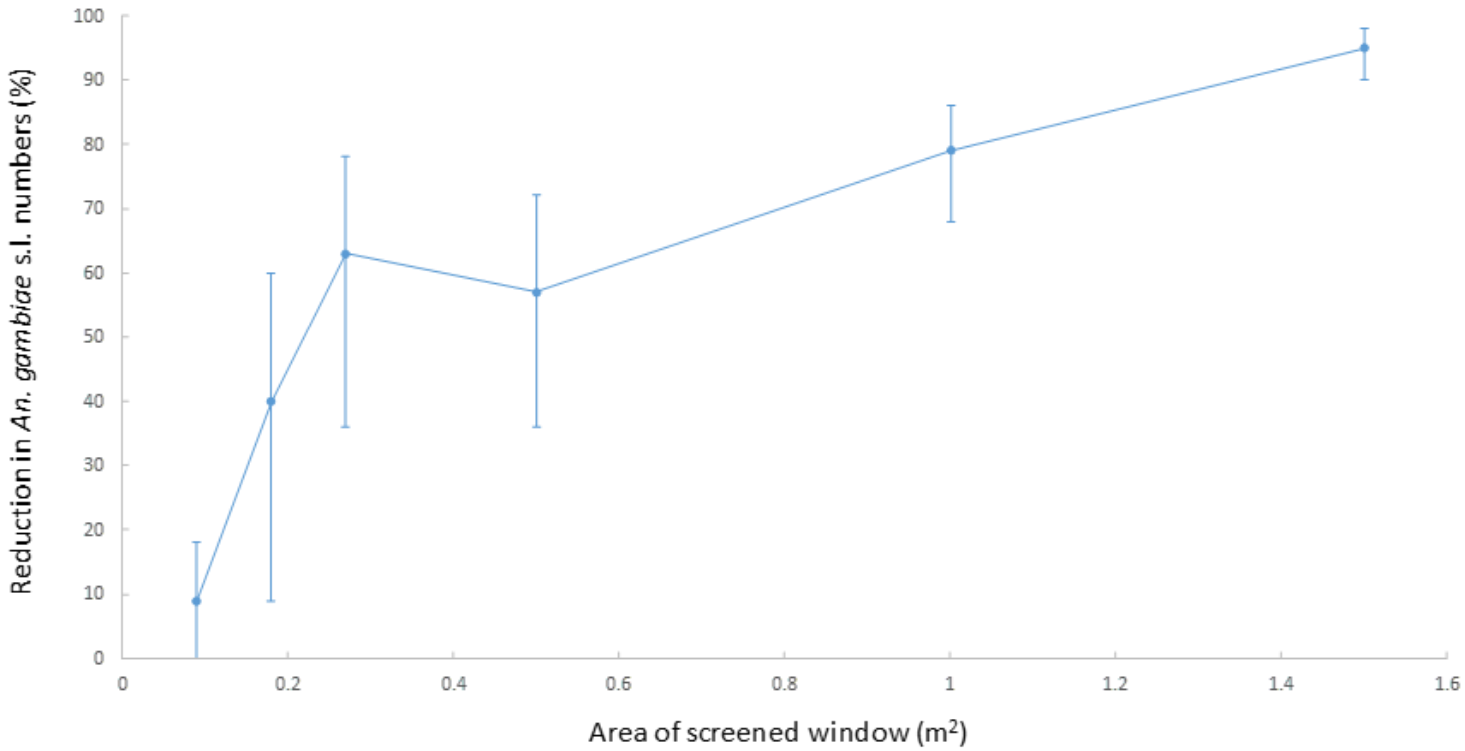


Large windows

Effect of large windows on *An. gambiae* house entry



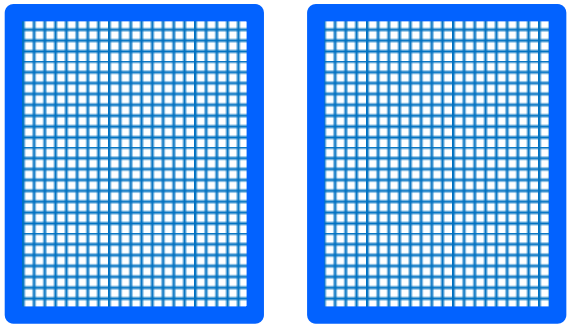
Increasing area of screening reduces indoor entry



Summary

- Closing the eaves reduces mosquito entry into thatched-roofed houses, but not metal-roofed ones;
- Screening doors or windows will help keep the house cooler at night;
- Screened windows may help reduce mosquito house entry if used in combination with solid doors.

How do we keep out mosquitoes from a house and keep it cool indoors at night so people will sleep under a mosquito net?

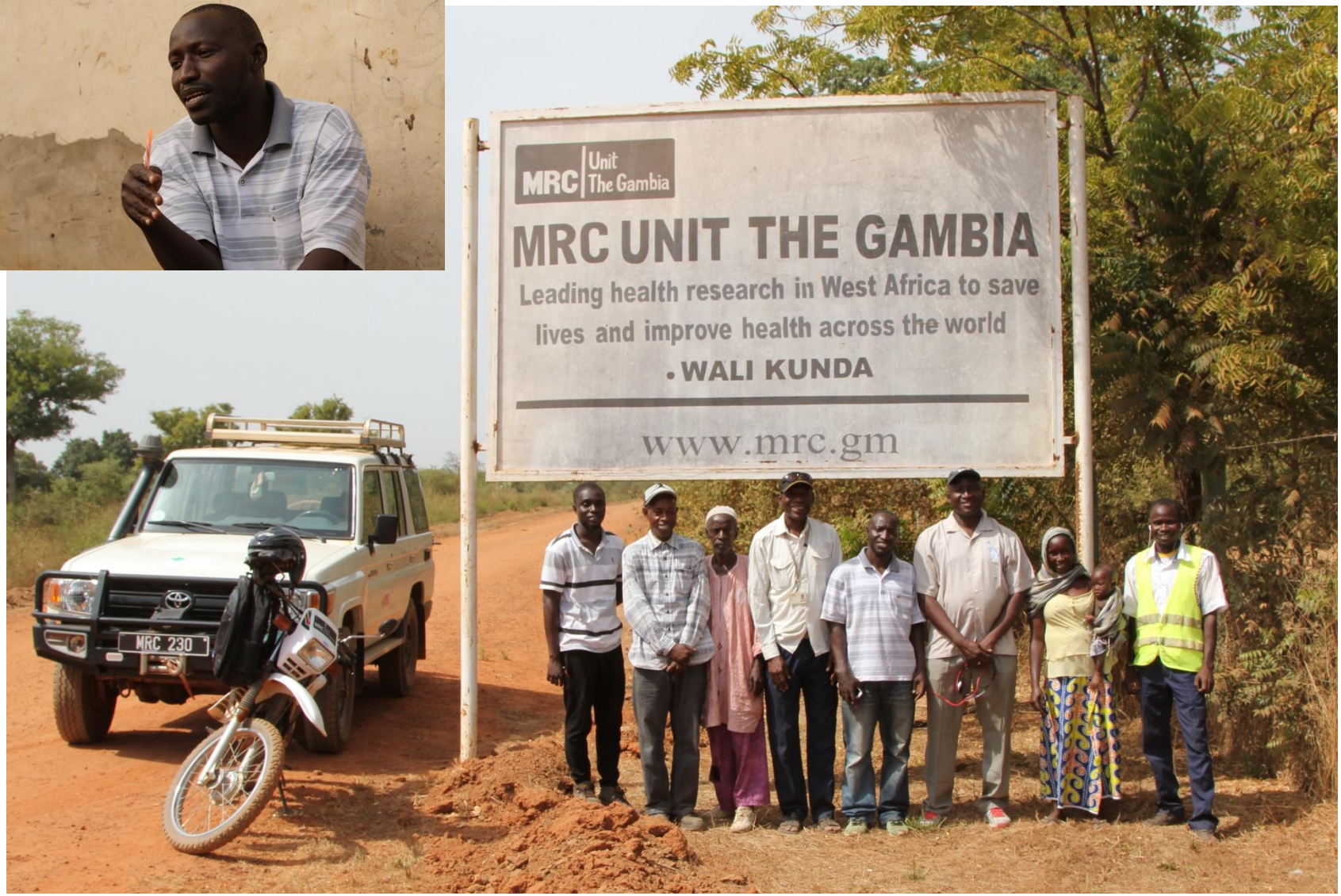


2 screened windows
on opposite walls &
solid doors

+

Long-lasting insecticidal net

After Knudsen


MRC Unit The Gambia
MRC UNIT THE GAMBIA
Leading health research in West Africa to save lives and improve health across the world
• WALI KUNDA
www.mrc.gm
MRC 230

Acknowledgements

Particular thanks to:
Ebrima Jatta
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Jakob Knudsen
Margaret Pinder
Anne Wilson

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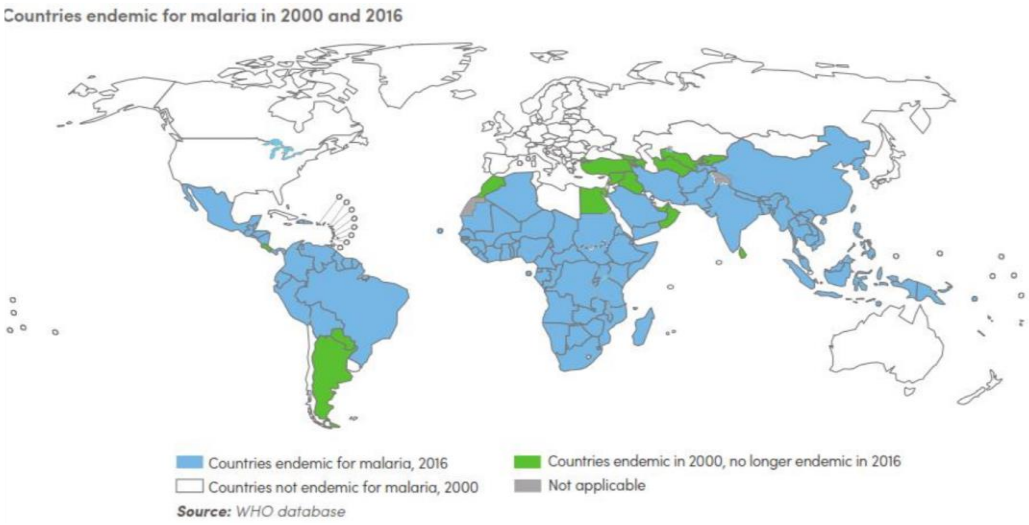
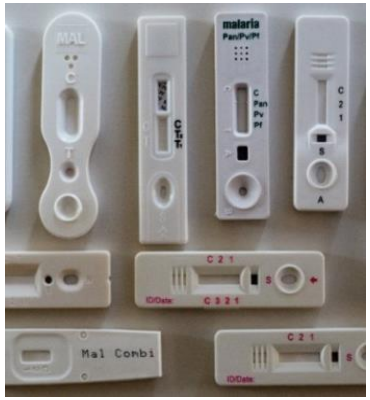
18 February, 2019

Eave-ribbons treated with spatial repellents, can effectively protect against indoor and outdoor-biting mosquito

Environmental Health and Ecological Sciences

Arnold Mmbando.





WHO, 2016. Malaria report

Challenges

- Resistance, i.e. parasite and mosquitoes
- Changing of mosquito behavior
- User compliance
- Lack of drugs to treat all forms of parasites
- Poverty which led to poor diagnosis, health system housing.

Housing and Malaria

VECTOR CONTROL, PEST MANAGEMENT, RESISTANCE, REPELLENTS

Importance of Eaves to House Entry by Anopheline, But Not Culicine, Mosquitoes

MBYE NJIE,[1,2] ERIN DILGER, STEVEN W. LINDSAY,[1] AND MATTHEW J. KIRBY[1,3]

510 Forum TRENDS in Parasitology Vol.18 No.11 November 2002

Science & Society

Reducing malaria by mosquito-proofing houses

Steve W. Lindsay, Paul M. Emerson and J. Derek Charlwood

Malaria Journal

BioMed Central

Research

Open Access

Window screening, ceilings and closed eaves as sustainable ways to control malaria in Dar es Salaam, Tanzania

Sheila B Ogoma*[1,2], Khadija Kannady[3], Maggy Sikulu[1,2], Prosper P Chaki[2,4,5], Nicodem J Govella[2,4,5], Wolfgang R Mukabana[1] and Gerry F Killeen[2,4,5]

Tusting *et al. Malar J (2016) 15:320*
DOI 10.1186/s12936-016-1349-8

Malaria Journal

COMMENTARY

Open Access

CrossMark

Building malaria out: improving health in the home

Lucy S. Tusting[1*], Barbara Willey[2] and Jo Lines[3]

Housing in rural Tanzania

Hessian-materials treated with spatial repellents

Ogoma *et al. Parasites & Vectors* 2012, **5**:54
http://www.parasitesandvectors.com/content/5/1/54

Parasites & Vectors

SHORT REPORT Open Access

Spatial repellency of transfluthrin-treated hessian strips against laboratory-reared *Anopheles arabiensis* mosquitoes in a semi-field tunnel cage

Sheila B Ogoma[1,2*], Hassan Ngonyani[1], Emmanuel T Simfukwe[1], Anthony Mseka[1], Jason Moore[1,2] and Gerry F Killeen[1,3]

Govella *et al. Parasites & Vectors* (2015) 8:322
DOI 10.1186/s13071-015-0937-8

Parasites & Vectors

RESEARCH Open Access

CrossMark

Impregnating hessian strips with the volatile pyrethroid transfluthrin prevents outdoor exposure to vectors of malaria and lymphatic filariasis in urban Dar es Salaam, Tanzania

Nicodem J. Govella[1*], Sheila B. Ogoma[1,2], John Paliga[1], Prosper P. Chaki[1] and Gerry Killeen[1,3]

PLOS | NEGLECTED TROPICAL DISEASES

RESEARCH ARTICLE

A low technology emanator treated with the volatile pyrethroid transfluthrin confers long term protection against outdoor biting vectors of lymphatic filariasis, arboviruses and malaria

Sheila B. Ogoma[1,2]*, Arnold S. Mmando[1], Johnson K. Swai[1], Sebastian Horstmann[3], David Malone[4], Gerry F. Killeen[1,5]

1 Ifakara Health Institute, Environmental Health and Ecological Sciences Thematic Group, Coordination Office, Dar es Salaam, United Republic of Tanzania, 2 US National Research Council, National Academies of Sciences, Engineering and Medicine, Washington, D.C., United States of America, 3 Bayer CropScience

Check for

Fitting of the eave-ribbons along the eave-spaces of the huts

Active ingredient/ surface area ribbon

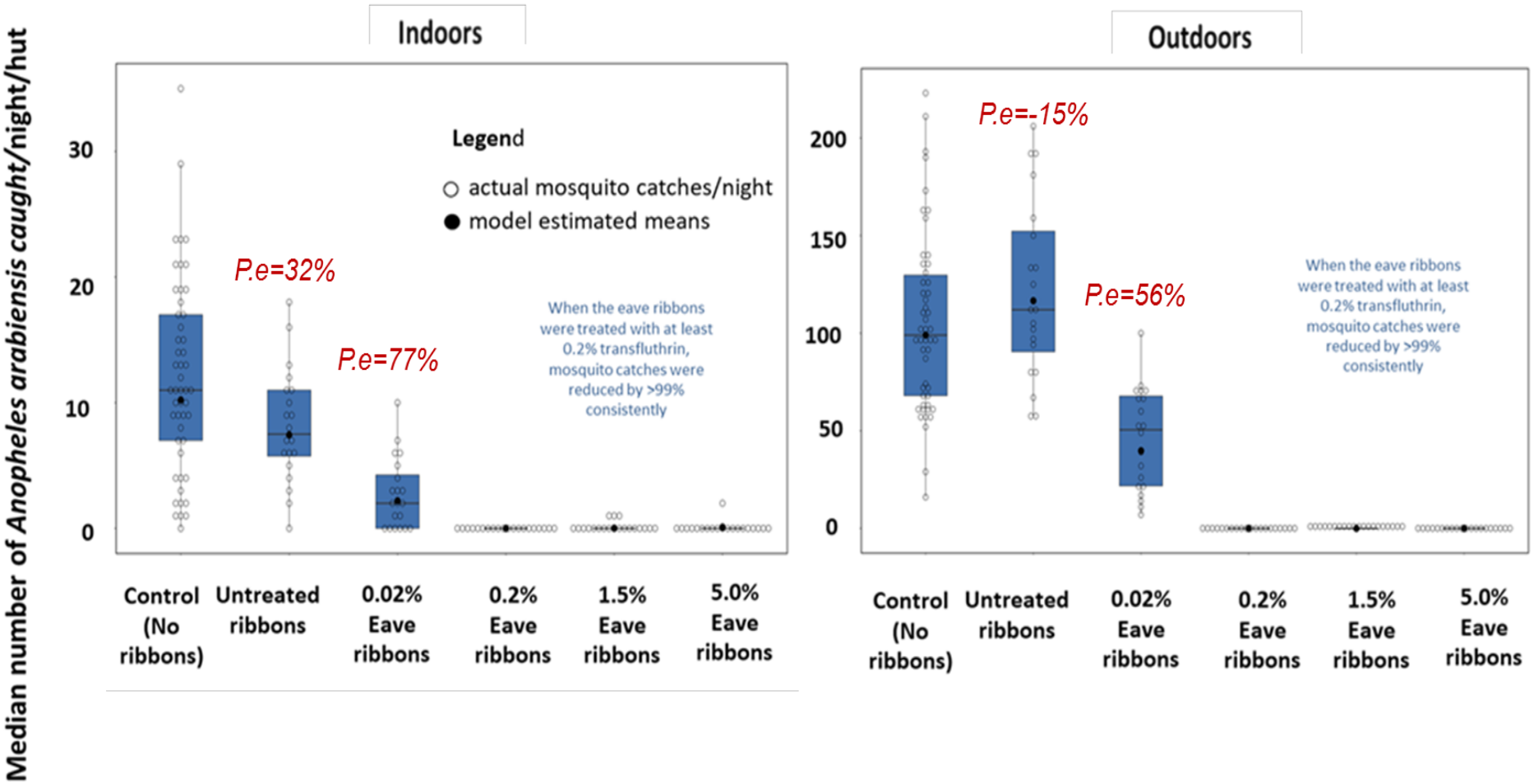
5%= 62g/m^2 , **1.5%**= 19g/m^2 , **0.2%**= 3g/m^2 and **0.02%**=0.3g/m^2

a= 15cm wide and 1m long: one pair for fitting left the other pair at the right side

b= 15cm wide and 2.5m long: for fitting front and back sides of the hut

Results

Mosquito-biting protection conferred with different set of eave-ribbons



Small-scale field evaluation of 1.5% treated eave-ribbons in experimental huts

Outcome measures:

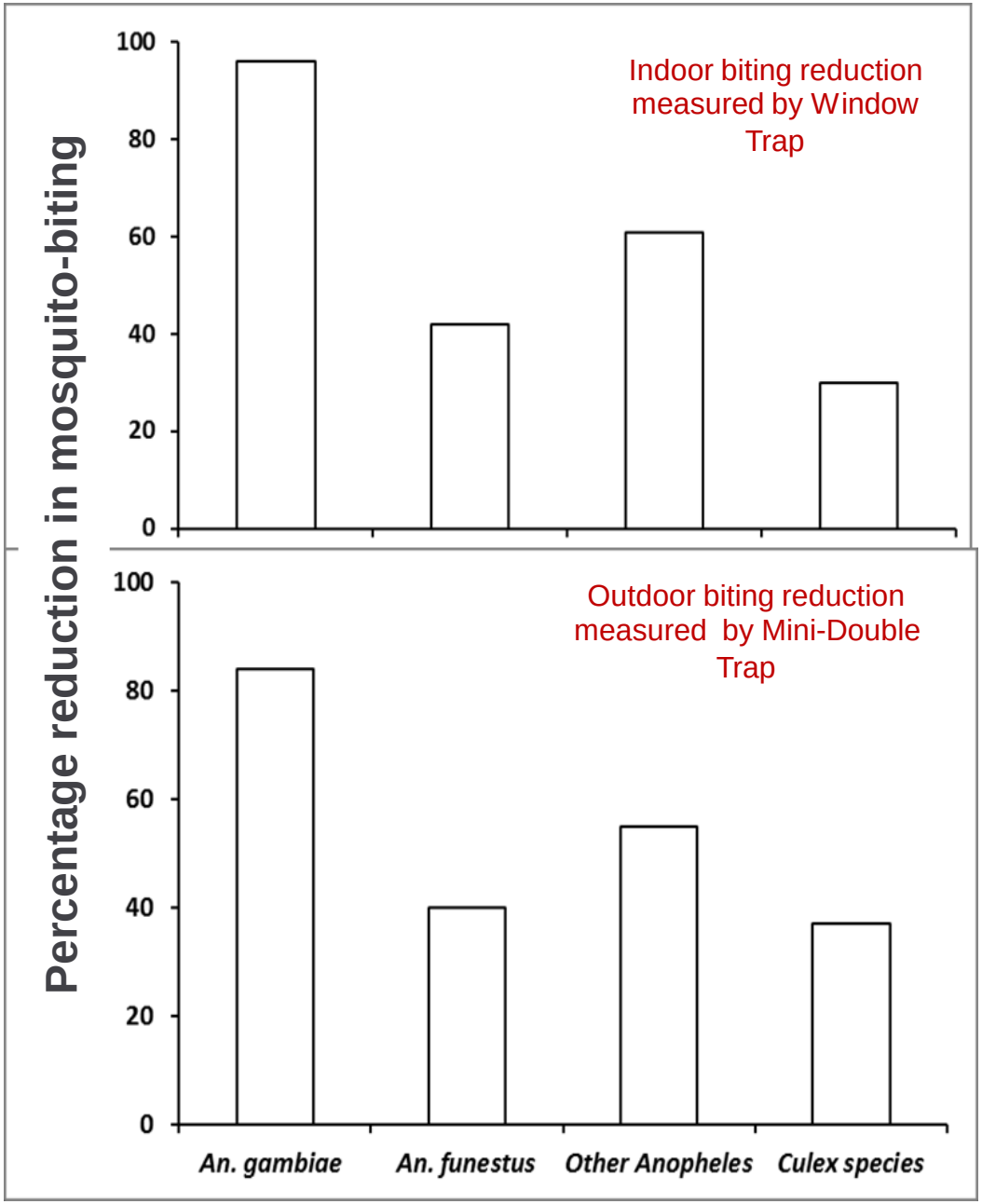
Indoor mosquito-biting risk

- assessed by Window-exit traps and Backpack aspirators.

Outdoor mosquito-biting risk

- assessed by using volunteer occupied exposure free (Mini-Double net) trap

Small-scale field evaluation of 1.5% transfluthrin treated eave-ribbons



Evaluation of 1.5% treated eave-ribbons in rice farm huts

Reduced indoor densities of *An. arabiensis* by 56% (p <0.001), *An. funestus* by 36% (p=0.001), spp. by 72% (p<0.001) and *Mansonia* spp. by 80% (p<0.001).

Outdoors, reductions were evident only for *An. arabiensis* 38% (p=0.034), *Culex* spp. 64% (p=0.001) and *Mansonia* spp. 47% (p<0.001).

Swai *et al* Unpublished

Conclusion and recommendations

- Transfluthrin treated eave-ribbons significantly protected against outdoor and indoor-biting malaria vectors, thus could potentially complement current intervention
- The eave-ribbons also offered protection against non-malaria vectors in the field settings.
- The technique is simple, low-cost (only 7USD/hut), highly-scalable which make it suitable even in poorly-constructed houses.
- It effectively addresses the problem with eave-spaces being the preferred mosquito entryway, also do not require frequent retreatment.
- Do not require external energy of vaporization and do not restrict people movements, yet it provide significant protection against both indoor and outdoor-biting mosquitoes.
- Additional improvement may include the odour-baited devices to create a stimulo-devisionary approach such as push-pull system which could aid to communal level protections.

Acknowledgements

- **Fredros Okumu (*PhD*)**
- **Halfan Ngowo (*MSc*.)**
- **Alex Limwagu (*BSc*)**
- **Johnson Kyeba (BSc)**
- **Khamis Kifungo**
- **Masoud Kilalangongono**
- **OMC+ group**

RBM Partnership To End Malaria

30th January, 2019

Discussion

Part 1

Housing design recommendations: what do and don’t we know?

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Wednesday 30th January 2019

House design recommendations

Professor Steve Lindsay, Durham University, UK

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What we did in 2015

ROLL BACK MALARIA PARTNERSHIP

UNDP
Empowered lives.
Resilient nations.

UN-HABITAT
FOR A BETTER URBAN FUTURE

Housing and Malaria

Consensus Statement

Vector Control Working Group
Roll Back Malaria

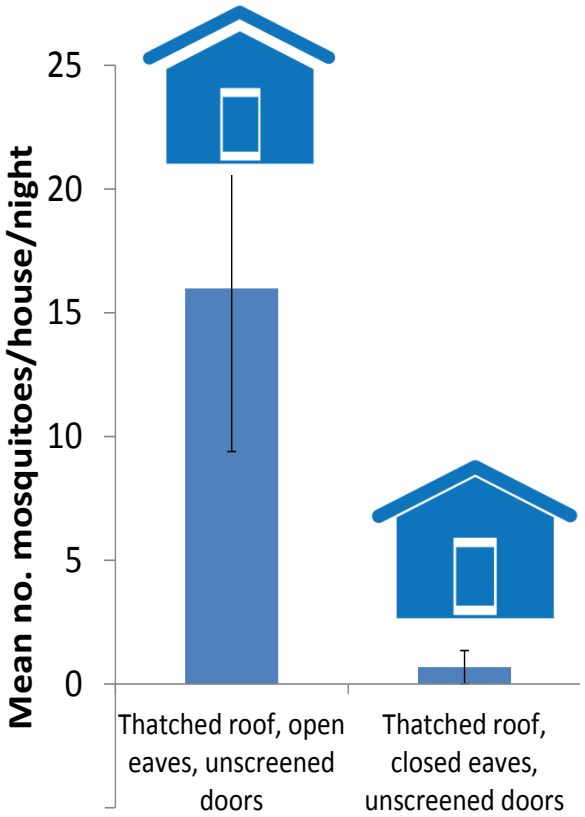
November 2015

What architectural features are protective?

Could these features be improved further, especially through actions by house owners themselves?

Roofs (& gaps)

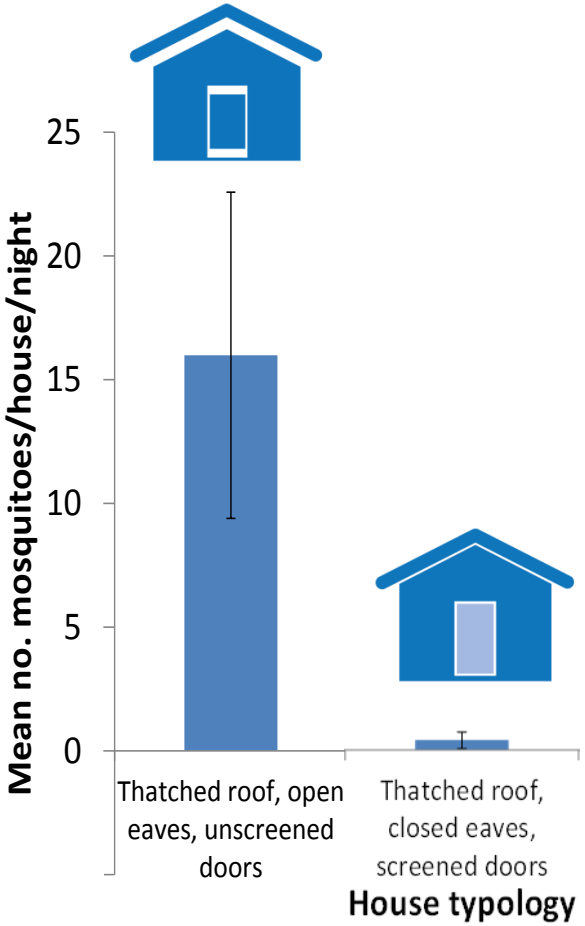
What we know works. I eaves



- Closing the eaves will reduce house entry by malaria mosquitoes, but not other types of mosquito, and it will make the house hotter. May not work in metal-roofed housing
- Weak evidence. No RCTs

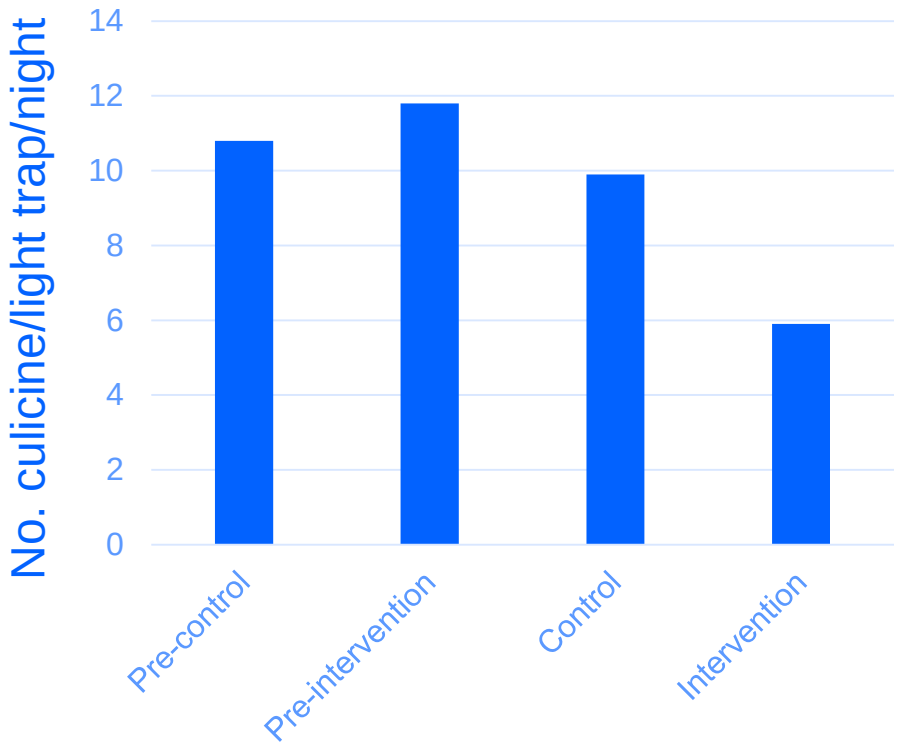
Doors

What we know works. 2 house screening



- Screened doors will also reduce malaria mosquito house entry & keep the house cool
- RCT of screened houses reduce indoor malaria mosquitoes & anaemia by 50% - Kirby et al. The Lancet 2009

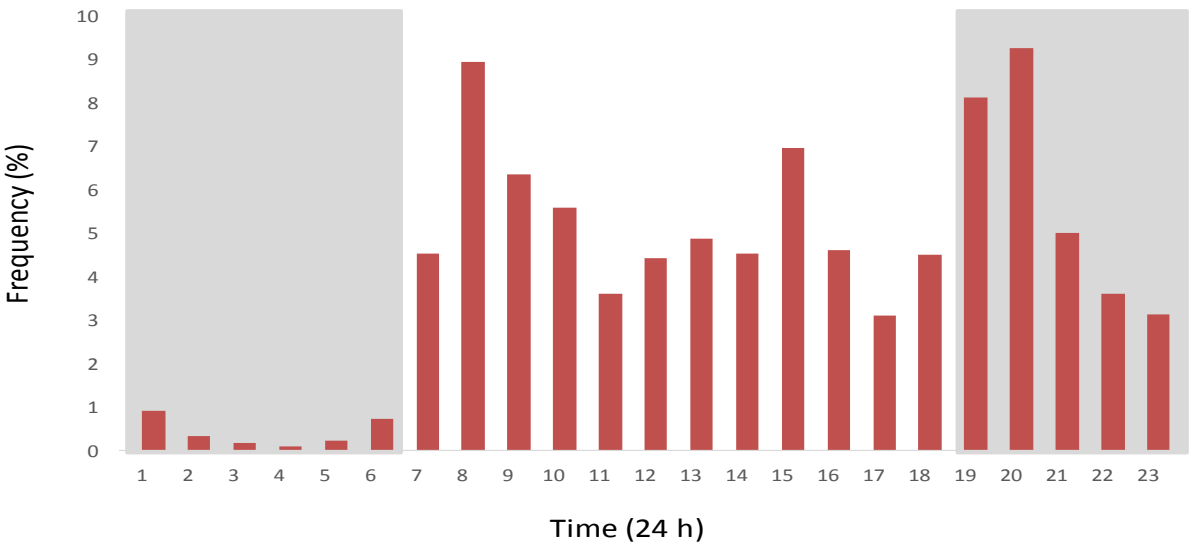
What we know works. 3 house screening



- RCT of 20 screened house & 20 unscreened houses in south-west Ethiopia
- 42% reduction in *An. arabiensis*

Massebo & Lindtjorn 2013 Malaria J 12: 139

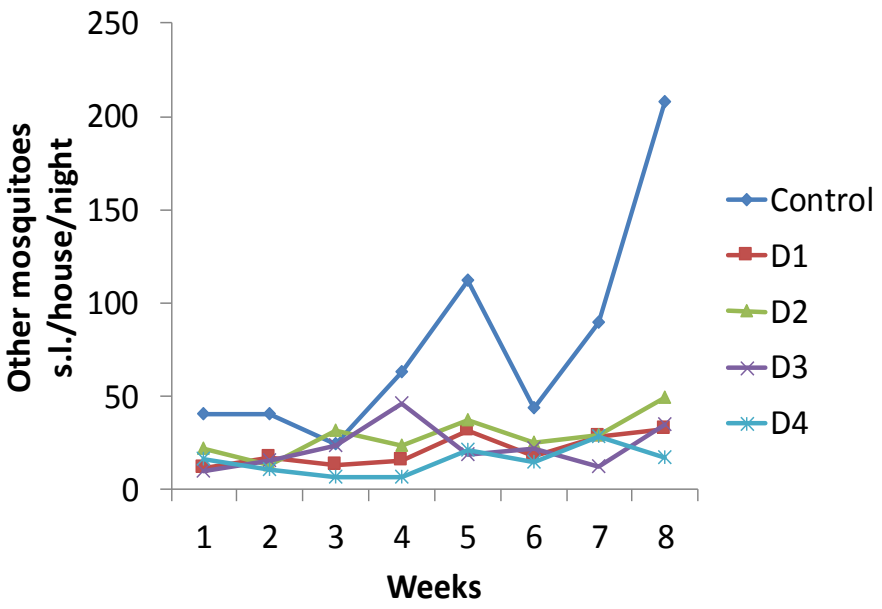
Problem with house screening



- Indication that house screening was not protective in The Gambia
- Due to damaged screening
- High frequency of door opening before midnight

Jawara et al 2018 ASTMH 99, 1475-1484

Even with self-closing doors mosquitoes get indoors



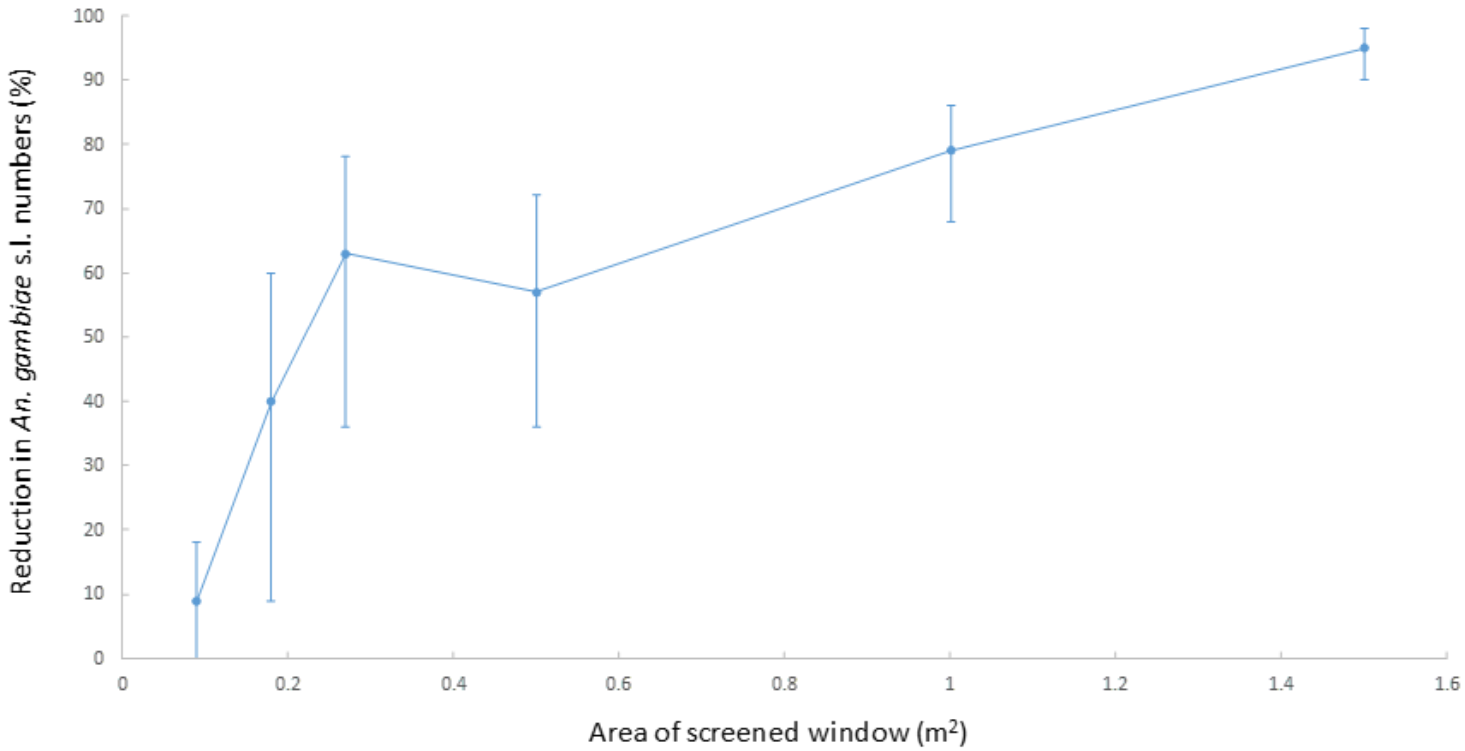
61-79% reduction in mosquitoes entering houses

Jawara et al 2018 ASTMH 99, 1475-1484

Windows

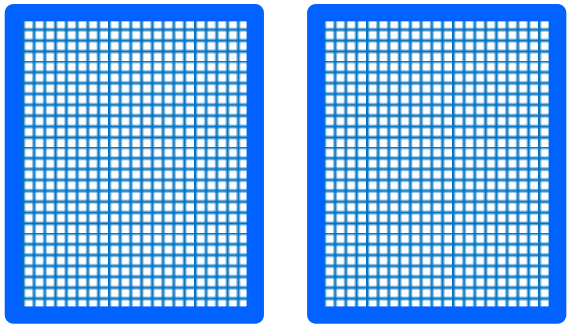
Large screened windows

Increasing area of screening reduces indoor entry



Summary

How do we keep out mosquitoes from a house and keep it cool indoors at night so people will sleep under a mosquito net?



2 screened windows
on opposite walls &
solid doors

+

Long-lasting insecticidal net

After Knudsen

Summary

- Closing the eaves reduces mosquito entry into thatched-roofed houses, but not metal-roofed ones;
- Screening doors or windows will help keep the house cooler at night;
- Screening must be robust & doors closed after dusk
- New materials needed for screening windows
- Screened windows and solid doors may be a better combination that screened doors & windows

House design recommendations - DISCUSSION

- Building high quality housing vs screening existing housing
- Building on traditional and vernacular African architecture
- Window screens – long term solution?
- Solution to door opening at night time – treated beads or strips?
- Tiered system – ideal housing, low-cost immediate solutions – must recognise practical constraints, need for equity
- Incorporating VBD into building regulations
- Housing is an approach involving long-term investment in public health – lack of support from major funders in health sector. So can we identify other funders (e.g. performance-based approach, agricultural sector, DfID).alternative approach – put cost issue aside and use infrastructure funding model?
- Incorporating insecticide into window screens?
- African Development Bank or government funding – many competing priorities
- Resettlement plans and other large scale projects have standard housing specs – opportunity to incorporate VBD
- Recommendations could differentiate between new build and retrofit. Also research questions
- Other models for scale up – copycat houses, incremental improvements/building – housing microfinance supports this

Scale-up of housing interventions

- Modular housing system fit ^s model of incremental building
- Options for :) incremental improvements , 1) permanent solutions
- Using best practices to improve, health and well being
- ADB seeking sugestions on how to improve their standards
- Need for experts to advice funding partners like ADB, inadequate number of experts to ensure large scale infrastructural developments are safe
- Ministries of health should get involved, multisectoral approaches, global vectorcontrol response
- What considerations are needed when looking at personal protection versus communal protection
- Effect sizes for persoinal and communal protection, even if the improvement is only small, treated curtains coulkd result in massive communal impact
- Investments in innovation to achieve high level effectiveness, and coverage at low cost
- Adapt products for different house designs and communitties
- Training local masons to scale up specific architecture
- Nubian
- Housing improvements in Ethiopia

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Thank you, find out more visit rollbackmalaria.org @RollBackMalaria

RBM Partnership to End Malaria
3rd floor, TCS Building, Chemin de Blandonnet 2, 1214 Vernier, Geneva, Switzerland. Info@rollbackmalaria.com

Part 2. The view from the countries:

- How do the health and building sectors link at local level?
- How can protective house designs be incorporated into local architecture?