This quarterly report is meant to serve as a way to keep the malaria community up-to-date on new research into the development of alternative vector control tools. This first edition summarizes interesting and relevant new studies and highlight possible interpretations and implications. Read on to discover the exciting new contributions to the vector control field.

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Insecticide Treated Materials

Strategies to increase the ownership and use of insecticide-treated bednets to prevent malaria

This Cochrane Review by Polec and colleagues focuses on new approaches for the use of ITNs in malaria prevention by presenting strategies to increase their ownership and use. The analysis focuses on three major topics. First, the influence of the cost of an ITN on ownership is explored and concludes that there is moderate evidence that providing free ITNs increases ownership compared to subsidized or at cost nets. Second, the impact of cost on the use of ITNs is assessed, concluding that there is "probably little or no difference in the use of ITNs" based on free vs. subsidized vs. at cost ITNs. Finally, the effect of "educational interventions" on ITN use shows some moderate evidence that these may indeed increase their use. These findings do not present any new knowledge but confirm – with the authority of a Cochrane Review – what has been the basis of most countries and program’s approach to malaria prevention with ITNs.

Read the full article.
Investigating the acceptability of non-mesh, long-lasting insecticidal nets amongst nomadic communities in Garissa County, Kenya using a prospective, longitudinal study design and cross-sectional household surveys

Alternative net designs that would enhance their sustainability and use by populations has long been part of the discussions around improvements and innovations for nets. These include non-mesh nets for outdoor sleeping, particularly for nomadic or migrant populations. In one study where this type of net was distributed, 95% of people on average have a favorable opinion of the net, and utilization reached 90%. The authors did find some reported “concerns” expressed by households regarding “heat” and color, not much different from what has been seen in other studies. The authors conclude that this gives evidence of high acceptability of this type of LLIN for the population in question and suggest that such products should be considered in mass campaigns rather than a “one size fits all” approach.

Read the full article.

Larval Control

Larvicidal activity of few select indigenous plants of North East India against disease vector mosquitoes (Diptera: Culicidae)

Many studies on the larvicidal effects of plant extracts have been published in the past and Dohutia and coworkers present their research looking at in-vitro effects of root extracts from three plants from North East India (Assam State) on larvae of malarial vector Anopheles stephensi. Using petroleum-ether extracts of the plants they show that all three have a similar larvicidal activity in bio-assays as the established larvicide Propoxur. However, the half-life of the extracts was rather short with only 2-4 days. This study shows the enormous potential of indigenous plants as larvicides. Unfortunately, it is very rare that any of these plant extracts is developed further into applicable interventions.

Read the full article.

Adulticides
The sterilizing effect of pyriproxyfen on the malaria vector Anopheles gambiae: physiological impact on ovaries development

Pyriproxifen (PPF) is an insect growth regulator that mimics a juvenile hormone. It is of increasing interest in malaria vector control as it has a very low toxicity in humans and no cross resistance to other classes of insecticide. Well established as a larval control agent that prevents the emerging of mosquitoes from the pupae, it is recently also used in baited traps and LLINs (e.g. Olyset Duo) based on its effects on adult mosquitoes. In this study, all study arms resulted in a dramatic reduction of mosquito fecundity and fertility irrespective of time of first exposure to PPF. In addition, the effect after a single exposure was strong even in the next three blood meals. This study provides strong evidence of the sterilizing effects of PPF after a single tarsal contact by adult Anopheles gambiae vectors and suggests that control approaches that include PPF are very promising.

Read the full article.

Effects of fungal infection on feeding and survival of Anopheles gambiae (Diptera: Culicidae) on plant sugars

Entomopathogenic fungi are another group of new adulticides that are being explored, as they kill mosquitoes slowly by interrupting feeding and they are not prone to resistance development. Fungi have been proposed to be used in eave tubes in houses, but other delivery mechanisms are possible. One such infection strategy was tested by Ondiaka and colleagues in Kenya. The results confirmed the known reduction in survival after infection of male and female mosquitoes. Based on these results the authors suggest that delivering the entomopathogenic fungi through plants inoculated with spores would be feasible and could have the advantage to target not only female vectors, but also males and could therefore enhance population reduction.

Read the full article.

Ivermectin as a complementary strategy to kill mosquitoes and stop malaria transmission

Ivermectin is a broad-spectrum antiparasitic drug that has been used over many years in veterinary medicine and later in humans in the control of river-blindness,
an infection with the filarial worm *Onchocerca volvulus*. In recent years studies have shown that ivermectin also affects adult mosquitoes that have fed on humans recently given ivermectin by causing flaccid muscle paralysis and death. This has triggered considerations to add ivermectin as a tool in the interventions to reduce malaria transmission, either as part of clinical treatment or mass drug administration (MDA) in humans. In their commentary to this study, Steketee and ter Kuile briefly review the data on ivermectin for malaria transmission reduction to date and consider how ivermectin could be practically used in malaria control in combination with other vector control measures.

Read the full article.

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**Adult vector control, mosquito ecology and malaria transmission**

Although not directly dealing with a product or approach for killing adult vectors, the modelling work by Brady and others is relevant in this context. They revisit the historical statement that the lifespan of the adult vector is the most important element in reducing “vectorial capacity”. In their model they are able to assess the relative impact of different aspects of vectorial capacity and find that reduction of transmission is most sensitive to methods that reduce mosquito survival, followed by blood feeding frequency, human blood feeding habits, and mosquito population density. This finding emphasizes the potential and importance of adulticides in an optimal vector control intervention mix.

Read the full article.

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**Attract, Lure, Kill**

**Understanding long-lasting attraction of malaria mosquitoes to odor baits**

Any trap or other device used for adult mosquito surveillance or control will depend on some kind of bait to attract the vectors, and the feasibility of any such approach will depend on the long-term effectiveness of the attractant delivery system. Mweresa and colleagues addressed this question by studying the long-lasting attraction of malaria mosquitoes to odor baits in a semi field setting (greenhouse) in Western Kenya, using the synthetic attractant “Ifakara blend 1” combined with carbon dioxide. As a delivery system either sachets of low-density polyethylene or
strips of nylon were used in a standard trap (MM-X counterflow geometry trap). Studying the composition of chemicals in the baits after one year showed that additional substances had appeared which came from bacteria, and these contributed to the longevity effect. These results are very encouraging as they provide good evidence that long-term baits delivered on nylon strips can remain effective without re-treatment for up to one year.

Read the full article.

 Mosquito host preferences affect their response to synthetic and natural odour blends

Busula and colleagues studied the effectiveness of different natural odors in catching vectors with different host preferences such as the strictly human biting \textit{Anopheles gambiae} s.s. and the more opportunistic \textit{Anopheles arabiensis} which also bites cattle. The study tested natural human, cow, and chicken odors and compared these to mixes of different synthetic odors with tests carried out in semi-field as well as field conditions. The results suggest that generally, the synthetic odors were highly effective, particularly for outdoor catches. However, not all mosquito species react in the same way to the odor blends which means that the selection of the optimal bait for the major vector targeted will be critical in any application.

Read the full article.

 Housing

 Mind the gap: house structure and the risk of malaria in Uganda

The impact of house design on the entry of malaria vectors and the malaria prevalence and incidence among the children living in these houses was studied by Wanzirah and colleagues in three areas of Uganda. Children age six months to 10 years were enrolled in a prospective study and followed for 24 months looking at malaria parasite prevalence and malaria incidence. In addition, house characteristics were assessed and mosquito entry measured monthly using CDC light traps. The study found that vector density per house from the light traps was significantly lower in "modern" houses than "traditional" ones, and malaria prevalence in children showed a similar picture with lower infection in modern
houses. In contrast, malaria incidence was only lower for modern houses in the moderate transmission area of Western Uganda, but not in the East where transmission is high. While these findings do not present any new insights, they provide good evidence of the magnitude of impact associated with economic development and the improved housing that goes along with it.

Read the full article.

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**Other Approaches**

**The interaction between seasonality and pulsed interventions against malaria in their effects on the reproduction number**

Griffin uses modelling to explore the influence of seasonality on the optimal timing of malaria control interventions based on the impact on the basic reproduction number (R0) of the infection. The findings suggest that if an intervention reduces transmission by a constant factor, the impact on R0 will be independent of whether transmission is seasonal or not. The model also suggests that the optimal timing of mass drug administration (MDA) for transmission reduction would be in the dry season while for IRS or a transmission blocking vaccine it would be just before the malaria season. As intuition suggests, the model confirms that timing of interventions gains importance as seasonal variation increases.

Read the full article.

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**Human-to-human transmission efficiency increases as malaria is controlled**

Another modelling exercise is presented by Churcher and others using data from the Dielmo “population laboratory” in Senegal. Based on the data that was collected between 1990 and the start of vector control interventions in 2008, the model outputs show that although infection rates in humans reduced from 70% to 20%, the infection rate among vectors remained constant. The evidence suggests that an increase in gametocyte density is the cause of this phenomenon which led to increased transmission efficiency. It remains uncertain, however, how this would be generalizable to other settings and the impact on control strategies remains unclear.
Lead clinical and preclinical antimalarial drugs can significantly reduce sporozoite transmission to vertebrate populations

Upton and colleagues address the question of how antimalarial medicines could contribute to malaria elimination by modelling impact on the reproductive number in various transmission settings using data from various drug trials in mouse models using *Plasmodium berghei*. The results show a strong impact on R0 of primaquine at doses of >6mg/kg and the new drug NITD609 (a spiroindolone with gametocidal activity) in all transmission settings. In contrast, artemether-lumefantrin and low dose primaquine (<1.25 mg/kg) only had an impact in the low transmission setting in the model.

Read the [full article](#).