Contents

Selected Recent Publications

Research for Action on Persistent and Residual Malaria

The Journal of Infectious Diseases 1 May 2021

The Journal of Infectious Diseases has published a special issue focused on residual malaria. It includes:

- *Residual Malaria: Limitations of Current Vector Control Strategies to Eliminate Transmission in Residual Foci*
- *Review of Issues on Residual Malaria Transmission*
- *Multiple Resistance Mechanisms to Pyrethroids Insecticides in Anopheles gambiae sensu lato Population From Mali, West Africa*
- *Special Programme for Research and Training in Tropical Diseases-coordinated Multicountry Study to Determine the Burden and Causes of Residual Malaria Across Different Regions*

and several other papers.

The impact of stopping and starting indoor residual spraying on malaria burden in Uganda

nature communications Published: 11 May 2021

Using data from 14 enhanced surveillance health facilities in Uganda, a country with high bed net coverage yet high malaria burden, we estimate the impact of starting and stopping IRS on changes in malaria incidence. We show that stopping IRS was associated with a 5-fold increase in malaria incidence within 10 months, but reinstating IRS was associated with an over 5-fold decrease within 8 months. In areas where IRS was initiated and sustained, malaria incidence dropped by 85% after year 4. IRS could play a critical role in achieving global malaria targets, particularly in areas where progress has stalled.

Sterile Insect Technique: Successful Suppression of an Aedes aegypti Field Population in Cuba

Insects 18 May 2021

The main focus of this pilot trial was to assess the efficacy of the SIT for the suppression of *Aedes aegypti* populations. Two areas in Havana city, Cuba, were selected as control and release trial sites. The presence, density and fertility of the target wild population were monitored through a network of ovitraps. Approximately 1,270,000 irradiated *Ae. aegypti* males were released in the 50 ha target area over a period of 20 weeks. The released mosquitoes showed excellent mating competitiveness and induced high levels of sterility in the wild *Ae. aegypti* population. The target natural population was suppressed as reflected in the ovitrap index and in the mean number of eggs/trap values which dropped to zero by the last 3 weeks of the trial. We conclude that the released sterile male *Ae. aegypti* competed successfully and induced significant sterility in the local target *Ae. aegypti* population, resulting in suppression of the vector.

The relationship between house height and mosquito house entry: an experimental study in rural Gambia

J Royal Society Interface 18 May 2021

Build it and they **won't** come…Raised buildings may help reduce malaria transmission in Africa.

These authors tested whether raising buildings off the ground would prevent the entry of *Anopheles gambiae*, the principal African malaria vector, in rural Gambia. Mosquito house entry declined with increasing height, with a hut at 3 m reducing *An. gambiae* house entry by 84% when compared with huts on the ground.

Piperonyl butoxide (PBO) combined with pyrethroids in insecticide-treated nets to prevent malaria in Africa

Cochrane Database Syst Rev Published 24 May 2021

The aim of this Cochrane Review was to find out if pyrethroid-PBO nets provide additional protection against malaria when compared to standard pyrethroid-only nets..

Authors' conclusions

In areas of high insecticide resistance, pyrethroid-PBO nets have greater entomological and epidemiological efficacy compared to standard LLINs, with sustained reduction in parasite prevalence, higher mosquito mortality and reduction in mosquito blood feeding rates 21 to 25 months post intervention. Questions remain about the durability of PBO on nets, as the impact of pyrethroid-PBO nets on mosquito mortality was not sustained over 20 washes in experimental hut trials, and epidemiological data on pyrethroid-PBO nets for the full intended three-year life span of the nets is not available. Little evidence is available to support greater entomological efficacy of pyrethroid-PBO nets in areas where mosquitoes show lower levels of resistance to pyrethroids.

Specific phytochemicals in floral nectar up-regulate genes involved in longevity regulation and xenobiotic metabolism, extending mosquito life span

Ecology and Evolution 25 May 2021

During nectar feeding, mosquitoes ingest a plethora of phytochemicals present in nectar. The ecological and physiological impacts of these ingested phytochemicals on the disease vectors are poorly understood. In this study, the authors evaluated the effects of three nectar phytochemicals--caffeine, p-coumaric acid, and quercetin--on longevity, fecundity, and sugar-feeding behavior of the Asian tiger mosquito (*Aedes albopictus*). Overall, their findings show that consuming certain nectar phytochemicals can enhance adult longevity of female Asian tiger mosquitoes, apparently by differentially regulating the expression level of genes involved in longevity and xenobiotic metabolism; this has potential impacts not only on life span but also on vectorial capacity and insecticide resistance.

Eave and swarm collections prove effective for biased captures of male Anopheles gambiae mosquitoes in Uganda

Parasit Vectors 26 May 2021

This is an interesting paper focused on improved Anopheles sampling techniques. The authors evaluated a range of collection methods which show promise in providing a more equal, or even male-biased, sex representation in the sample. Swarm sampling caught the most males, but when man/hour effort was factored

in, sampling of eaves by aspiration was the more efficient method and also provided a representative sample of females. Aspiration of bushes was more productive at the peak of the wet season than at the start.

Serological biomarker for assessing human exposure to Aedes mosquito bites during a randomized vector control intervention trial in northeastern Thailand

PLoS Negl Trop Dis 27 May 2021

The human exposure to *Aedes* mosquito bites (i.e., Mosquito Exposure Index or MEI) was estimated by ELISA measuring levels of human antibody response to the specific Nterm-34 kDa salivary antigen. This study represents an important step toward the validation of the specific IgG response to the *Aedes* salivary peptide Nterm-34kDa as a proxy measure for *Aedes* infestation levels and human-mosquito exposure risk in a dengue endemic setting.

Improving mosquito control strategies with population genomics

Trends in Parasitology Published 29 May 2021

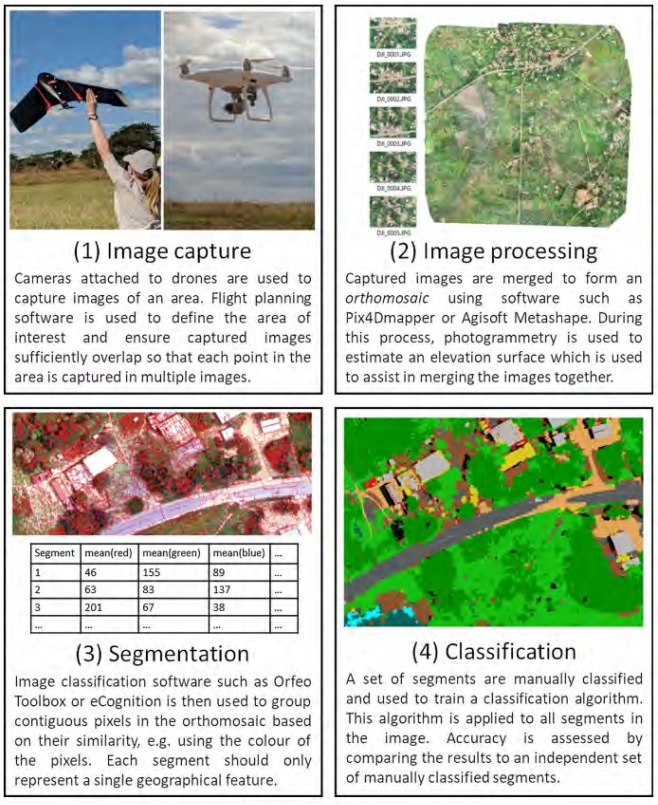
Mosquito control strategies increasingly apply knowledge from population genomics research. This review highlights recent applications to three research domains: mosquito invasions, **insecticide resistance evolution**, and rear and release programs. Current research trends follow developments in reference assemblies, either as improvements to existing assemblies (particularly *Aedes*) or assemblies for new taxa (particularly *Anopheles*). With improved assemblies, studies of invasive and rear and release target populations are better able to incorporate adaptive as well as demographic hypotheses. New reference assemblies are aiding comparisons of insecticide resistance across sister taxa while helping resolve taxon boundaries amidst frequent introgression. *Anopheles* gene drive deployments and improved *Aedes* genome assemblies should lead to a convergence in research aims for *Anopheles* and *Aedes* in the coming years.

The application of drones for mosquito larval habitat identification in rural environments: a practical approach for malaria control?

Malaria Journal 31 May 2021

Conclusions

This study demonstrates the potential for drone imagery to be used as a tool to support the identification of mosquito larval habitat in rural areas where malaria is endemic. While this technology has the capacity to complement the more labour-intensive approach of identifying larval habitat from the ground, there are technical challenges to overcome before it can be smoothly integrated into malaria control activities. The authors believe that outsourcing the capturing and processing of drone imagery to private companies with the equipment and skills necessary to extract the required information is a more practical approach to developing equivalent skills in house. These services are becoming increasingly available in other sectors such as agriculture, forestry and environmental monitoring and there are promising developments in the African drone sector to support this local capacity. It is however important to emphasize that drone imagery should not be used to completely replace larval surveys. Instead, this technology could provide Additional information which may help to reduce the time spent finding locations to be sampled, monitor environmental changes over time and help to guide the frequency and scale of any LSM intervention, ultimately increasing its potential for success. Further consultations between experts and stakeholders in the fields of drones, image analysis and vector control are needed to develop more detailed guidance on how this technology can be most effectively exploited.



Processes undertaken to identify larval habitat from drone imagery

Fine-scale estimation of key life-history parameters of malaria vectors: implications for next-generation vector control technologies

Parasites & Vectors 8 June 2021

Gaps in our knowledge of mosquito population dynamics mean that mathematical modelling of vector control interventions have typically made simplifying assumptions about key aspects of mosquito ecology. Often, these assumptions can distort the predicted efficacy of vector control, particularly next-generation tools such as gene drive, which are highly sensitive to local mosquito dynamics. We developed a discrete-time stochastic mathematical model of mosquito population dynamics to explore the fine-scale behaviour of egg-laying and larval density dependence on parameter estimation. By modelling fine-scale behaviour of egg-laying under varying density dependence scenarios we refine our life history parameter estimates, and in particular we see how model assumptions affect population growth rate (Rm), a crucial determinate of vector control efficacy.

Insecticide resistance exerts significant fitness costs in immature stages of Anopheles gambiae in western Kenya

Malaria Journal 9 June 2021

There is a paucity of information on the potential fitness costs of pyrethroid resistance in malaria vectors. This study aimed to assess the fitness cost effects of insecticide resistance on the development and survival of immature *Anopheles gambiae* from western Kenya. The study showed that pyrethroid resistance in *An. gambiae* had a fitness cost on their pre-imaginal development time and survival. Insecticide resistance delayed the development and reduced the survivorship of *An. gambiae* larvae.

Development of a chimeric odour blend for attracting gravid malaria vectors

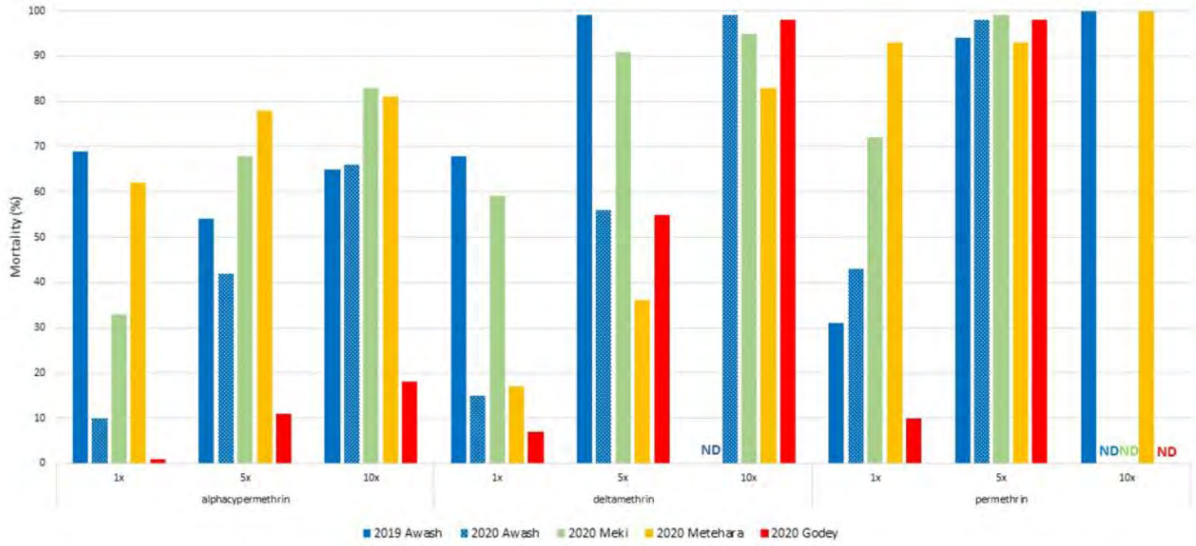
Malaria Journal 9 June 2021

Odour-based tools targeting gravid malaria vectors may complement existing intervention strategies. *Anopheles arabiensis* are attracted to, and stimulated to oviposit by, natural and synthetic odours of wild and domesticated grasses associated with mosquito breeding sites. While such synthetic odour lures may be used for vector control, these may have limited efficacy when placed in direct competition with the natural source. In this study, workflows developed for plant-feeding pests was used to design and evaluate a chimeric odour blend based on shared attractive compounds found in domesticated grass odours. In this study a ratio-optimized chimeric blend was identified that significantly attracted gravid *An. arabiensis* under laboratory conditions. In the field, trap captures of *An. arabiensis* and *Anopheles pharoensis* were dependent on the presence of the lure, trap type (CDC, BG Sentinel and Suna traps), placement relevant to ground level, with low release rates generally luring more mosquitoes.

An update on the distribution, bionomics, and insecticide susceptibility of Anopheles stephensi in Ethiopia, 2018-2020

Malaria Journal 9 June 2021

To better inform policies and vector control decisions, it is important to understand the distribution, bionomics, insecticide susceptibility, and transmission potential of *An. stephensi*. These aspects were studied as part of routine entomological monitoring in Ethiopia between 2018 and 2020. *An. stephensi* larvae were collected in urban and rural sites in eastern Ethiopia, but *An. stephensi* larvae were not found in western Ethiopian sites. Blood-meal analysis revealed a high proportion of blood meals that were taken from goats, and only a small proportion from humans. *Plasmodium vivax* was detected in wild-collected *An. stephensi*. High levels of insecticide resistance were detected to pyrethroids, carbamates and organophosphates. Pre-exposure to piperonyl butoxide increased susceptibility to pyrethroids. Larvae were found to be susceptible to temephos.



Intensity of resistance to pyrethroids in *Anopheles stephensi* in 2019 (Awash Sebat Kilo, designated Awash) and 2020 (Awash Sebat Kilo, Meki, Metehara, and Godey), Ethiopia. Tests were not done (ND) if susceptibility (> 98%) was attained with a lower dose

Dengue fever and insecticide resistance in Aedes mosquitoes in Southeast Asia: a review

Parasites & Vectors 10 June 2021

This is a thorough review of insecticide resistance in dengue vectors across Southeast Asia. The authors review the distribution of dengue fever from 2000 to 2020 and its associated mortality in Southeast Asian countries, and we gather evidence on the trend of insecticide resistance and its distribution in these countries since 2000, summarising the mechanisms involved. The prevalence of resistance to these insecticides is increasing in Southeast Asia, and the mechanisms of resistance are reported to be associated with target site mutations, metabolic detoxification, reduced penetration of insecticides via the mosquito cuticle and behavioural changes of mosquitoes.

Efficacy of Wolbachia-Infected Mosquito Deployments for the Control of Dengue

N Engl J Med 10 June 2021

Big news for the dengue prevention world!

Background: *Aedes aegypti* mosquitoes infected with the *wMel* strain of *Wolbachia pipientis* are less susceptible than wild-type *A. aegypti* to dengue virus infection.

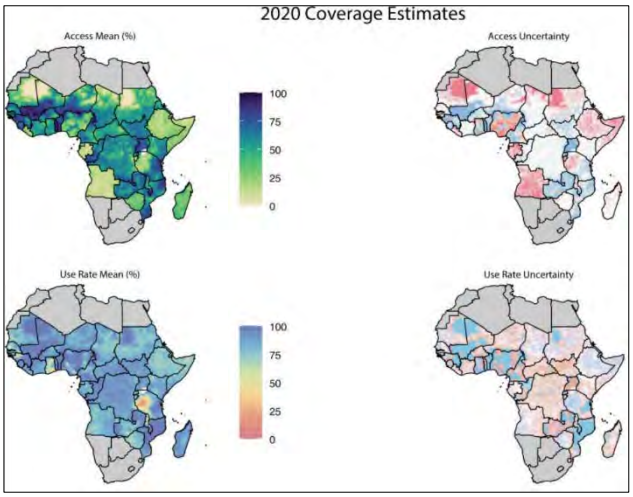
Methods: We conducted a cluster-randomized trial involving releases of *wMel*-infected *A. aegypti* mosquitoes for the control of dengue in Yogyakarta, Indonesia.

Results: In the intention-to-treat analysis, virologically confirmed dengue (VCD) occurred in 67 of 2905 participants (2.3%) in the intervention clusters and in 318 of 3401 (9.4%) in the control clusters. The **protective efficacy of the intervention was 77.1%** (95% CI, 65.3 to 84.9) and was similar against the four dengue virus serotypes. The incidence of hospitalization for VCD was lower among participants who lived in intervention clusters (13 of 2905 participants [0.4%]) than among those who lived in control clusters (102 of 3401 [3.0%]) (**protective efficacy, 86.2%**; 95% CI, 66.2 to 94.3).

Maps and metrics of insecticide-treated net access, use, and nets-per-capita in Africa from 2000-2020.

Nature Communications 11 June 2021

Using data from multiple sources, we generate high-resolution maps of ITN access, use, and nets-per-capita annually from 2000 to 2020 across the 40 highest-burden African countries. Our findings support several existing hypotheses: that use is high among those with access, that nets are discarded more quickly than official policy presumes, and that effectively distributing nets grows more difficult as coverage increases.



A Three-Pronged Approach to Studying Sublethal Insecticide Doses: Characterising Mosquito Fitness, Mosquito Biting Behaviour, and Human/Environmental Health Risks

Insects 11 June 2021

Extensive research has been carried out to assess the effects of sublethal pyrethroid doses on mosquito fitness and behaviour. Although pyrethroids are mainly used as insecticides, they can also act as repellents, depending on the dosage and/or exposure time. However, much remains unknown about the biological, physiological, demographic, and behavioural effects on individual mosquitoes or mosquito populations when exposure occurs via spatial treatments. Here, females and males of two laboratory-reared mosquito species, *Culex pipiens* and *Aedes albopictus*, were exposed to five different treatments: three doses of the pyrethroid prallethrin, as well as an untreated and a negative control. The effects of each treatment on mosquito species, sex, adult mortality, fertility, F1 population size, and biting behaviour were also evaluated. The results showed that **sublethal doses reduced mosquito survival, influencing population size in the next generation.** They also provided 100% protection to human hosts and presented relatively low risks to human and environmental health. These findings emphasise the need for additional studies that assess the benefits of using sublethal doses as part of mosquito management strategies.

Comparison of four outdoor mosquito trapping methods as potential replacements for human landing catches in western Kenya

Parasites & Vectors 12 June 2021

Scalable traps designed specifically for monitoring outdoor biting and resting malaria vectors are urgently needed. The choice of collection method for operational surveillance should be driven by trap efficacy and scalability rather than fine-scale precision with respect to human landing catches (HLC). This study compared four outdoor traps with HLC as a positive control to identify a suitable replacement for the HLC for longitudinal surveillance of outdoor biting malaria vectors. The primary objective was to determine outdoor trap efficacy for estimating *Anopheles* numbers per trapping night in comparison with the 'gold standard' HLC. The Furvela tent trap (FTT) and outdoor CDC light traps (OLT) are simple, easily scalable traps and are potential replacements for HLC in outdoor sampling of *Anopheles* mosquitoes. However, the FTT closely mirrored indoor CDC light trap in mosquito indices and therefore may be more of an indoor mimic than a true outdoor collection tool. The host decoy trap (HDT) and mosquito electrocuting traps (MET) show potential for sampling outdoor host-seeking mosquitoes. However, the traps as currently designed may not be feasible for large-scale, longitudinal entomological monitoring. Therefore, the baited outdoor CDC light trap may be the most appropriate tool currently available for assessment of outdoor-biting and malaria transmission risk.

Toys or Tools? Utilization of Unmanned Aerial Systems in Mosquito and Vector Control Programs

J Econ Entomol 12 Jun 2021

This manuscript highlights the strengths and weaknesses of Unmanned aerial systems (UAS) within mosquito control programs (MCP) in the United States, provides an update on systems and methods used, and charts the future direction of UAS technology within MCP tasked with public health protection. The advantages of UAS are no longer conjectural. In addition to locating mosquito larval habitats, UAS affords MCP real-time imagery, improved accuracy of aerial insecticide applications, mosquito larval detection and sampling. UAS are also leveraged for applying larvicides to water in habitats that range in size from multi-acre wetlands to small containers in urban settings.

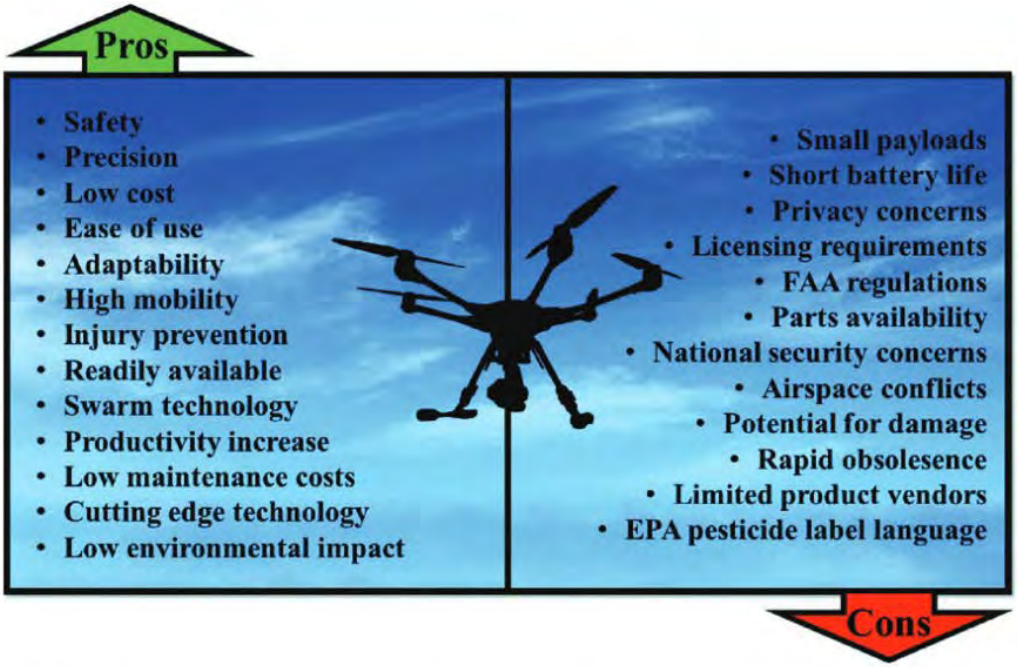


Fig. 7. Conceptual drawing of the benefits and drawbacks of UAS platforms for mosquito and vector control.

Pyriproxyfen-treated bed nets reduce reproductive fitness and longevity of pyrethroid-resistant Anopheles gambiae under laboratory and field conditions

Malaria Journal 22 June 2021

The efficacy of insecticide-treated nets (ITNs) containing the insect growth regulator pyriproxyfen (PPF) and pyrethroid insecticides (PPF-ITNs) is being assessed in clinical trials to determine whether they provide greater protection from malaria than standard pyrethroid-treated ITNs in areas where mosquitoes are resistant to pyrethroids. Understanding the entomological mode of action of this new ITN class will aide interpretation of the results from these trials.

The authors conclude--**Exposure to a mixture of PPF and pyrethroids on netting shortens the lifespan of mosquitoes and reduces reproductive output. Sterilization of vectors lasted at least one year under operational conditions. These findings suggest a longer effective lifespan of PPF-pyrethroid nets than reported previously.**

Insecticide resistance status of Anopheles arabiensis in irrigated and non-irrigated areas in western Kenya

Parasites & Vectors 26 June 2021

The use of pesticides for agricultural purposes has been implicated as one of the sources driving the selection of resistance. The current study was undertaken to assess the status and mechanism of insecticide resistance in malaria vectors in irrigated and non-irrigated areas with varying agrochemical use in western Kenya. This study revealed increased phenotypic resistance in the *Anopheles arabiensis* from the irrigated area, and the intensive use of pesticides for crop protection in this region may have contributed to the selection pressure resulting in the resistance genes observed.

Projecting the risk of mosquito-borne diseases in a warmer and more populated world: a multi-model, multi-scenario intercomparison modelling study

The Lancet Planetary Health 1 July 2021

Those of you following the impact of climate change on vectors and the pathogens they carry may find this paper interesting. The aim of this study was to quantify the extent to which climate change will influence the length of the transmission season and estimate the population at risk of mosquito-borne diseases in the future, given different population densities across an altitudinal gradient. The authors predict increases of about 1.4 billion additional people at risk of malaria and dengue in urban areas in Africa and southeast Asia. Urbanisation is an important driver of mosquito-borne disease transmission, because it enhances the creation of mosquito breeding sites via human-made containers, increases the likelihood of vector–human interactions because of higher population densities, and facilitates spatial spread through the movement of people and goods.

To read more on the effects of temperature on *Anopheles* mosquito development and survival check out ***A Systematic Review of the Effects of Temperature on Anopheles Mosquito Development and Survival: Implications for Malaria Control in a Future Warmer Climate*** published on 7 July 2021 in the Int. J. Environ. Res. Public Health

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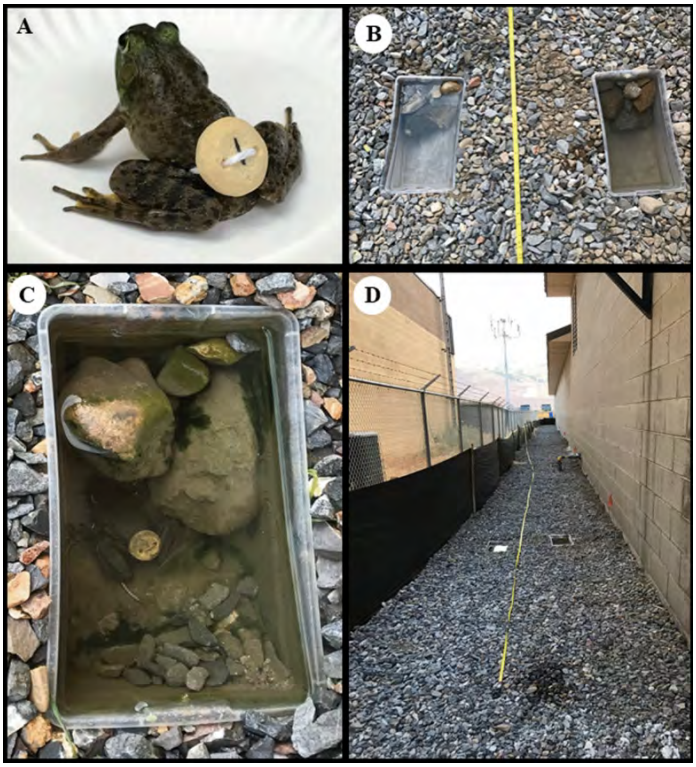
Now for something that might be at the intersection of crazy and clever…

Heterodissemination: precision insecticide delivery to mosquito larval habitats by cohabiting vertebrates

Sci Rep 8 July 2021

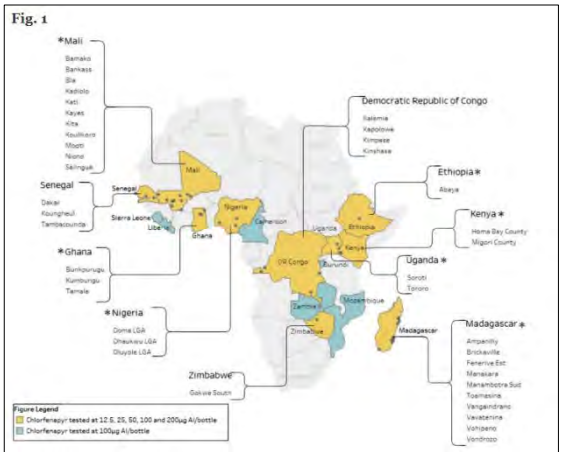


Conventional larvicide delivery strategies originally developed for permanent and floodwater mosquitoes have proved suboptimal in the small, scattered, and cryptic larval habitats preferred by container-inhabiting *Aedes* mosquitoes. New methods such as autodissemination, wherein adult mosquitoes spread insecticides to their own larval habitats, have been under study. Another novel delivery method termed heterodissemination, i.e. larvicide delivery by other species sharing the same habitats, has also been proposed. We conducted a proof-of-concept study with four independent experiments using American bullfrogs (*Lithobates catesbeianus*) and green frogs *Lithobates clamitans* as carriers of pyriproxyfen, an insect growth regulator, under semi-field conditions in three different locations, two in New Jersey, and one in Utah. Frogs with attached slow-release pyriproxyfen tablets were introduced into outdoor enclosures with water containers. Water samples from the containers were periodically tested using larval *Aedes albopictus* and *Culex pipiens* mosquitoes to assess mortality and percent eclosure inhibition. Overall pupal mortality [95% credible intervals] estimated by Bayesian analysis for the treatment group was 73.4% [71.3-75.2] compared to 4.1% [2.9-5.5] for the control group. Mortality within treatment groups in four different experiments ranged from 41 to 100%, whereas control mortalities ranged from 0.5% to 11%. We conclude that heterodissemination is a promising and effective approach deserving of further study. Another potential target for heterodissemination are those mosquito species that thrive in permanent water habitats in disturbed areas such as *Anopheles* mosquitoes. Although *Anopheles* spp. in Africa can inhabit large permanent water bodies which can be treated using area-wide methods, the same species are found in high numbers in smaller more ephemeral larval habitats that are difficult to locate and treat effectively. These temporary habitats, especially those in urbanized environments, may be good candidates for heterodissemination treatments.

Determination of the discriminating concentration of chlorfenapyr (pyrrole) and Anopheles gambiae sensu lato susceptibility testing in preparation for distribution of Interceptor® G2 insecticide-treated nets

Malaria Journal 14 July 2021

In anticipation of Interceptor G2 nets being distributed in sub-Saharan Africa, chlorfenapyr susceptibility testing using a modified bottle bioassay protocol was conducted to determine a suitable discriminating concentration and to gather baseline susceptibility information. This study determined that 100 or 200 µg AI/bottle chlorfenapyr in bottle bioassays are suitable discriminating concentrations for monitoring susceptibility of wild *An. gambiae s.l.*, using mortality recorded up to 72 h. Testing in 16 countries in sub-Saharan Africa demonstrated vector susceptibility to chlorfenapyr, including mosquitoes with multiple resistance mechanisms to pyrethroids.



Locations of insecticide susceptibility testing sites where mortality of wild *Anopheles gambiae s.l.* was measured in bioassays following exposure to a full (yellow) or limited (blue) range of concentrations of chlorfenapyr. *denotes countries where a susceptible insectary strain was also tested with the full range of concentrations

Evaluation of different deployment strategies for larviciding to control malaria: a simulation study

Malaria Journal 27 July 2021

In this study the impact of larviciding applications was simulated to assess the influence of different deployment strategies on expected entomological outcomes and malaria infections in humans for different seasonality and transmission settings. Overall, larviciding would be more effective in settings with low and seasonal transmission, and at the beginning and during the peak densities of the target species populations. For maximum impact, implementers should consider the practical ranges of coverage, duration, frequency, and timing of larviciding in their respective contexts. In seasonal transmission settings, larviciding was predicted to be most impactful if done before and during the peak in vector density; in many settings this corresponded to the rainy season instead of during the dry season as currently recommended by WHO.

WHO News and Publications

Guidance framework for testing of genetically modified mosquitoes, second edition

19 May 2021

Overview

For more than 2 decades, scientists have been working to harness the promise of molecular biology to develop genetically modified mosquitoes (GMMs) for use as public health tools to prevent the transmission of vector-borne diseases. Responding to a need for additional standards and guidance, the WHO Special Programme for Research and Training in Tropical Diseases (WHO-TDR) and the Foundation for the National Institutes of Health (FNIH) published in 2014 the first WHO Guidance framework for testing genetically modified mosquitoes. This revised version takes into account the technical progress made and lessons learned in this rapidly advancing field of research. Like the original guidance framework, it is intended to provide standards that foster quality and consistency in the processes for developing, testing and regulating these new genetic technologies. Best practices recommended in the 2021 guidance framework will further contribute to the comparability of results and credibility of conclusions in order to facilitate decision-making by countries interested in the potential use of GMMs as public health tools for the control of vector-borne diseases.

Latest meeting report of the Malaria Policy Advisory Group (MPAG)

24 May 2021

On 13–15 April 2021, MPAG convened virtually to review updates and progress, and to provide guidance on thematic areas of work by the Global Malaria Programme. The meeting focused on 9 topics:
1) "Rethinking Malaria";
2) clinical malaria: parasite density analysis and implications for diagnostic test specifications;
3) an update on the situation of antimalarial drug efficacy and resistance in Africa;
4) a proposed technical consultation to stage *P. knowlesi* along the continuum between zoonosis and human pathogen;
5) an update on the threat of *pfhrp2/3* deletions in the Horn of Africa;
6) a proposed technical consultation on the response to malaria in urban areas;
7) an update on guidance for severe malaria;
8) an update on work related to implementing a revised classification of insecticide treated net products; and
9) an update on Digital Solutions for Malaria Elimination (DSME) surveillance.

Fourteenth meeting of the WHO Vector Control Advisory Group

30 June 2021

On 13–15 April 2021, the WHO Malaria Policy Advisory Group (MPAG) convened virtually to review updates and progress, and to provide guidance on thematic areas of work by the Global Malaria Programme. The meeting focused on 9 topics: 1) "Rethinking Malaria"; 2) clinical malaria: parasite density analysis and implications for diagnostic test specifications; 3) an update on the situation of antimalarial drug efficacy and resistance in Africa; 4) a proposed technical consultation to stage P. knowlesi along the continuum between zoonosis and human pathogen; 5) an update on the threat of pfhrp2/3 deletions in the Horn of Africa; 6) a proposed technical consultation on the response to malaria in urban areas; 7) an update on guidance for severe malaria; 8) an update on work related to implementing a revised classification of insecticide treated net products; and 9) an update on Digital Solutions for Malaria Elimination (DSME) surveillance.

From 30 million cases to zero: China is certified malaria-free by WHO

30 June 2021 News release

Following a 70-year effort, China has been awarded a malaria-free certification from WHO – a notable feat for a country that reported 30 million cases of the disease annually in the 1940s.
China is the first country in the WHO Western Pacific Region to be awarded a malaria-free certification in more than 3 decades. Other countries in the region that have achieved this status include Australia (1981), Singapore (1982) and Brunei Darussalam (1987).

WHO Guidelines for malaria

13 July 2021

Overview

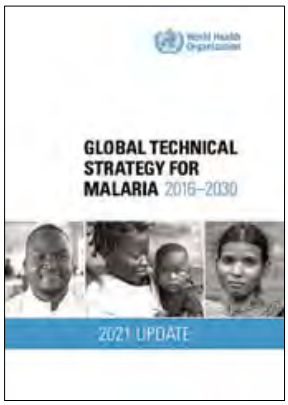
The WHO Guidelines for malaria bring together the Organization's most up-to-date recommendations for malaria in one user-friendly and easy-to-navigate online platform.

The WHO Guidelines for malaria supersedes 2 previous WHO publications: the Guidelines for the treatment of malaria, third edition and the Guidelines for malaria vector control. Recommendations on malaria will continue to be reviewed and, where appropriate, updated based on the latest available evidence. Any updated recommendations will always display the date of the most recent revision in the MAGICapp platform. With each update, a new PDF version of the consolidated guidelines will also be available for download on the WHO website.

The second version of the Guidelines includes updates to the vector control guidance in the malaria prevention section and replaces the version published on 16 February 2021.

Global technical strategy for malaria 2016-2030, 2021 update

19 July 2021



Overview

The Global technical strategy for malaria 2016–2030 was adopted by the World Health Assembly in May 2015. It provides a comprehensive framework to guide countries in their efforts to accelerate progress towards malaria elimination. The strategy sets the target of reducing global malaria incidence and mortality rates by at least 90% by 2030.

This updated version reflects lessons learned in the global malaria response over the last 5 years. The strategy highlights the need for innovation in five key areas:

- Vector control
- Diagnostics and treatment
- Vaccines
- Surveillance
- Elimination

Tracking biological threats to malaria control and elimination

The WHO Malaria Threats Map is an interactive data visualization platform that presents the latest status of the 4 major biological threats to malaria control and elimination: insecticide resistance in malaria vectors; *P. falciparum hrp2/3 gene* deletions; antimalarial drug efficacy and resistance; and invasive malaria vector species. New videos from the Global Malaria Programme explain how the map is supporting national malaria programmes and the research community.

Introductory video | Malaria Threats Map

Webinars, websites and other resources

Recent Webinars

Ifakara Master Classes in Public Health & Medical Entomology

Hosted by Fredros Okumu (Ifakara Health Institute) and Sheila Ogoma (Clinton Health Access Initiative), the recorded Q and A sessions with experts in the field on various topics are available on YouTube and well worth viewing. Recent topics include:

- ❑ 12 August - ***Malaria Strategies***: A MasterClass with Prof. Marcel Tanner
- ❑ 5 August - ***Malaria Meds***: a MasterClass with Profs. Timothy Wells, Pierre Hugo, George Jagoe & Abdoulaye Djimde
- ❑ 15 July - ***Vectors of Asia, Africa & the Americas***: S. Manguin, I. Vythilingam, Y. Rubio Palis, L. Koekemoer
- ❑ 1 July - ***Maps & Models of Malaria & Its Control***: a MasterClass with Profs. Samir Bhatt, Samson Kiware, Lucy Tusting & Jaline Gerardin
- ❑ 24 June - ***Two Billion Mosquito Nets & Counting***: a MasterClass with Prof. Christian Lengeler
- ❑ 3 June - ***The Enduring Search for Malaria Vaccines:*** a MasterClass with Prof. Stephen Hoffman (Sanaria Inc.)
- ❑ 20 May - ***Genomic Surveillance***: With Profs. D Wirth, S Volkman, D Ishengoma, A Miles & M Lawniczak
- ❑ 12 May - ***Malaria Delenda Est***: a MasterClass with Drs. Phillip Welkhoff, Helen Jamet & Meera Venkatesan
- ❑ 5 May - ***Fixed, Few & Findable:*** a MasterClass with Profs. H Kafy, P Dambach, P Dechant & S Majambere

MESA Webinars: Science for Malaria Impact

MESA will virtually celebrate a series of monthly discussions, the **MESA Webinars: Science for Malaria Impact**. These webinars bring together the malaria community of innovators and showcase the work of **malaria-endemic researchers**. Starting in May, the virtual events will be held on the **first Wednesday of each month** and will feature two researchers. These one-hour sessions will cover a range of topics, from social sciences to entomology, through insecticide drug resistance, stratification and genomics.
When: First Wednesday of each month until December
Time: 8:00 am EDT - 2:00 pm CEST/CAT - 8:00 pm SGT

Recent recordings:

- ❑ 10 June - Webinar 2 - ***New Approaches to Improve Malaria Mosquito Surveillance and Control***
- ❑ 7 July - Webinar 3 – ***Integrating Genomics into the Malaria Interventions Toolbox***

APMEN Webinar YouTube channel

APMEN has launched 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 topics include:

- ❑ 15 May - ***Sustaining malaria services during a pandemic: What do we need to do?***
- ❑ 11 June - ***Forest-goers and residual malaria: Addressing the challenge***
- ❑ 29 June - ***New tools to reach outdoor-biting malaria vectors***

Upcoming meetings

The following meetings are all pending, subject to COVID-19 related changes:

- **20-22 September 2021** PAMCA Annual Conference - Virtual: Empowering local institutions to set the agenda for the elimination of vector-borne diseases. More information *here*
- **27 September-1 October 2021** 12th European Congress on Tropical Medicine and International Health (ECTMIH). More information *here*
- **17-21 November 2021** 70th ASTMH Annual Meeting in Washington, D.C. More information *here*

In the news and social media

'Miraculous' mosquito hack cuts dengue by 77%

BBC 10 June 2021

The use of *Wolbachia*-infected mosquitos reduced cases of dengue fever by 77 percent in a clinical trial conducted in Yogyakarta, Indonesia, new data shows. The findings also showed an 86 percent reduction in hospitalizations due to dengue fever.

The trial, conducted by the World Mosquito Program, used mosquitoes infected with *Wolbachia* bacteria, which reduces virus replication inside mosquitoes, limiting their likelihood of passing on dengue infection. *Wolbachia* can also alter the fertility of their hosts to ensure they are passed on to the next generation of mosquitoes, providing continued protection against dengue infection. The trial will be expanded across the whole city and surrounding areas, with the aim of eradicating dengue in the region.

Additional coverage in *Nature*, *The Atlantic*, *The Scientist*

Grand Prize Winner Announced in $5M IBM Watson AI XPRIZE Competition

23 June 2021

LOS ANGELES--(BUSINESS WIRE)--XPRIZE, the world's leader in designing and operating incentive competitions to solve humanity's grand challenges, and IBM Watson, IBM's AI technology for business, today announced the Grand Prize Winner in the $5M IBM Watson AI XPRIZE Challenge. "After five years of hard work and dedication, XPRIZE is thrilled to announce ***Zzapp Malaria*** as the grand prize winner of IBM Watson AI XPRIZE," said Anousheh Ansari, CEO of XPRIZE. Based out of Tel Aviv, Israel, ***Zzapp Malaria*** is committed to malaria elimination. The team's AI technology is geared towards tackling the main challenges faced by malaria elimination campaigns by creating custom models, built with tools like IBM Watson Studio for Cloud Pak for Data, to predict the number of small water bodies caused by weather, enabling it to optimize the timing for launching larviciding operations.

Note this issue covers the period from May 2021 through July 2021.