MalMod User manual

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# Description

This is a web-based mathematical modelling tool to support *Plasmodium falciparum* malaria elimination strategy design. This tool is intended for use by policymakers to support decision-making on malaria elimination strategy at the national and sub-national level.

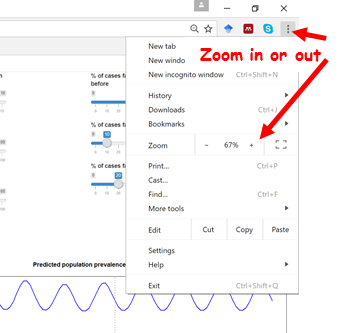
The application is based on a simple mathematical model for malaria transmission and control which runs in the background. This model can be set up by the user to reflect local epidemiology and current malaria control activities in a district, province or township. The design features of a new strategy can then be adjusted until the desired outcome is predicted for that district. The model is not intended as an accurate representation of any specific setting, but rather to be used to support national and sub-national strategy design as part of a larger evidence base in the decision-making process of a National Malaria Control Program.

# Getting started

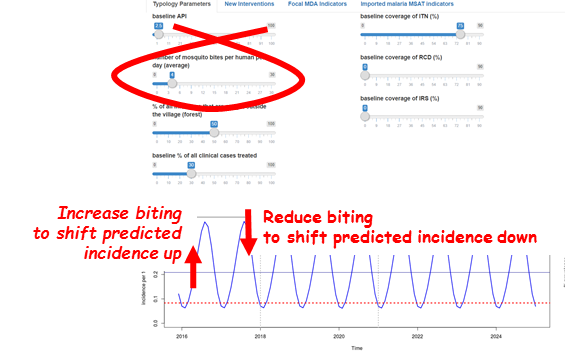
1. To get started, open the following website: [**https://saitheinthantun.shinyapps.io/malmod/**](https://saitheinthantun.shinyapps.io/malmod/). You will see the front page of the MalMod tool:



1. Adjust the zoom setting in your browser to zoom in or out:



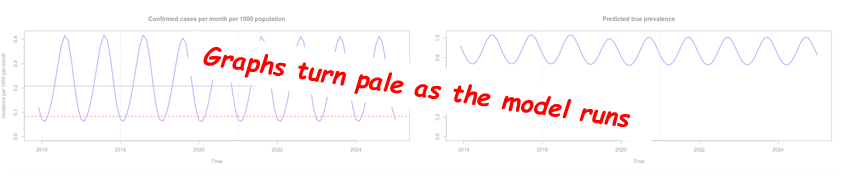
1. There are two graphs. **The left graph shows the model prediction for monthly incidence of confirmed clinical cases**. The number of confirmed cases will be less than the true clinical burden since the model assumes that not all clinical cases are detected and treated by the health system. The more cases that are detected by the health system, the more the confirmed cases will reflect the model’s prediction of the true clinical burden. **The right graph shows the model prediction for true prevalence.** This is defined as the percentage of the population that have a clinical infection, a microscopically detectable asymptomatic infection or a microscopically undetectable asymptomatic infection. It is intended to represent the entire transmission reservoir associated with each scenario.
2. The “Typology Parameters” tab allows the selection of the baseline scenario. Adjust the sliders until the baseline scenario desired is set. The dark blue line represents the average baseline API. After all the baseline values are selected, adjust the “no. of mosquito bites per human per day” parameter until the API line (dark blue, flat) passes through the centre of the model prediction for monthly incidence line (blue, wavy). Sliders can be adjusted using click and drag with a mouse, or by clicking on to the slider button and then using the keyboard arrow keys.



1. Note that in order to obtain API levels below 1 per 1000 per year, the imported cases must be reduced. This can be done by adjusting the three sliders in the third column in the “Typology Parameters” tab. Since every clinical case will most likely be accompanied by asymptomatic carriers (both detectable and undetectable by microscopy), then it is recommended to include roughly 10 times the number of clinical cases being imported to be imported as asymptomatic carriers of each category. For example, if the user choses 1 clinical cases per 1000 per year to be imported, they should also set 10 microscopically detectable and 10 microscopically undetectable carriers per 1000 per year.



1. While the model is running, the graphs will look pale and then become bright again when the model has completed its run. If multiple changes are made in quick succession, the graphs will slowly flash pale and bright until all the changes have been run in sequence.



1. Now explore options for the elimination strategy design. These can be found in tabs labelled: “New Interventions”, “Focal MDA Indicators”, and “Imported malaria MSAT Indicators”. Various components of the strategy can be switched on and off using the check boxes. Also, their efficacy and coverage can be adjusted using the sliders. Once some new interventions are switched on, the baseline model prediction will be depicted as a grey solid line, with the selected strategy model prediction in blue.



Note that some activities are predicted to increase the confirmed cases per 1000 population per month (left graph above). This is because increasing early detection and treatment (EDAT) will lead to increased numbers of clinical malaria cases being discovered and treated. Since only treated clinical cases are reported by the model (the modelled untreated clinical burden going unmeasured as it is in reality), then this figure can increase during an elimination strategy even though the prevalence declines (right graph above). The increase in confirmed cases per month is therefore an artefact since the true clinical burden will remain constant of reduce as a result of increased interventions, whereas detecting and treating more cases can lead to more confirmed cases.

# Definitions

|  |  |
| --- | --- |
| **Parameter name** | **Definitions** |
| **Typology parameters** | **This group of parameters will determine the malaria infection trend for a specific setting. If a particular intervention is not currently used (eg. IRS), you can put the coverage to 0.** |
| Baseline API | Annual Parasite Incidence per 1000 population for the country/region being modelled. It also determines the initial prevalence. |
| No. of mosquito bites per human per day (average) | Average no. of mosquitos bites per human per day, influencing the rate of infection. |
| % of all infections that are caught outside the village (forest) | Of all the infections reported, what percent of infections are from people working in the forest, plantations, etc |
| baseline % of all clinical cases treated | Current coverage of Early Diagnosis and Treatment of malaria. |
| baseline coverage of ITN (%) | Current coverage of Insecticide Treated Nets, LLINs. |
| baseline coverage of RCD (%) | Current coverage of Reactive Case Detection. |
| baseline coverage of IRS (%) | Current coverage of Indoor Residual Spraying. |
| imported clinical cases per 1000 population per year | Symptomatic/Clincal malaria cases that are imported per 1000 population per year into the region. |
| imported super-microscopic asymtomatic infection per 1000 population per year | Asymptomatic malaria cases detectable by microscopy or RDT that are imported per 1000 population per year into the region. |
| imported sub-microscopic asymtomatic infections per 1000 population per year | Asymptomatic malaria cases detectable only by PCR that are imported per 1000 population per year into the region. |
| % of cases failing treatment in 2018 and before | Percentage of malaria treatment failure in 2018 and before |
| % of cases failing treatment in 2019 | Percentage of malaria treatment failure in 2019 |
| % of cases failing treatment in 2020 and after | Percentage of malaria treatment failure in 2020 |
| **New interventions** | **On this tab, you can turn on/off new interventions . You can also change coverage, effect, etc for each new intervention.** |
| switch on scale up of EDAT | Turn on/off Early Diagnosis and Treatment of malaria as a new intervention using the parameters on this tab. |
| ACT+primaquine for EDAT and MDA | Turn on/off the use of primaquine in Early Diagnosis and Treatment, and in Mass Drug Administration. |
| years to scale up EDAT | No. of years it takes to achieve the new coverage of Early Diagnosis and Treatment of malaria. |
| new % of all clinical cases treated | New coverage of Early Diagnosis and Treatment of malaria. |
| switch on scale up of ITN | Turn on/off Insecticide Treated Nets as a new intervention using the parameters on this tab. |
| years to scale up ITN | No. of years it takes to achieve the new coverage of Insecticide Treated Nets . |
| new coverage of ITN (%) | New coverage of Insecticide Treated Nets, LLINs. |
| new % of infections averted due to ownership of ITN | Percentage of infections averted due to the ownership/usage of Insecticide Treated Nets. |
| switch on scale up of RCD | Turn on/off Reactive Case Detection as a new intervention using the parameters on this tab. |
| years to scale up RCD | No. of years it takes to achive the new coverage of Reactive Case Detection. |
| new coverage of RCD (%) | New coverage of Reactive Case Detection. |
| no. people screened per clinical case | No. of people screened for malaria for each clinical case detected. |
| sensitivity RCD test (clinical) | Sensitivity of the test used in RCD to detect a clinical case |
| sensitivity RCD test (super-micro, asym) | Sensitivity of the test used in RCD to detect an asymptomatic patent case |
| sensitivity RCD test (sub-micro, asym) | Sensitivity of the test used in RCD to detect an asymptomatic non-patent case |
| % increased likelihood of finding cases with radial search | Percent increased in likelihood of finding malaria cases with radial search. |
| change RCD from radial search to co-exposure search | Change Reactive Case Detection from radial search to co-exposure search |
| % increased likelihood of finding cases with co-exposure search | Percent increased in likelihood of finding malaria cases with co-exposure search. |
| switch on scale up of IRS | Turn on/off Indoor Residual Spraying as a new intervention using the parameters on this tab. |
| years to scale up IRS | No. of years it takes to achieve new coverage for Indoor Residual Spraying. |
| new coverage of IRS (%) | New coverage of Indoor Residual Spraying. |
| % reduction in biting rate due to IRS | Percentage reduced in biting rates due to the use of IRS. |
| **Focal MDA Indicators** |  |
| switch on MDA | Turn on/off Mass Drug Administration. |
| effective population coverage of focal MDA in round 1 | Effective population coverage of focal MDA in round 1 |
| effective population coverage of focal MDA in round 2 | Effective population coverage of focal MDA in round 2 |
| effective population coverage of focal MDA in round 3 | Effective population coverage of focal MDA in round 3 |
| timing of 1st round [2018+ no. of month, 1 means Jan'2018, 13 means Jan'2019] | The year+month when the 1st round of MDA starts |
| timing of 2nd round [2018+ no. of month] | The year+month when the 2nd round of MDA starts |
| timing of 3rd round [2018+ no. of month] | The year+month when the 3rd round of MDA starts |
| months to complete each round | No. of months to complete each round of MDA |
| days prophylaxis provided by the ACT | No. of days protected from malaria because of the ACT. |
| % population coverage of 1st MDA round | Population coverage of 1st round of MDA. |
| % of 1st MDA round population to get 2nd | % of population of 1st MDA round getting a 2nd MDA. |
| % of 2nd MDA round population to get 3rd | % of population of 2ND MDA round getting a 3rd MDA. |
| **Imported malaria MSAT indicators** |  |
| switch on MSAT for imported cases | Turn on/off Mass Screening and Treatment for the imported cases. |
| years to scale up MSAT | No. of years it takes to achieve the new coverage of MSAT. |
| new coverage of MSAT (%) | New coverage of MSAT. |
| sensitivity MSAT test (clinical) | Sensitivity of the test used in MSAT to detect a clinical case |
| sensitivity MSAT test (super-micro, asym) | Sensitivity of the test used in MSAT to detect an asymptomatic patent case |
| sensitivity MSAT test (sub-micro, asym) | Sensitivity of the test used in MSAT to detect an asymptomatic non-patent case |