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Evaluation of the effectiveness of topical repellent distributed by village health volunteer networks against *Plasmodium* spp. infection in Myanmar: A stepped-wedge cluster randomised trial

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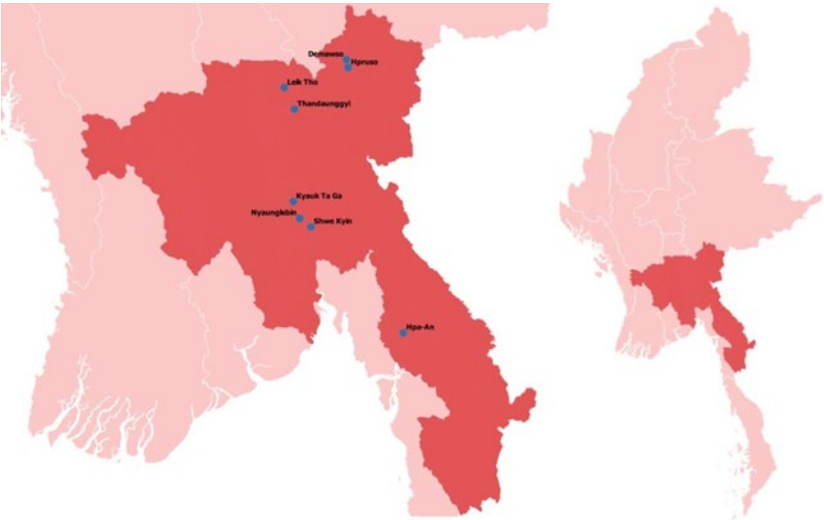
An open stepped wedge cluster-randomised controlled trial to test effectiveness of repellent distributed by village health volunteer (VHV)

- **Primary Objective:** To determine effectiveness of distributing repellent to villagers through VHV in high risk geographically isolated populations to reduce the incidence of *P. falciparum* and *P. vivax* infections.
- **Primary outcome:** Incidence of *P. falciparum and P. vivax* infections (in village) by Rapid Diagnostic Test (RDT)
- **Secondary outcome:** Incidence of PCR detectable *Plasmodium* spp. infections (from dried blood spot)
- **Intervention:** Mosquito repellent cream (N,N-diethyl-benzamide – 12% w/w, cream)

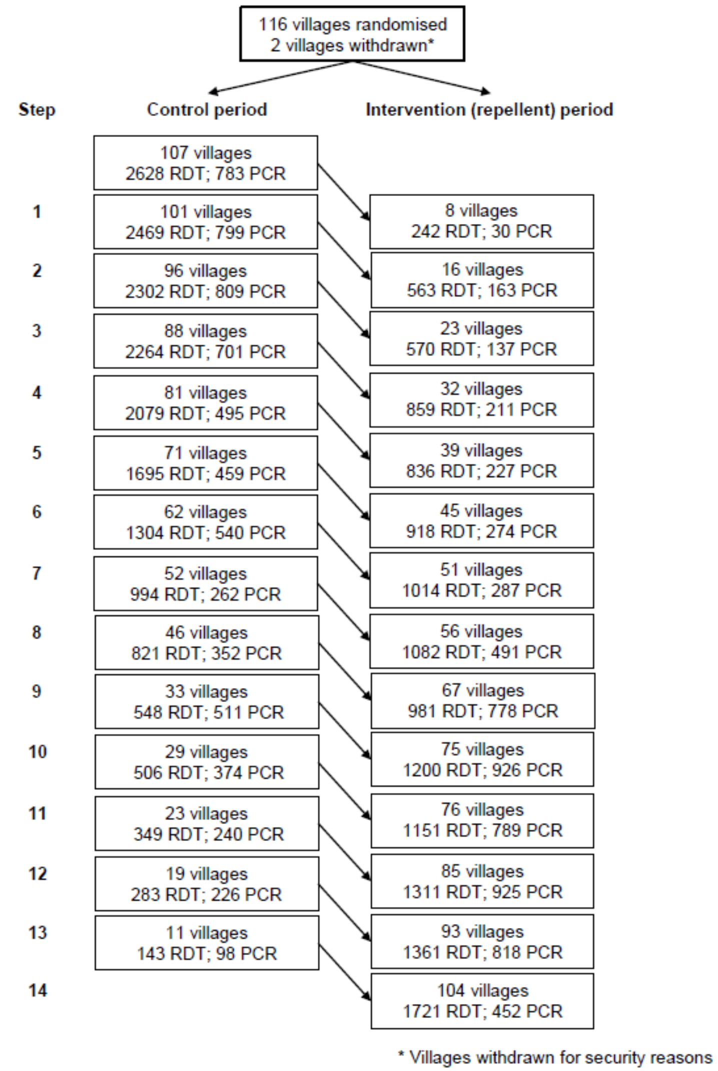


Townships included in trial

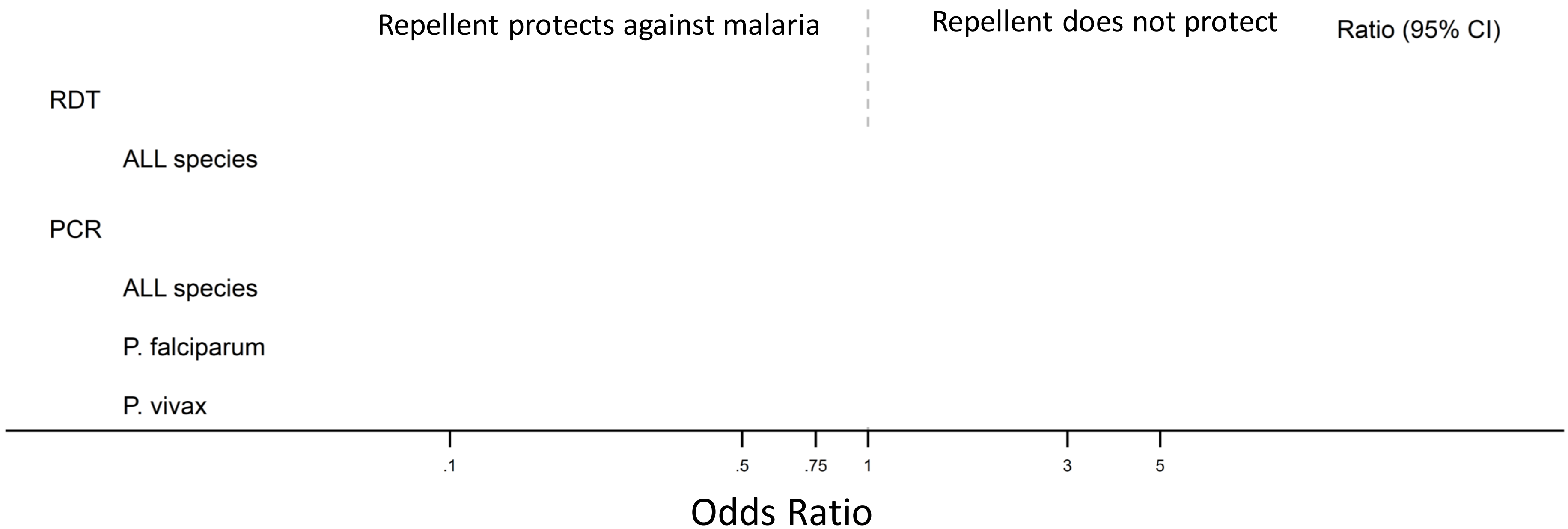
- Conducted in 2015 - 16
- Delivered malaria services to geographically isolated populations:
  - Early diagnosis; quality treatment, behavior change communication, malaria prevention
- 116 villages in Bago, Kayah, Kayin selected based on Myanmar NMCP data
- Total population ~28,000 people

Malaria testing results

- **Primary outcome (RDT)**
  - n=32,194 RDT tests
  - average 2146 tests per month
  - average 14 months of observations per village
  - On average per village:
    - 282 total tests
    - 20 tests per month
  - n=50 *Plasmodium* spp. infections (.16%).
- **Secondary outcome (PCR)**
  - n=13,157 dried blood spot PCR tests
  - n=419 *Plasmodium* spp. infections (3%)
  - n=20 RDT
  - ➢ PCR detected 21x the infection



Does repellent protect against malaria?
Does repellent protect against both species equally?



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Repellent protected against
- 75% of RDT-detectable infections
- 18% of PCR-detectable infections
- 33% of *P. falciparum* infections
- 0% of *P. vivax* infections

GLMM model fixed part: Repellent distribution (dummy indicator, monotonic time-varying), Time (continuous linear), Season (dummy indicators, time-varying, ‘cool’, ‘hot’ and ‘rainy’)
Random part: Village (intercept), Month (intercept),Repellent distribution (slope)

- Repellent distribution significantly reduced *P. falciparum* but not *P. vivax* infections (which can also be caused by relapses)
- indicates that repellent can protect against new *Plasmodium* spp. infections

Is repellent similarly effective across villages of varying malaria prevalence?

Malaria prevalence varies according to village and decreases over time

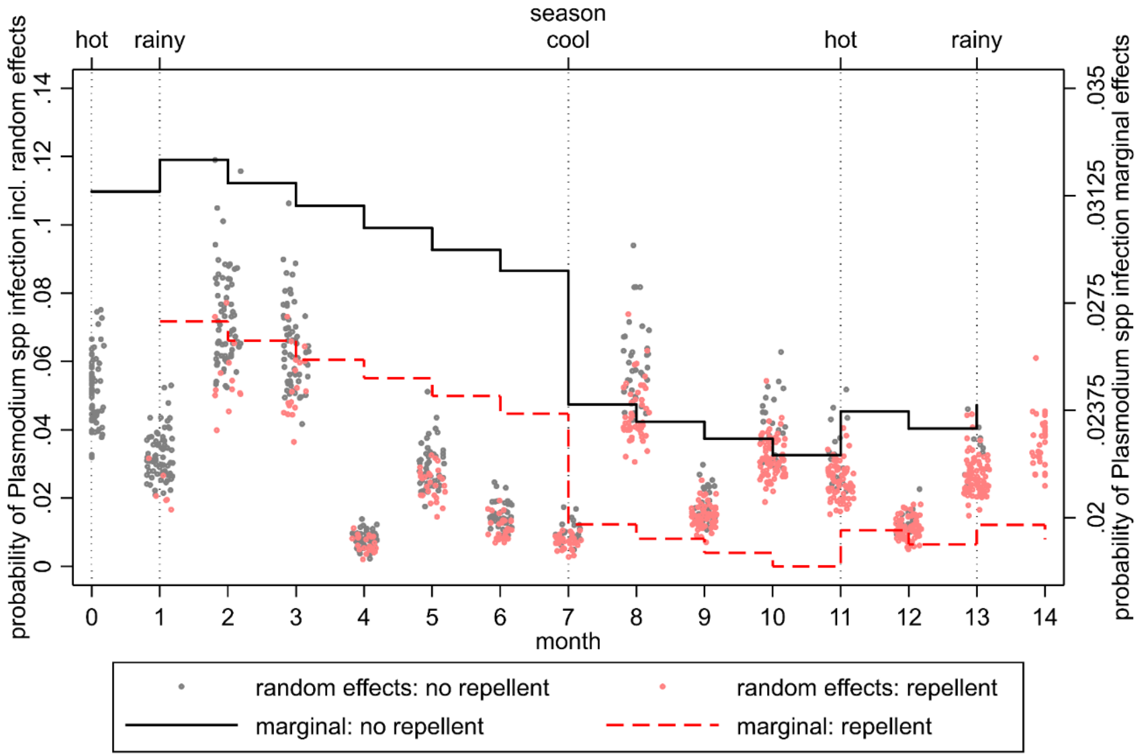

Figure 1: Marginal and village specific probabilities (PCR) by month, season and repellent status from GLMM

- Repellent reduced PCR-detectable *Pf* infection by 33% regardless of prevalence of malaria in a village
- Indicates that repellent will be effective at reducing the malaria infectious reservoir regardless of the prevalence of malaria at baseline and across time

Is repellent similarly effective across risk groups (forest dwellers/migrants)?

	PCR (AOR)	(95%CI)	*P*	*P. falciparum* (ARRR)	(95%CI)	*P. Vivax* (ARRR)	(95%CI)	*P*
Resident	0.65	(0.44-0.96)	0.18	0.58	(0.38-0.88)	1.17	(0.58-2.36)	0.73
Forest Dweller	0.90	(0.63-1.29)		0.74	(0.45-1.22)	1.49	(0.79-2.82)	
Migrant	1.13	(0.62-2.06)		0.77	(0.35-1.72)	2.05	(0.70-5.95)	

AOR = Adjusted Odds Ratio; ARRR = Adjusted Relative Risk Ratio

Was repellent more effective against malaria when it was used more?

- Trend for increasing protection with increasing repellent use
- Caveat: Reported by VHV, large 95%CI

Factors	Adj Odds Ratio	95% CI	p-value	% Reduction in malaria
Intervention				
No repellent	ref.	-	-	
Repellent – monthly	1.54	0.14,16.7	0.722	0%
Repellent – weekly	0.33	0.01,22.2	0.604	66%
Repellent – daily	0.05	0.0002,10.3	0.272	95%

GLMM model fixed part: Repellent distribution (dummy indicator, monotonic time-varying),
Time (continuous linear), Season (dummy indicators, time-varying, ‘cool’, ‘hot’ and ‘rainy’), Repellent use as shown
Random part: Village (intercept), Month (intercept),Repellent distribution (slope)

Summary

- Repellent distributed by VHV reduces the odds of
  - Routinely detected RDT infections by 75%
  - PCR-detectable infections (by 33%) which contribute to ongoing malaria transmission
- Repellent specifically protected against new *P. falciparum* infections
- For PCR infections - low heterogeneity of the effect of repellent across villages
- Repellent as an intervention to reduce malaria is applicable across a range of transmission settings, and populations

Win Han Oo *et al. BMC Infectious Diseases* (2018) 18:663
https://doi.org/10.1186/s12879-018-3566-y

BMC Infectious Diseases

STUDY PROTOCOL Open Access

Effectiveness of repellent delivered through village health volunteers on malaria incidence in villages in South-East Myanmar: a stepped-wedge cluster-randomised controlled trial protocol

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RESEARCH ARTICLE

Evaluation of the effectiveness of topical repellent distributed by village health volunteer networks against *Plasmodium* spp. infection in Myanmar: A stepped-wedge cluster randomised trial

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OPEN ACCESS

Citation: Agius PA, Cutts JC, Han Oo W, Thi A, O'Flaherty K, Zayar Aung K, et al. (2020) Evaluation of the effectiveness of topical repellent distributed by village health volunteer networks against *Plasmodium* spp. infection in Myanmar: A stepped-wedge cluster randomised trial. PLoS

Acknowledgements

Participants, Village Health Volunteers, Malaria Officers

Burnet Institute, Myanmar

- Nyi Nyi Zaw
- Toe Than Tun
- Phone Myint Win
- Poe Poe Aung
- Wai Yan Min Htay
- Ai Pao Yawn
- So Pyay Shin That

Burnet Institute, Melbourne

- Freya Fowkes
- Win Han Oo
- Naanki Pasricha
- Julia Cutts
- Paul Agius
- Katherine O'Flaherty
- Ricardo Ataíde
- Nicole Romero
- Damien McCarthy
- Viv Newton
- James Beeson
- Lia Burns
- Brendan Crabb

Karuna Mission Social Solidarity (KMSS)

- Dr Win Tun Kyi, Mr Augustine Tual Sian Piang , Mr Min Thant Zin Latt, Mrs Nwe Ni Aye, Ms Khine Zar Lwin **(KMSS National Office, Yangon, Myanmar)**
- Fr Joseph Maung Win, Dr Tun Tun Aung, Mr Richard Joseph, Mr Shein Thu Ag, Mr Thet Naing, Mr Myo Tint **(KMSS Yangon, Yangon, Myanmar)**
- Fr Ludovico Saw Piko, Ms Benedetta, Ms Win Win Aye, Mr Ngo Petru, Mr Maurice Nyo, Mr Daniel Win, Mr Saw Golbert **(KMSS Taunggo, Taunggo, Myanmar)**
- Fr Albino Htwe Win, Mr Tin Aung, Mrs Perpetua Aye Aye Mon, Ms Mupaula, Mr John Bosco, Mr Alfred, Mr John Min Aung, Mr Poe Rah **(KMSS Loikaw, Loikaw, Myanmar)**
- Fr Paul Thar San, Mr Saw Isidore, Mrs Theresa, Mr Saw Micheal, Mr Saw Pho Muo **(KMSS Hpa An, Hpa An, Myanmar)**

University of Melbourne

- Julie Simpson
- Sophie Zaloumis

Walter and Eliza Hall Institute

- Alyssa Barry
- Zahra Razook

National Malaria Control Program

- Aung Thi

Funding

We gratefully acknowledge the following funding sources, the 3 MDG fund, the National Health and Medical Research Council of Australia and Burnet Institute, Australia