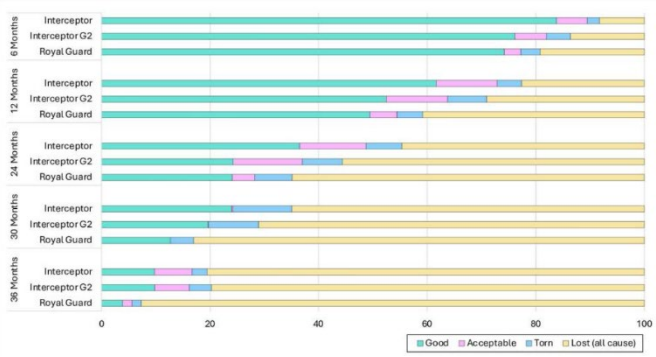
Selected Scientific Publications (between 1 Oct and 31 Jan 2025)

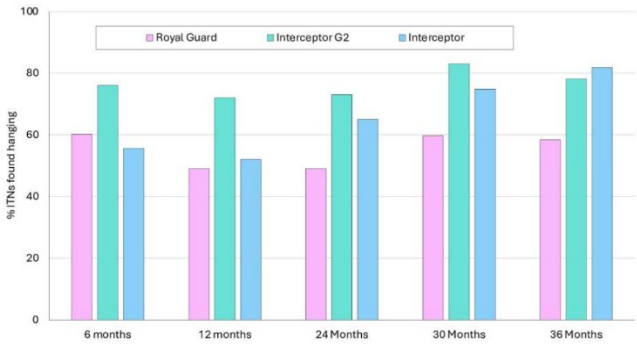
LLINs

The attrition, physical and insecticidal durability of two dual active ingredient nets (Interceptor® G2 and Royal Guard®) in Benin, West Africa: results from a durability study embedded in a cluster randomised controlled trial

Parasites and Vectors 7 Oct 2024

We performed a prospective study embedded in a cluster randomised controlled trial (cRCT) to evaluate the attrition, fabric integrity and insecticidal durability of Interceptor® G2 (alpha-cypermethrin-chlorfenapyr) and Royal Guard® (alpha-cypermethrin–pyriproxyfen), compared to Interceptor® (alpha-cypermethrin) in Benin. The median ITN survival time for Interceptor® G2 (2.1 years) and Royal Guard® (1.6 years) in Benin is substantially lower than 3 years. Royal Guard® nets were discarded more quickly by householders, partly due to their low preference for polyethylene nets. The insecticidal activity of the non-pyrethroid insecticides in both dual AI ITNs was short-lived compared to alpha-cypermethrin.





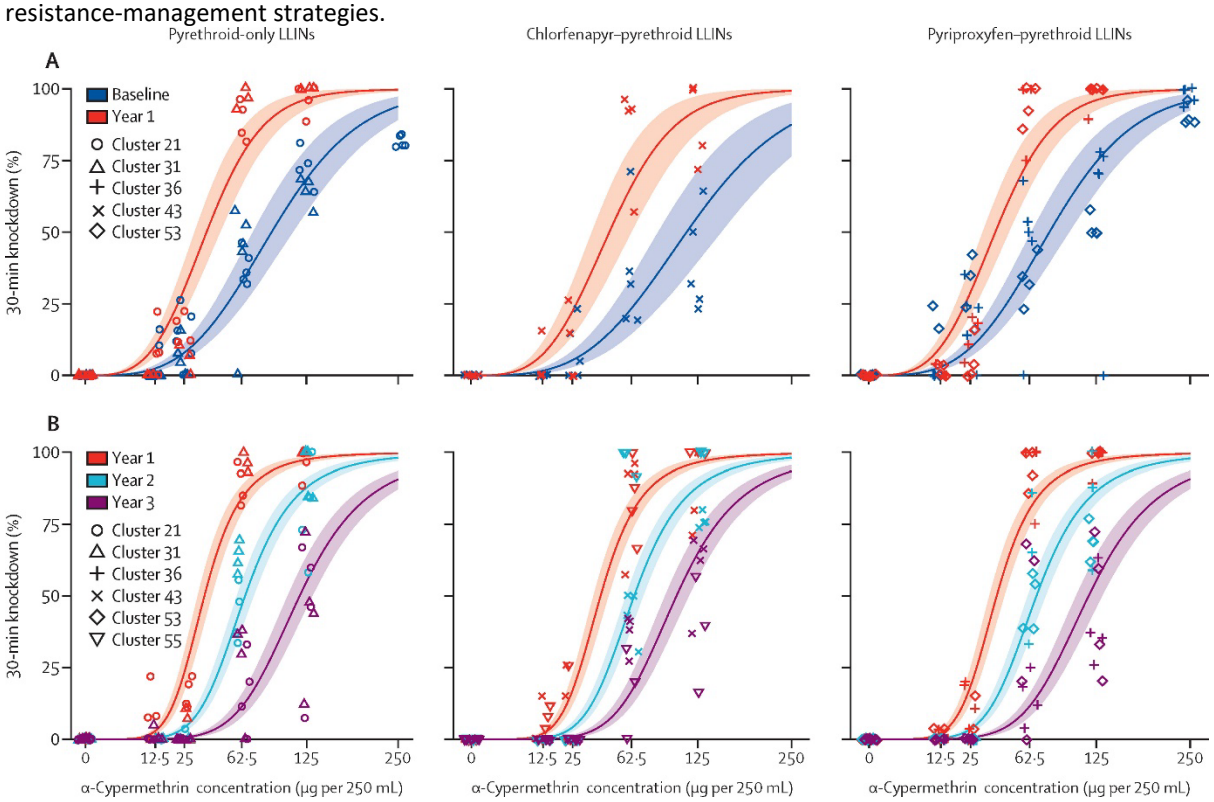
The effect of next-generation, dual-active-ingredient, long-lasting insecticidal net deployment on insecticide resistance in malaria vectors in Benin: results of a 3-year, three-arm, cluster-randomised, controlled trial

Lancet Planet Health Nov 2024

We aimed to assess the longitudinal effect of two dual-active-ingredient LLINs on insecticide resistance during a cluster-randomised, controlled trial in Benin. This 3-year, three-arm, cluster-randomised, controlled trial was conducted between Oct 17, 2019, and Oct 24, 2022, in three districts in southern Benin, to compare the effects of LLINs containing chlorfenapyr–pyrethroid or pyriproxyfen–pyrethroid with LLINs containing pyrethroid only.

Implications of all the available evidence

The escalation of pyrethroid resistance after 24 months' use of pyrethroid-only LLINs and pyriproxyfen–pyrethroid LLINs suggests that continued widespread distribution of these nets could have potentially severe consequences for the selection of cross-resistance mechanisms among major malaria vector populations. Parallel observations from Tanzania that piperonyl butoxide–pyrethroid LLINs, which now protect more than 50% of the population in sub-Saharan Africa, exacerbate pyrethroid resistance selection to a greater extent than pyrethroid-only and pyriproxyfen–pyrethroid LLINs raise substantial concerns about their role in worsening the insecticide resistance crisis. Reliance on a single intervention (eg, LLINs combining a partner pyrethroid with a chemical from another class, such as chlorfenapyr–pyrethroid LLINs) for reactive resistance management is not recommended given the propensity of *Anopheles* vectors to rapidly evolve resistance to new active ingredients and recent reports of reduced chlorfenapyr susceptibility from other parts of west and central sub-Saharan Africa. The differential effects of LLIN types on malaria outcomes also argue for revisions to contemporary net-procurement regimens and the design of more tailored and pragmatic prospective resistance-management strategies.



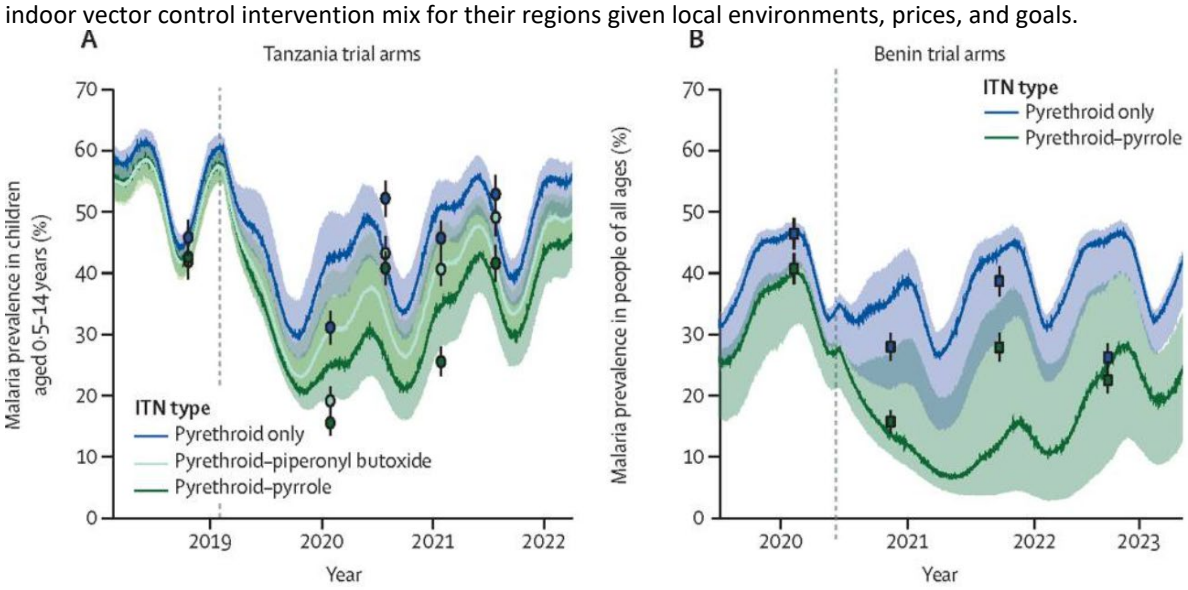
Model-derived estimates of *Anopheles gambiae* sensu lato 30-min knockdown proportions at increasing concentrations of α-cypermethrin

The epidemiological benefit of pyrethroid-pyrrole insecticide treated nets against malaria: an individual-based malaria transmission dynamics modelling study

Lancet Glob Health Dec 2024

It remains unclear how effective more costly pyrethroid–pyrrole ITNs are compared with other tools, or whether they should be deployed when budgets are limited. We aimed to compare the epidemiological impact and cost-effectiveness of the mass distribution of pyrethroid–pyrrole ITNs relative to other ITNs over 3 years in different African settings. The full impact of new ITNs was quantified for trial sites and simulation was used to project impact in different settings which were included within an accessible interface (the Malaria

Intervention Tool) to support National Malaria Programmes to explore how vector control tools and budgets could be allocated across regions to avert the most cases.
Interpretation: The benefit of pyrethroid–pyrrole ITNs varies by setting but is generally the most cost-effective indoor vector control intervention in Africa.
Our online tool provides a validated framework to support local decision makers to make the most appropriate indoor vector control intervention mix for their regions given local environments, prices, and goals.



Changes in malaria prevalence following ITN distribution in the Tanzania and Benin cluster-randomised, controlled trials. Points indicate observed disease prevalence (with associated vertical lines indicating 95% CrIs) and solid lines show model projections (different age groups in each study) for pyrethroid-only, pyrethroid–piperonyl butoxide, and pyrethroi–pyrrole ITNs. The vertical dashed line indicates when the ITNs were introduced

The experimental hut efficacy of next-generation insecticide-treated nets against pyrethroid-resistant malaria vectors after 12, 24 and 36 months of household use in Benin

Malaria Journal 18 Dec 2024

A series of experimental hut trials were performed to evaluate the bioefficacy of new and field-aged next-generation ITNs (PermaNet® 3.0, Royal Guard®, Interceptor® G2) compared to a pyrethroid-only net (Interceptor®) against pyrethroid-resistant malaria vectors in Covè, southern Benin. Field-aged nets were withdrawn from households at 12, 24 and 36 months. Net pieces cut from whole ITNs were analysed for chemical content, and susceptibility bioassays were performed during each trial to assess changes in insecticide resistance in the Covè vector population.
Interceptor® G2 induced superior mosquito mortality than the other ITNs across all time points confirming the superiority of pyrethroid-chlorfenapyr nets over other net types.

Community benefits of mass distribution of three types of dual-active-ingredient long-lasting insecticidal nets against malaria prevalence in Tanzania: evidence from a 3-year cluster-randomized controlled trial

BMC Public Health 28 Jan 2025

Understanding the minimum community usage at which these LLINs elicit an effect that also benefits non-users against malaria infection is important. We conducted a secondary analysis of a 3-year randomized controlled trial (RCT) in 84 clusters in North-western Tanzania to evaluate the effectiveness of three dual-AI LLINs: pyriproxyfen and alpha(α)-cypermethrin, chlorfenapyr and α-cypermethrin, and the piperonyl-butoxide (PBO) and permethrin compared to α-cypermethrin only LLINs. We measured malaria infection prevalence using 5 cross-sectional surveys between 2020 and 2022. We assessed net usage at the cluster level and malaria infection in children aged from 6 months to 14 years in 45 households per cluster.

Conclusion: Our study demonstrated that at a community usage of 40% or more of dual-AI LLINs non-users benefited from the presence of these nets. Noticeably, even when usage was ≤ 40% in the chlorfenapyr arm, non-users were better protected than non-users in the higher coverage pyrethroid-only arm.

IRS

Long-lasting residual efficacy of a new indoor residual spraying product, VECTRON™ T500 (broflanilide), against pyrethroid-resistant malaria vectors and its acceptance in a community trial in Burkina Faso

Parasites and Vectors 23 Nov 2024

VECTRON™ T500, a new indoor residual spraying (IRS) formulation using broflanilide, applied at a dosage of 100 mg AI/m^2 was tested in a Phase III community trial, alongside Actellic® 300CS.
VECTRON™ T500 consistently achieved 100% mortality across all wall types for both susceptible and resistant mosquito strains over the 12-month period. In comparison, Actellic® 300CS induced < 80% mortality for both strains, irrespective of the wall substrate. This new IRS formulation has the potential to play a crucial role in managing insecticide resistance by being integrated into a rotational strategy alongside other IRS products containing insecticides with different modes of action.

The bioefficacy of a novel VECTRON™ T500 indoor residual spray formulation in an experimental huts trial against Anopheles gambiae s.l. populations

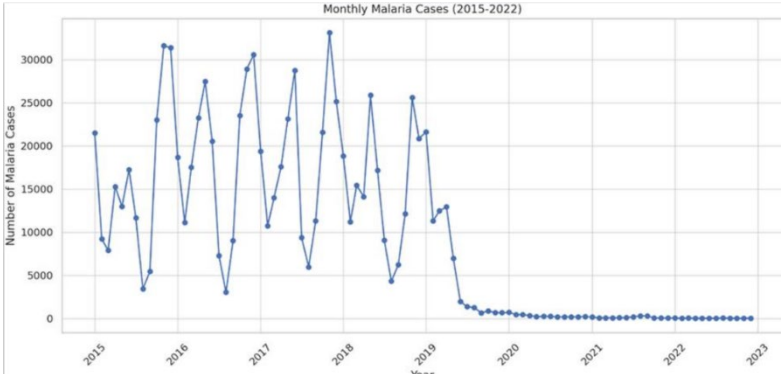
Acta Tropica Nov 2024

The current study assessed the bioefficacy of the new indoor residual spray formulation, VECTRON™ T500 against Klypson 500 WG and water against laboratory reared and wild populations of *Anopheles gambiae* s.l.. The findings of this study have shown VECTRON™ T500 to have extended efficacy against malaria vector mosquitoes when applied to cement and mud walls.

Indoor residual spraying uptake and its effect on malaria morbidity in Ngoma district, Eastern province of Rwanda, 2018–2021

Malaria Journal 18 Dec 2024

Indoor residual spraying (IRS) has been implemented in Rwanda in districts with high malaria transmission, including Ngoma District. The first IRS campaign (IRS-1) was conducted in March 2019, ahead of the peak malaria season, followed by a second campaign (IRS-2) in August 2020, targeting 89,331 structures. This study assessed factors influencing IRS uptake and evaluated the impact of IRS interventions on malaria morbidity in Ngoma District, Eastern Province, Rwanda.



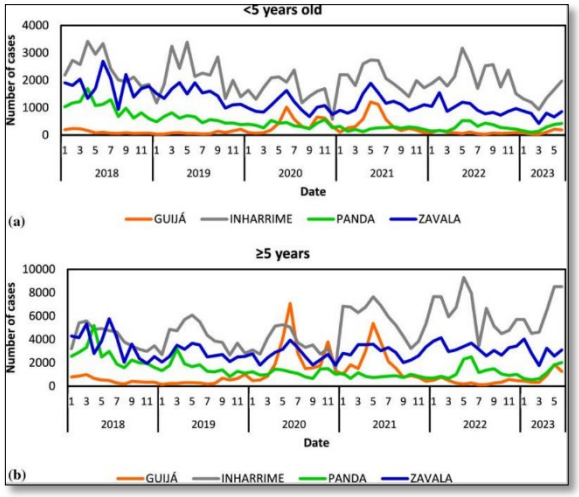
Trends of monthly new malaria cases in Ngoma district, Rwanda (January 2015–December 2022)

First IRS Intervention (March 2019): A marked and statistically significant reduction in malaria cases was observed following the first intervention in March 2019. The model estimated a decrease of approximately 14,380 cases, a substantial decline with a *p*-value less than 0.001, indicating a high level of statistical significance. This result indicates that the first intervention had a considerable and measurable impact on reducing malaria morbidity.

The epidemiology of malaria in four districts in southern Mozambique receiving indoor residual spray as part of a cross-border initiative

Malaria Journal 21 Jan 2025

The study revealed that IRS implementation decreased malaria prevalence in Inharrime and Panda but not in Guija and Zavala. Panda's overall malaria prevalence decreased from 19.20% to 10.82% (p-value < 0.001) whereas overall prevalence in Inharrime, decreased from 27.68% to 19.50% (p-value < 0.001). Overall, there was no significant change in prevalence in Zavala, from baseline to endline (p-value = 0.611). Prevalence for sentinel sites in Guija district indicated that the prevalence of malaria increased slightly from baseline to endline in all sentinel sites in Guija.



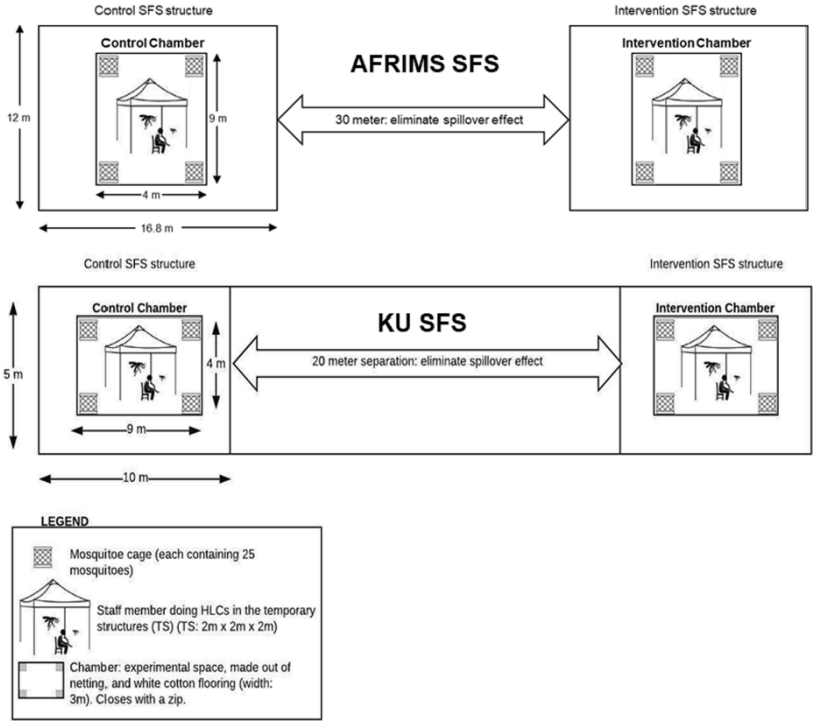
Spatial emanators

The effect of novel mosquito bite prevention tools on Anopheles minimus landing and key secondary endpoints: semi-field evaluations in Thailand

Malaria Journal 18 Dec 2024

This study evaluated two transfluthrin- and one metofluthrin-based volatile pyrethroid spatial repellents (VPSRs), and etofenprox insecticide-treated clothing (ITC) with and without a topical repellent in a semi-field system (SFS) at two research sites in Thailand.

The interventions' modes of action were studied by measuring their impact on mosquito landing, and on key life history traits known to affect vectoral capacity (knockdown, post-exposure blood feeding, and 24-h mortality) using a block-randomized crossover design. The odds ratio (OR) for each intervention compared to the control on each outcome was estimated.



All interventions substantially reduced *An. minimus* landings and prevented more than 50% mosquito landings when new (VPSRs) or unwashed (treated clothing). In addition to landing reduction, all interventions decreased post-exposure blood feeding, induced knockdown and increased mortality at 24 h. The VPSR interventions were the most protective against landing ranging from 70 to 99% reduction in mosquito landing.

Conclusion: This SFS evaluation indicates an effect of these VPSR and ITC interventions in reducing *An. minimus* landing for the user and indicates their potential for community protection by secondary modes of action. This study demonstrates the utility of SFS trials in the evaluation of bite prevention tools and

emphasizes the need for multiple evaluations at different sites. It also highlights possible sources of biases observed, including the measuring of mosquito landing rather than biting, weather parameters, and low mosquito recapture.

Effect of a spatial repellent on malaria incidence in an area of western Kenya characterised by high malaria transmission, insecticide resistance, and universal coverage of insecticide treated nets (part of the AEGIS Consortium): a cluster-randomised, controlled trial

Lancet 19 Dec 2024

A prospective, cluster-randomised, controlled trial in Busia County, western Kenya was done to quantify the efficacy of a transfluthrin-based spatial repellent against human malaria infection following mass distribution of insecticide treated nets.

The outcome of the primary endpoint indicated that spatial repellents significantly reduced the hazard rate of first-time malaria infection by 33·4% (95% CI 11·1-50·1; p=0·0058) and the hazard rate of overall new malaria infections by 32·1% (15·9-45·2; p=0·0004). No reported adverse events and serious adverse events were deemed to be associated with the spatial repellent.

Our trial provides the first evidence of a demonstrative spatial repellent protective efficacy in reducing risk of malaria infection in an African setting characterised by high malaria transmission, pyrethroid resistant malaria vectors, and high coverage of insecticide treated nets.

	Number of patients	Number of first-time infections	Person-years	Incidence rate per person-year (SE)	Hazard ratio* (95% one-sided CI) (95% two-sided CI)†	Protective efficacy‡, % (95% one-sided CI) (95% two-sided CI)†	One-sided and two-sided p values
Interim data							
Spatial repellent	764	233	234	1·00 (0·088)	0·67 (0–0·85)	33·4% (15·2–100)	0·0029
Placebo	762	297	216	1·38 (0·130)	(0·50–0·89)	(11·1–50·1)	0·0058
Final data							
Spatial repellent	769	392	456	0·86 (0·071)	0·67 (0–0·84)	32·7% (16·2–100)	0·0015
Placebo	777	482	413	1·17 (0·108)	(0·52–0·87)	(12·6–48·2)	0·0030

Summary of protective efficacy estimates from patient data for intention-to-treat analyses (cluster core areas) for the spatial repellent intervention against first-time malaria infection measured by microscopy (primary endpoint) including covariate effects. *Obtained from the complementary-log-log (grouped proportional hazard) model. †The primary hypothesis on the protective efficacy of spatial repellent against the first-time infection is one-sided per the study protocol and the prespecified statistical analysis plan (the rationale for using the one-sided is provided in the appendix pp 137–38). The reviewers suggested presenting two-sided 95% CI and two-sided p value as the primary results in the main text. Whether one-sided or two-sided, there is confirmatory evidence on the protective efficacy of spatial repellent against the first-time malaria infection. ‡Protective efficacy=(1 – hazard ratio) × 100%.

Table 2: **Summary of protective efficacy estimates**

Grapefruit-derived nootkatone potentiates GABAergic signaling and acts as a dual-action mosquito repellent and insecticide

Current Biology 6 Jan 2025

Our study demonstrates that nootkatone acts as a potent spatial and contact repellent against multiple mosquito species. At higher doses, nootkatone induces paralysis and death, presumably through broad-range synaptic transmission disruption. Our findings of nootkatone evoking spatial and contact repellency at low to moderate doses and knockdown and mortality at high doses are reminiscent of the actions of transfluthrin, a volatile pyrethroid insecticide.

Binary mixtures of Vanderbilt University allosteric agonist thermolysis components act as volatile spatial repellents for malaria vector mosquitoes

Pest Manag Sci Jan 2025

The discovery and characterization of Vanderbilt University allosteric agonists (VUAAs), a family of small-molecule agonists that target the highly conserved, insect-specific odorant receptor coreceptor (Orco), raise the potential for the development of a novel repellent paradigm for vector/pest management. VUAAs have the potential to target nearly all insect olfactory sensory neurons, leading to highly aversive behavioral responses, but importantly have limited volatility, thereby reducing their utility as spatial repellents.

We have characterized VUAA thermolysis components and identified a suite of volatiles (VUAA-based active ingredients, VUAIs) that act specifically in novel binary combinations as robust and long-lasting spatial repellents against Anopheline mosquitoes. In mobility-based behavioral experiments, VUAIs act synergistically as effective spatial repellents and outperform parent VUAA compounds against host-seeking Anopheline mosquitoes.

Larval control

Larval source management in Ethiopia: modelling to assess its effectiveness in curbing malaria surge in dire Dawa and Batu Towns

Malaria Journal 3 Dec 2024

In this paper, we describe the evaluation of a larval source management (LSM) strategy implemented in response to *An. stephensi*. The primary outcome was the malaria incidence rate compared between intervention and non-intervention sites in the presence of *An. stephensi*. An interrupted time series model with a cyclic second-order random walk structure periodic seasonal term was used to assess the impact of LSM on malaria incidence rate in the intervention and control settings.

Conclusions: An overall increasing trend in the malaria incidence rate was observed irrespective of the implementation of LSM in the urban settings of Ethiopia, where *An. stephensi* has been found. Further investigations and validations of the incorporation of LSM into control activities are warranted.

Development of a controlled-release mosquito RNAi yeast larvicide suitable for the sustained control of large water storage containers

Sci Rep 4 Dec 2024

Here we examine the hypothesis that development of a shelf-stable controlled-release RNAi yeast formulation can facilitate lasting control of *A. aegypti* juveniles in large water storage containers. In this study, a dried inactivated yeast was incorporated into a biodegradable matrix containing a mixture of polylactic acid, a preservative, and UV protectants. The formulation was prepared using food-grade level components to prevent toxicity to humans or other organisms. Both floating and sinking versions of the tablets were prepared for treatment of various sized water containers, including household water storage tank-sized containers. The tablets passed accelerated storage tests of shelf life stability and demonstrated up to six months residual activity in water. The yeast performed well in both small and large containers, including water barrels containing 20-1000 larvae each, and in outdoor barrel trials. Future studies will include the evaluation of the yeast larvicide in larger operational field trials that will further assess the potential for incorporating this new technology into integrated mosquito control programs worldwide.

COMPARATIVE LABORATORY ACTIVITY AND SEMI-FIELD EFFICACY OF OMNIPRENE® G AND ALTOSID® PELLETS AGAINST AEDES AEGYPTI

J Am Mosq Control Assoc 11 Dec 2024

Mosquito larval control by biorational larvicides plays a crucial role in mosquito and mosquito-borne disease management. However, the availability of larvicides that meet the criteria of efficacy, safety, and quality is limited and conventional pesticides are no longer preferred for larval control. Although efforts are made to research new active ingredients (AIs), it is equally important to innovate new formulations based on currently available AIs such as microbial agents and insect growth regulators. Studies were therefore conducted to compare the laboratory activity and semi-field efficacy of OmniPrene® G (US EPA reg# 73487-2 Synergetica International Inc) and Altosid® Pellets with DR-tech (US EPA reg# 2724-448 Central Life Sciences), both containing 4.25% S-methoprene, at 2.8 kg/ha and 11.2 kg/ha against the yellow fever mosquito *Aedes aegypti* (L.) in outdoor microcosms. Overall, newly available OmniPrene G provided comparable activity and efficacy with Altosid Pellets against the test species, with the advantages of fast initial AI release and even coverage, particularly when applied at low doses.

Empowering rural communities for effective larval source management: A small-scale field evaluation of a community-led larviciding approach to control malaria in south-eastern Tanzania

Parasite Epidemiology and Control. 4 Oct 2024

This study evaluated the potential of training community members to identify, characterize and target larval habitats of *Anopheles funestus* mosquitoes, the dominant vector of malaria transmission in south-eastern Tanzania.

The trained community volunteers identified and characterized 360 aquatic habitats, of which 45.6 % had *Anopheles funestus*, the dominant malaria vector in the area. The preferred larval habitats for *An. funestus* were deep and had either slow- or fast-moving waters. Application of biolarvicides reduced the abundance of adult *An. funestus* and *Culex* spp. species inside human houses in the same villages, by 46.3 % and 35.4 % respectively. Abundance of late-stage instar larvae of the same taxa was also reduced by 74 % and 42 %, respectively.

Conclusion: This study demonstrates that training community members to identify, characterize, and target larval habitats of the dominant malaria vectors can be effective for larval source management in rural Tanzania. Community-led larviciding reduced the densities of adult and late-stage instar larvae of *An. funestus* and *Culex* spp. inside houses, suggesting that this approach may have potential for malaria control in rural settings. However, efforts are still needed to increase awareness of larviciding in the relevant communities.

Larviciding for malaria control and elimination in Africa

Malaria Journal 15 Jan 2025

This Perspective explores the major challenges hindering wider-scale implementation of larviciding in Africa and identifies potential solutions and opportunities to overcome these barriers.

Malaria programmes hoping to implement larviciding face significant barriers, including (1) poor global technical, policy, and funding support; (2) fragmented implementation and experience; (3) high complexity of delivery and impact evaluation; and (4) limited access to the full range of WHO prequalified larvicide products. As more African countries implement larvicide programmes, establishing a regional Community of Practice platform for exchanging experiences and best practices is necessary to strengthen the evidence base for cost-effective implementation, advocate for support, and inform policy recommendations, thus supporting Africa's progress toward malaria elimination.

Larvicides in use in Africa

Larvicide	Type	# products	# manufacturers	# African countries using
WHO prequalified larvicides				
Temephos	Organophosphate	3	2	1
Pirimiphos methyl	Organophosphate	1	1	-
Polydimethylsiloxane	Monomolecular film	1	1	1
Diflubenzuron	Insect growth regulator	3	1	-
Novaluron	Insect growth regulator	1	1	-
Pyriproxyfen	Insect growth regulator	3	2	-
Bacillus thuringiensis israelensis (Bti)	Bacterium (dry formulation)	2	1	6
Bacillus sphaericus	Bacterium	1	1	-
Spinosad	Bacterium	6	2	-
Other larvicides (not prequalified)				
Methoprene	Insect growth regulator	3	1	1
Bti	Bacterium (liquid formulation)	1	1	6

*Source: RBM Vector Control Working Group landscaping survey, 2022

New vector control tools and approaches

Malaria burden and residual transmission: two thirds of mosquito bites may not be preventable with current vector control tools on Bioko Island, Equatorial Guinea

Int J Infectious Dis Oct 2024

This study assesses exposure to malaria vector mosquitos that is nonpreventable through use of nets, the contribution of outdoor and indoor biting towards residual vector exposure, and the risk factors for being bitten and for being infected with malaria parasites on Bioko Island, Equatorial Guinea.

On average, each person received 2.7 (95% CI: 2.6-2.8) bites per night outdoors, 8.5 (8.3 to 8.7) bites indoors if not using a net, and 4.7 (4.5 to 4.8) bites indoors if using a net. Malaria infection was associated with more bites, regardless of whether received indoors or outdoors. Older age, male gender, not using a net, rural location, and going indoors later increased the risk of being bitten. The proportion of bites not averted by using a net was estimated as 66% (61 to 71).

A large proportion of biting, mostly indoors, may not be preventable by bednets.

Efficacy of attractive targeted sugar bait stations against malaria in Western Province Zambia: epidemiological findings from a two-arm cluster randomized phase III trial

Malaria Journal 15 Nov 2024

A two-arm cluster-randomized controlled trial (cRCT) was conducted in Western Province Zambia.

Two ATSB stations deployed per eligible structure for two consecutive transmission seasons did not result in a statistically significant reduction in clinical malaria incidence among children aged 1–14 years or in *P. falciparum* prevalence in rural western Zambia.

Development of flame retardant slow release insecticides paint and testing its efficacy for four years against dengue and malaria vectors

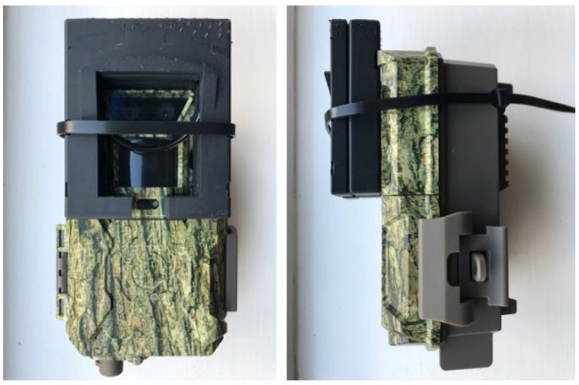
Sci Reports 25 Nov 2024

Insecticide based paint formulations have been available for years, however the concept of using such paint products at household level has not gotten attention due to various reasons.

In the present study, optimum concentrations of deltamethrin (1%), chlorpyriphos (0.5%) and pyriproxyfen (0.075%) were used as active ingredients (AIs) to develop flame retardant slow-release insecticides paint (FRSRIP) formulation. The formulation was evaluated against *Ae. aegypti* and *An. stephensi* mosquitoes in laboratory up to four years.

Scalable camera traps for measuring the attractiveness of sugar baits for controlling malaria and dengue vectors

Parasites and Vectors 3 Dec 2024



Reproducible and quantitative information on the level of attractiveness of sugar baits under field conditions is needed. Therefore, we customized camera traps for close-up imaging. We integrated them into a rugged attractive targeted sugar bait monitoring station for day and nighttime recording of mosquitoes landing on the bait.

Conclusions: Using camera traps to record still images of mosquitoes present on ASBs offers reliable, reproducible and quantitative data on their attractiveness in various environmental conditions. Therefore, modified camera traps are effective tools for assessing mosquito interactions with sugar baits or other attractants in semifield and field conditions. The present study demonstrated that the ASB attractant used in the ASB stations, version 1.2.1 by Westham, is attractive to *An. arabiensis* under both semifield and field conditions while rarely attracting NTOs. Future studies using the same camera stations could help clarify the complex relationships among seasonality, rainfall, drought and sugar source availability and their impacts on absolute and relative ATSB attractiveness.

Chromobacterium biopesticide overcomes insecticide resistance in malaria vector mosquitoes

Science Advances 4 Dec 2024

Here, we show that a biopesticide derived from the soil-dwelling bacterium *Chromobacterium* sp. Panama (*Csp_P*) kills insecticide-resistant *Anopheles* mosquitoes, regardless of their resistance mechanisms. In addition, sublethal dose of *Csp_P* acts as a synergist to now used chemical insecticides across multiple classes. Moreover, *Csp_P* reduces host-seeking behavior and malaria parasite infection in vector mosquitoes in ways that further decrease transmission. Mosquito glutathione *S*-transferases are essential for *Csp_P*'s mosquito-killing mechanism. Enclosed field trials in Burkina Faso, conducted in diverse ecological settings and supported by a mathematical model, have now demonstrated its potential for malaria control in settings with widespread insecticide resistance.

Anopheles stephensi

Urban malaria and its determinants in Eastern Ethiopia: the role of Anopheles stephensi and urbanization

Malaria Journal 9 Oct 2024

This study aimed to assess the determinants of urban malaria, focusing on the role of urbanization and the distribution of *An. stephensi* in Eastern Ethiopia.

A matched case control study was conducted among febrile urban residents of Dire Dawa (malaria positive as cases and negative as a control). A capillary blood sample was collected for parasite identification using microscopic examination and an interviewer administered questionnaire was used to collect additional data. CDC light traps and Prokopack aspirators were used to collect adult mosquito vectors from the selected cases and control houses to identify the mosquito vector species. Conditional logistic regression was done to identify determinants, and principal component Analysis (PCA) was done for some independent variables.

This study enrolled 132 cases and 264 controls from urban setting only. Of the 132 cases, 90 cases were positive for *Plasmodium falciparum*, 34 were positive for *Plasmodium vivax* and 8 had mixed infections. About 34 adult *Anopheles* mosquitoes were collected and identified from those selected cases and control houses and 27 of them were identified as *An. stephensi*.

This study identified travel history, house condition, past infection, livestock ownership, stagnant water, bed net use, and malaria knowledge as determinants of infection. This study also found the dominance of the presence of *An. stephensi* among the collected mosquito vectors. This suggests that the spread of *An. stephensi* may be impacting malaria infection in the study area.

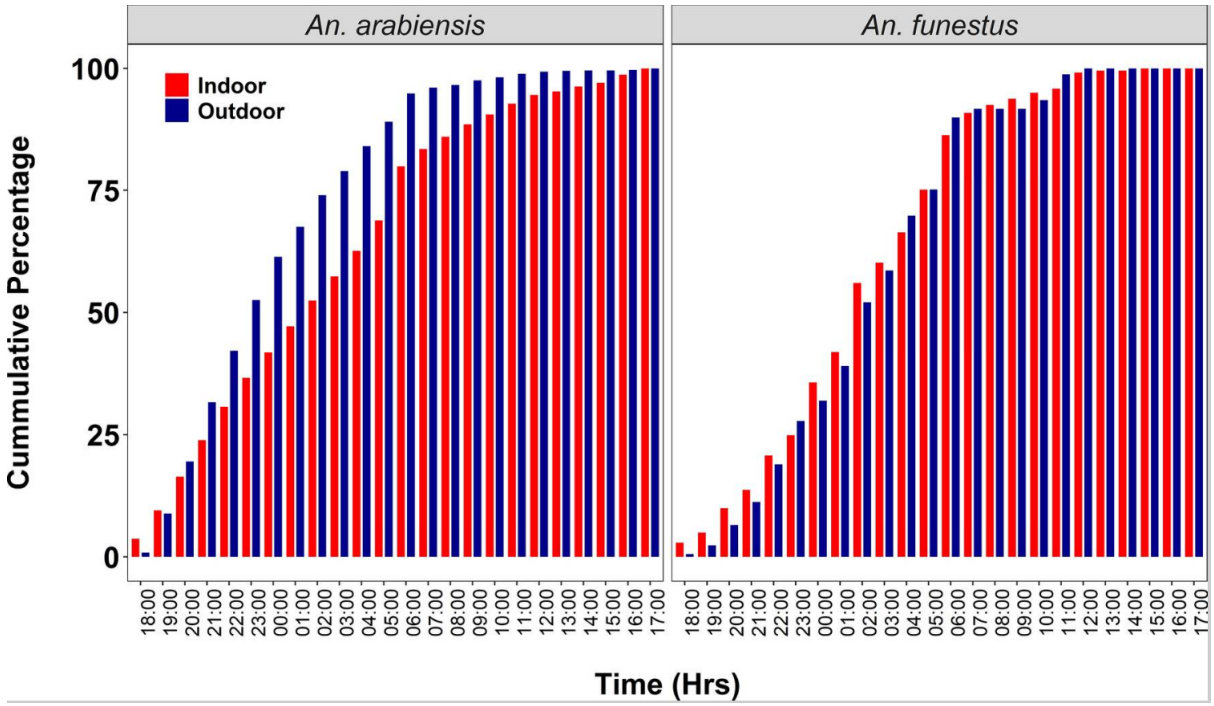
Analysis of the 24-h biting patterns and human exposures to malaria vectors in south-eastern Tanzania

Parasites and Vectors 30 Oct 2024

Recent evidence shows that *Anopheles* biting can extend way into the daytime, coinciding with human activities at dawn, daytime and evenings, suggesting a broader risk spectrum and potential protection gaps. We have therefore investigated the diurnal and nocturnal biting patterns of the malaria vectors *Anopheles arabiensis* and *Anopheles funestus* in south-eastern Tanzania, to better understand the scope of residual transmission and inform strategies for improved control.

Daytime biting accounted for 15.03% of *An. arabiensis* catches, with peaks around 7–11 a.m. and after 4 p.m., and for 14.15% of *An. funestus* catches, peaking around mid-mornings, from 10 a.m. to 12 p.m. Nighttime exposure to *An. arabiensis* was greater outdoors (54.5%), while daytime exposure was greater indoors (80.4%). For *An. funestus*, higher exposure was observed indoors, both at nighttime (57.1%) and daytime (69%).

Conclusions: This study updates our understanding of malaria vector biting patterns in south-eastern Tanzania, revealing considerable additional risk in the mornings, daytime and evenings. Consequently, there may be more gaps in the protection provided by ITNs, which primarily target nocturnal mosquitoes, than previously thought.



A systematic review of interventions targeting Anopheles stephensi

Wellcome Open Res. 16 Dev 2024

We reviewed studies published between 1995 and 2018 following inclusion and exclusion criteria. Fourteen studies met the criteria and looked at control methods such as larvicides (3 studies), repellents (1 study), indoor residual spraying (2 studies), mosquito nets (3 studies), insecticide-treated materials other than nets (3 studies including blankets and curtains) and combinations of some of these interventions (2 studies). Most of the studies focused on reducing mosquito populations and a few looked at the impact on malaria cases.
The literature provides strong evidence that Insecticide Treated Nets (ITNs) and Indoor Residual Spraying (IRS) are effective in controlling malaria and *An. stephensi* in its native range, whilst repellents show promise as a complementary control measure. The private sector could play a critical role in scaling up the production and distribution of repellents in Africa, which experiences the spread of invasive species and high incidence of vector borne diseases, offering an affordable, widely accessible option for malaria prevention. Addressing the gap of cost-effectiveness analysis is also crucial for optimizing resources and improving the overall impact of malaria vector control efforts.

Odds & Ends

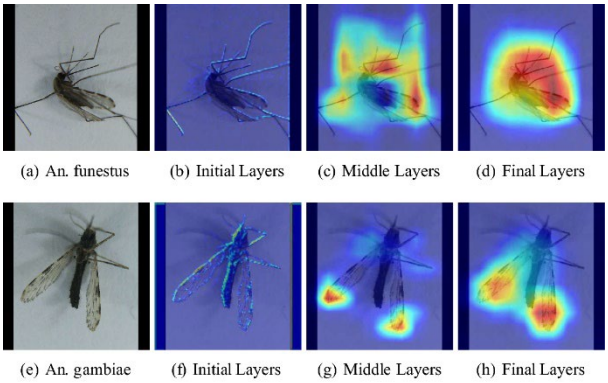
Discovery of Knock-Down Resistance in the Major African Malaria Vector Anopheles funestus

Molecular Ecology 7 Oct 2024

Despite being common in most malaria *Anopheles* vector species, knock-down resistance *(kdr)* mutations have never been observed in *Anopheles funestus*, the principal malaria vector in Eastern and Southern Africa, in which resistance is mainly being conferred by detoxification enzymes. We monitored 10 populations of *An*. *funestus* in Tanzania for insecticide resistance unexpectedly identified resistance to a banned insecticide, DDT, in the Morogoro region. Through whole-genome sequencing of 333 *An*. *funestus* samples from these populations, we found eight novel amino acid substitutions in the *Vgsc* gene, including the *kdr* variant, L976F (equivalent to L995F in *An*. *gambiae*), in tight linkage disequilibrium with another (P1842S). Notably, *kdr* L976F was strongly associated with survivorship to exposure to DDT insecticide, while no clear association was noted with a pyrethroid insecticide (deltamethrin). Continued monitoring is necessary to understand the origin of *kdr* in *An*. *funestus*, and the threat posed to insecticide-based vector control in Africa.

Towards transforming malaria vector surveillance using VectorBrain: a novel convolutional neural network for mosquito species, sex, and abdomen status identifications

Nature Sci Reports 24 Oct 2024



The current manual identification of mosquitoes is a time-consuming and intensive task, posing challenges in low-resource areas like sub-Saharan Africa; in addition, existing automated identification methods lack scalability, mobile deployability, and field-test validity. To address these bottlenecks, a mosquito image database with fresh wild-caught specimens using basic smartphones is introduced, and we present a novel CNN-based architecture, VectorBrain, designed for identifying the species, sex, and abdomen status of a mosquito concurrently while being efficient and lightweight in computation and size. Overall, our proposed approach achieves 94.44±2% accuracy with a macro-averaged F1 score of 94.10±2% for the species classification, 97.66±1% accuracy with a macro-averaged F1 score of 96.17±1% for the sex classification, and 82.20±3.1% accuracy with a macro-averaged F1 score of 81.17±3% for the abdominal status classification. VectorBrain running on local mobile devices, paired with a low-cost handheld imaging tool, is promising in transforming the mosquito vector surveillance programs by reducing the burden of expertise required and facilitating timely response based on accurate monitoring.

Malaria vector control in sub-Saharan Africa: complex trade-offs to combat the growing threat of insecticide resistance

The Lancet Planetary Health 5 November 2024

This Personal View explores contemporary malaria vector control trends in sub-Saharan Africa and cost implications for improved disease control and resistance management.

Based on current projections, WHO estimates that key 2030 malaria incidence milestones outlined in the Global Technical Strategy for Malaria will be missed by a staggering 89%. While a portfolio of four types of ITN (pyrethroid, PY-PBO, PY-PPF, and PY-CFP) might appear to be reason for optimism, the reality is in stark contrast. The absence of a diverse ITN portfolio risks over-reliance on chlorfenapyr, with PY-PBO already becoming unviable in several locations due to rapidly evolving loss of PBO synergy and PY-PPF ITNs providing little or no public health benefit against pyrethroid-resistant mosquitoes. To enhance prospects for malaria control and elimination in sub-Saharan Africa, considerable funding is urgently needed both to develop a diverse range of insecticide classes for proactive resistance management and to support continent-wide roll-out of more expensive, but more cost-effective, ITNs. Considering the cost to develop a new insecticide is estimated at more than $250 million with more than 10 years of development time, rotational targeted IRS campaigns for resistance management might be worth maintaining in some locations despite the high associated funding required.

Characterization of human exposure to Anopheles and Aedes bites using antibody-based biomarkers in rural zone of Cameroon

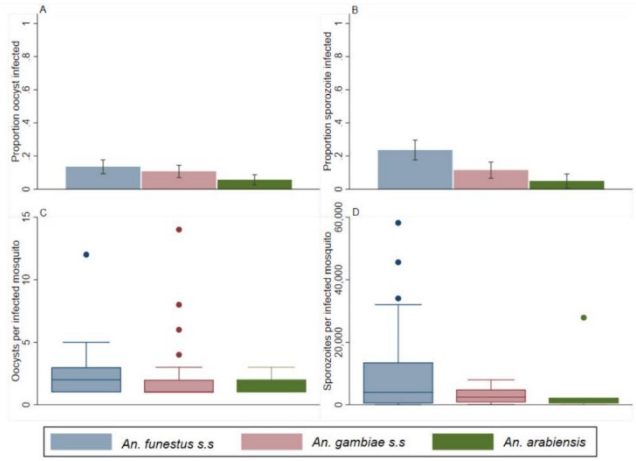
PLoS One 5 Dec 2024

Due to the limitations of current surveillance tools used to assess human exposure to mosquito bites, human antibody (Ab) responses to salivary peptides from Anopheles (gSG6-P1) and Aedes (Nterm-34kDa) are increasingly being used to measure direct human-Anopheles or Aedes contact. This study reports on the assessment of Human IgG Ab responses to gSG6-P1 and Nterm-34-kDa salivary peptides as biomarkers to track exposure to Anopheles and Aedes bites, in rural localities of Cameroon.

Individuals not using their LLIN, those using damaged bed nets, and those who reported vegetation around their houses developed higher IgG responses compared to those who did not (all $p<0.05$). The immune-epidemiological biomarkers have shown promising potential as indicators for monitoring human exposure to various mosquito bites and their heterogeneity in the same site. Standardized and optimized methods for assessing these specific antibody-based biomarkers are essential to the operational utilization of these tools by vector control and surveillance programs.

Contrasting vector competence of three main East African Anopheles malaria vector mosquitoes for Plasmodium falciparum

Sci Reports 17 Jan 2025



There are three *Anopheles* mosquito species in East Africa that are responsible for the majority of malaria transmission, posing a significant public health concern. Understanding the vector competence of different mosquito species is crucial for targeted and cost-effective malaria control strategies. This study investigated the vector competence of laboratory reared strains of East African *An. gambiae sensu stricto*, *An. funestus s.s.*, and *An. arabiensis* mosquitoes towards local isolates of *Plasmodium falciparum* infection.

Our findings indicate that all three malaria vector species may contribute to malaria transmission in East Africa, with *An. funestus* demonstrating superior vector competence. In conclusion, there is a need for comprehensive malaria control strategies targeting major malaria vector species, an update of malaria transmission models to consider vector competence and evaluation of malaria transmission blocking interventions in assays that include *An. funestus* mosquitoes.

WHO news and publications

World Malaria Report 2024

11 Dec 2024

Each year, the World malaria report serves as a vital tool to assess global progress and gaps in the fight against malaria. This year's report provides a critical and up-to-date snapshot of efforts to control and eliminate the disease in 83 countries worldwide.

In 2023 alone, there were an estimated 597 000 malaria deaths and 263 million new cases – an increase of 11 million cases over the previous year. In view of current trends, progress towards critical targets of the WHO global malaria strategy is off track.

Egypt is certified malaria-free by WHO

20 Oct 2024

As the third most populous country in Africa, Egypt's malaria-free certification by WHO in October 2024 is a significant public health milestone. Malaria was detected in the country as early as 4000 B.C., with genetic markers of the disease identified in Tutankhamun and other ancient Egyptian mummies.

Georgia certified malaria-free by WHO

23 January 2025

Malaria has plagued Georgia since ancient times. Before the introduction of systematic control efforts in the early 1900s, at least 3 malaria parasite species—*P. falciparum, P. malariae and P. vivax*—were endemic in the

country. In the 1920s, an estimated 30% of the population suffered from malaria caused by the *P. vivax* malaria species.

WHO guidelines for malaria

30 Nov 2024

This version of the Guidelines includes an updated recommendation for malaria vaccines, new recommendations on the use of near-patients qualitative and semiquantitative G6PD tests to guide anti-relapse treatment of *P. vivax* and *P. ovale*, updated recommendations on primaquine and the recommendation on the use of tafenoquine. It replaces the previous version published on 16 Oct 2023.

Webinars, websites and other resources

RAFT TechTalk Series: *Emerging threats in a changing world, Aedes & Anopheles stephensi "Could we eradicate Anopheles stephensi in Africa?"*

11 Nov 2024

This is the 5th webinar of the RAFT TechTalk series on: Emerging threats in a changing world, *Aedes & Anopheles stephensi* with the following speakers:

- ❑ Jo Lines: Why focus on "Could we eradicate *An. stephensi* in Africa?"
- ❑ Mark Benedict: A historical perspective on application of the Sterile Insect Technique (SIT)
- ❑ Chantel De Beer: The essential techniques and infrastructure required for SIT
- ❑ Tony Nolan: Non-SIT (gene-drive) eradication technologies

Originally endemic to South Asia and the Arabian Peninsula, *Anopheles stephensi* has jumped into the Horn of Africa and is now spreading across the continent. Up to now, malaria in Africa has been primarily a rural challenge, but *An. stephensi* flourishes in urban settings and could bring a paradigm shift in malaria epidemiology in Africa, a serious threat to regional malaria elimination objectives. We have a limited window of opportunity to address this threat. Genetic control methods are probably best and are more likely to be effective against a target population that is small and confined. So if we want to do this, we must act decisively. Could it be done, and what would it take?

APMEN Webinar YouTube channel

APMEN hosts a *webinar series* to provide a platform for discussing a variety of topics of interest and sharing information related to malaria elimination. Recorded sessions are available on their YouTube channel. Recent and upcoming topics include:

- ❑ 21 Nov 2024 – *Technology Advances in Vector Control*
  Speakers/Panellists
  - Peter Haddawy, Mahidol University
  - Muhammad Mukhtar, Malaria Control Program, Pakistan
  - Kristopher Nolte, Bernhard Nocht Inst for Tropical Medicine
  - Luke Alphey, University of York
  - Kwon Hyung-Wook, Incheon National University
- ❑ 10 Dec 2024 - *Enhancing Community level Surveillance to Ensure Quality Services & Sustainable Malaria Elimination*
  Speakers/Panellists
  - Maxime Whittaker, RAI Regional Steering Committee
  - Akramul Islam, BRAC Health Programme and Humanitarian Crisis Mgmt Programme
  - Tenzin Wangdi, Vector-borne Disease Control Programme, Bhutan
  - Viengakhone Souriyo, Community Health and Inclusion Assoc, Lao PDR

Climate Change, Malaria, and Neglected Tropical Diseases

RSTMH 1 Jan 2025

On World NTD Day 2025, RSTMH hosted a webinar on climate change, malaria, and Neglected Tropical Diseases (NTDs) in collaboration with the WHO Task Team on Climate Change, NTDs, and Malaria. The session highlighted a new scoping review published in *Transactions of the Royal Society of Tropical Medicine and Hygiene*, which synthesizes over a decade of research on climate-driven disease dynamics. Speakers discussed the urgent need for comprehensive research to refine strategies addressing climate-related health challenges. The review was conducted under the guidance of Dr. Ibrahima Socé Fall, with support from multiple global health organizations.

Speakers:

- Dr Alastair Robb (Global Malaria Programme, WHO)
- Dr Anthony Solomon (Chief Scientist, Global NTD Programme, WHO)
- Dr Ebere Okereke (Chief Program Officer, Reaching the Last Mile)
- Professor Deirdre Hollingsworth (University of Oxford)
- Dr Petra Klepac (Global Health Modelling Consultant, WHO)

Session Chair: Dr Samson Kiware (Ifakara Health Institute)

MESA Track - the malaria projects database

Increase the visibility of your malaria research and connect with other researchers in your field by adding your project to this open database.

MALARIA KNOWLEDGE HUB
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