Supplementary material: Evaluating human landing catches as a measure of mosquito biting and the importance of considering additional modes of action

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1 Bayesian hierarchical models

We use Bayesian hierarchical models to consider the nightly variations in the parameters. For α_B and α_M, the nightly rates for the control experiments are assumed to follow lognormal distributions. We consider ϕ_a and ϕ_b, describing how a and b deviate nightly from the mean of of $\log(\bar{\alpha}_B)$ and $\log(\bar{\alpha}_M)$ according to the scale of the standard deviation. We denote the nightly parameter values with a subscript k, for $k = 1, 2, \ldots, 6$ elements, therefore the nightly rates are given as

$$\bar{\alpha}_{B,k} = \exp(a + \phi_{a,k}\sigma_a) \text{ and}$$
$$\bar{\alpha}_{M,k} = \exp(b + \phi_{b,k}\sigma_b).$$

The expected value of these distributions, i.e. the mean of the rates, are therefore calculated as

$$\bar{\alpha}_B = [\bar{\alpha}_{B,k}] = \exp(a + \sigma_a^2/2) \tag{1}$$
$$\text{and } \bar{\alpha}_M = [\bar{\alpha}_{M,k}] = \exp(b + \sigma_b^2/2). \tag{2}$$

The probability a mosquito encountering an unprotected host dies after biting ($\bar{P}_S$) is assumed to follow a logistic distribution. The nightly probability is given as

$$\bar{P}_S = \text{logit}^{-1}(z + \phi_{z,k}\sigma_z);$$

where z, σ_z and $\phi_{z,k}$ are the mean, standard deviation and nightly deviation from the mean of $\text{logit}(\bar{P}_{S_k})$ on night k. The mean probability over all nights is calculated as

$$\bar{P}_S = [\bar{P}_{S_k}] = \text{logit}^{-1}(z). \tag{3}$$

2 Supplementary table S1

Table S1: Hyperparamters of the models. k denotes the night for parameters that vary nightly.

Parameter	Definition	Prior
a	$\log(\bar{\alpha}_{B,k})$ mean	$\mathcal{N}(0,6)$
σ_a	$\log(\bar{\alpha}_{B,k})$ standard deviation	Half-Cauchy(0,1)
$\phi_{a,k}$	Normalised deviation of $\log(\bar{\alpha}_{B,K})$ from mean	$\mathcal{N}(0,1)$
b	$\log(\bar{\alpha}_{M,k})$ mean	$\mathcal{N}(0,6)$
σ_b	$\log(\bar{\alpha}_{M,k})$ standard deviation	Half-Cauchy(0,1)
$\phi_{b,k}$	Normalised deviation of $\log(\bar{\alpha}_{M,K})$ from mean	$\mathcal{N}(0,1)$
z	$\text{logit}(\bar{P}_{S,k})$ mean	Logistic(0,1)
σ_z	$\text{logit}(\bar{P}_{S,k})$ standard deviation	Half-Cauchy(0,1)
ϕ_{r_k}	Normalised deviation of $\text{logit}(\bar{P}_{S,k})$ from mean	$\mathcal{N}(0,1)$
$1-\pi$	Intervention effect on host-availability rate	Lognormal(0,5)
κ	Intervention effect on preprandal mortality	Lognormal(0,5)
ξ	Intervention effect on postprandial mortality	Uniform(0,1)

3 Vectorial capacity model parameters

Parameters for an unprotected host are given in Table S2.

In the original model there is a distinction between the rate of mortality while host-seeking (μ_{va}) and the probability of preprandial mortality (P_b). In the current model, preprandial mortality is modelled as a rate, similar to mortality while host-seeking, in the original model. This technique was first adopted by [1] where, simularly to this study, a dummy host was added to model the rate of preprandial mortality. This makes results easier to interpret than the original model, which allowed for negative repellency in the presence of secondary effects. This formulation has since also been utilised in Fairbanks et al. [2] and Wang et al. [3].

Table S2: Definitions and values of parameters used to calculate the vectorial capacity. Baseline values, considering all humans as unprotected, for *Plasmodium falciparum* malaria and *Anopheles Minimus* are given.

Symbol	Definition	*An. gambiae*	*An. funestus*	Ref.
N_H	Number of humans	10,000	10,000	Assumption
N_A	Number of non-human hosts	10,000	10,000	Assumption
θ_d	Maximum time a mosquito unsuccessfully searches for a blood meal per day	0.33 days	0.33 days	[4]
P_B	Probability that a mosquito bites after encountering a host	0.95	0.95	[4]
P_C	Probability that a mosquito finds a resting place	0.95	0.95	[4]
P_D	Probability that a mosquito survives the resting phase	0.99	0.99	[4]
P_E	Probability that a mosquito lays eggs and returns to host-seeking	0.88	0.88	[4]
τ	Time between feeding and laying eggs	3 days	3 days	[4]
θ_s	Duration of the extrinsic incubation period (time required for sporozoites to develop in the mosquito)	11 days	11 days	[4]
A_0	The sac rate of mosquitoes (estimated proportion of host-seeking mosquitoes which laid eggs the same day)	0.45	0.59	[7]
M	The parity rate of mosquitoes (proportion of host-seeking mosquitoes that have previously laid eggs)	60.70	68.65	[5]
χ	Human blood index (proportion of blood-fed mosquitoes which fed on a human)	0.65	0.70	[6]
α_{human}	Human availability rate	9.02×10^{-5} days^{-1}	1.64×10^{-4} days^{-1}	Calculated
$\alpha_{non-human}$	Non-human availability rate	4.90×10^{-5} days^{-1}	7.03×10^{-5} days^{-1}	Calculated
μ_{vA}	Per-capita mosquito death rate while searching for a blood meal	0.40 days^{-1}	0.33 days^{-1}	Calculated

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