Supplementary information

Developing the interactive costing tool

We developed an interactive malaria mass intervention costing tool, using the R programming language, to estimate the full costs of implementing malaria mass interventions. The tool is available via the Mathematical and Economic Modelling group website https://moru.shinyapps.io/Mass-Malaria-Interventions-Costing-Tool/. Figure 1 shows a screenshot of the mass malaria intervention costing tool. The main aim in developing this tool was to estimate the programmatic costs of mass malaria interventions intended to eliminate *P. falciparum* malaria in the elimination setting. The web application was developed based on unit costs estimated from a pilot MDA project implemented in Kayin State, Myanmar. Users can evaluate the costs of different malaria mass interventions for their intended setting, or scale up the costs of an existing MDA programme, by moving the slider bars in the application. The costs of programmes change as users change the value of variables on the slider bars.

We developed an interactive malaria mass intervention costing tool, using the R programming language, and the shiny package. The tool can be accessed at https://moru.shinyapps.io/Mass-Malaria-Interventions-Costing-Tool/. Table 3 shows the parameters and the values used to estimate the programmatic cost of targeted MDA in Kayin State.

The aims of developing an interactive mass malaria intervention costing tool are to help funders and program managers to understand the implementation costs of MDA and to predict the full costs of implementing malaria elimination program. The tool was based on the unit costs estimated from three pilot targeted malaria treatment projects implemented in Myanmar.

The users can estimate the costs of malaria programs for their intended setting, or scale up the costs of an existing MDA program, by moving the slider bars in the application. In this costing tool, the users can estimate the existing malaria interventions such as community health workers programme and distribution of long-lasting insecticide-treated bed-nets. The user can predict the cost of malaria elimination using malaria mass interventions. If the pre-assigned resources are not enough to predict the budget, this tool provides a component that the users are allowed to

add the resources as an extra/optional. The costs of the extra/optional resources are included in the total estimated cost. Summary of the total costs is displayed in a costing table and a bar graph by activity or resources used in a program.

Outputs of the costing model

Outputs are displayed in a table and a bar graph by activity or resource used in the interventions. Although local currencies are used in-country, the preparation and submission of budgets to funder organisations are generally made using United States dollars (US$). Therefore, the outputs of the tool are given in US$.

There are four tabs in the malaria mass intervention costing tool. When a user clicks the link provided above, an introduction page appears and briefly explains the purpose behind the development of the malaria mass intervention costing model and how to use it. The contact details of the tool's developers are available in case the user would like to know more about the costing model or provide comments or suggestions.

Baseline

The second tab collects baseline information regarding the setting and the unit cost of resources to estimate the cost of an intervention. If the setting has existing malaria interventions, for example community health workers (CHWs) or the distribution of insecticide-treated bed-nets (ITNs), the tool can also estimate their maintenance costs. Information regarding village accessibility and field visits to perform various activities was also collected, as were the unit costs and salaries of field and management staff.

Mass interventions

The third tab is the mass intervention tab. Community engagement forms an essential foundation in the preparation for any mass intervention. The community engagement can be clicked if the user wants to add any costs of community engagement to their budget. The user can also adjust information regarding community engagement under the community engagement tab.

Mass interventions include (i) mass drug administration, (ii) mass screening and treatment, (iii) mass vaccination, (iv) mass drug administration plus mass vaccination, and (v) mass screening and treatment plus mass vaccination. The user can choose one malaria intervention for their intended setting by selecting the appropriate radio button.

A useful feature incorporated into this costing tool is a targeting strategy option. If a user would like to target a proportion of villages that have higher numbers of malaria cases in their communities, they can select one of three targeting strategies. These different targeting strategies that can be used to identify hotspot villages are (i) mass blood screening using a quantitative uPCR method, (ii) reviewing monthly malaria reports from CHWs, and (iii) providing antimalarial drugs to all villages regardless of their malaria burden (no targeting).

Optional (extra costs)

All ingredients consumed in the pilot MDA projects are included in the interactive malaria mass intervention costing model. However, if a user would like to add any resources to their budget that are not included in the built-in ingredients, the tool allows them to add additional components. The user can fill in the name of these ingredients, their unit costs, and the quantity required in their intended programme. The values of these items will then be calculated and added to the total costs. Users can add up to a maximum of six items in the development of their budget.

Exporting data

The user can save the values of the parameters they used in the budget estimation for future reference. They can also export a summary of the cost of their programme roll-out or future project by clicking the download button in the last tab (Detailed costs) of the costing tool. This will create a comma-separated values (CSV) file that can be saved.

Table 1 Two-year programmatic costs of targeted MDA with different numbers of villages selected for MDA

Cost of screening 272 villages using uPCR	**Percentage of villages targeted MDA**	**Number of villages**	**Cost of community engagement**	**Cost of mass treatment**	**Total cost**	**Cost per village ***	**Cost per person reached** **

541 042	1%	13	56 735	111 551	709 328	579	1·9
541 042	2%	25	61 534	155 684	758 260	618	2·1
541 042	3%	37	66 332	199 816	807 190	658	2·2
541 042	4%	50	71 531	247 626	860 199	702	2·4
541 042	5%	62	76 330	291 759	909 131	742	2·5
541 042	6%	74	81 128	335 891	958 061	781	2·6
541 042	7%	86	85 927	380 024	1 006 993	821	2·8
541 042	8%	99	91 126	427 834	1 060 002	865	2·9
541 042	9%	111	95 924	471 966	1 108 932	905	3·0
541 042	10%	123	100 732	516 099	1 157 864	944	3·2

* Cost per village is estimated by dividing the total cost of targeted MDA by the total number of villages in the four townships (1226 villages). These targeted MDA costs will be shared among all villages in the region because targeted MDA is provided in addition to other malaria interventions, so the total cost is distributed among all villages in the region.

** Cost per person reached is calculated by the total cost divided by the total population in that area (365 000).

MDA, mass drug administration; uPCR, ultrasensitive polymerase chain reaction

Table 2 Detailed costs of targeted MDA using three different molecular assays to identify hotspot villages. Cells are highlighted with different colours to illustrate the areas of equivalent costs in the three strategies.

Percentage of villages targeted for MDA	**Number of villages targeted for MDA**	**Prevalence survey using uPCR**		**Prevalence survey using RNA test**		**Prevalence survey using ELISA test**	
		Total cost	**Cost per person reached**	**Total cost**	**Cost per person reached**	**Total cost**	**Cost per person reached**
1%	13	709 328	1·9	624 278	1·71	369 128	1·01
2%	25	758 260	2·1	673 210	1·84	418 060	1·15
3%	37	807 190	2·2	722 140	1·98	466 990	1·28
4%	50	860 199	2·4	775 149	2·12	519 999	1·42

5%	62	909 131	2·5	824 081	2·26	568 931	1·56
6%	74	958 061	2·6	873 011	2·39	617 861	1·69
7%	86	1 006 993	2·8	921 943	2·53	666 793	1·83
8%	99	1 060 002	2·9	974 952	2·67	719 802	1·97
9%	111	1 108 932	3·0	1 023 882	2·81	768 732	2·11
10%	123	1 157 864	3·2	1 072 814	2·94	817 664	2·24

MDA, mass drug administration; uPCR, ultrasensitive polymerase chain reaction; HS-RDT, highly sensitive rapid diagnostic test; MPW, malaria post worker

Table 3 The parameters used in the costing model and the value of the parameters used to estimate the costs of *P. falciparum* malaria elimination in Kayin State, Myanmar

Parameter	Value	Unit
Programme assumptions		
Total number of villages	1 226	Village
Average village population	250	People
Project duration	12	Month
Village Accessibility		
Motorbike	50	Percentage
Rented car	50	Percentage
Salaries for central staff		
General director	8 000	US$
Salaries for field staff		
Team leader	1 000	US$
Programme manager's assistant	500	US$
Lab staff	500	US$
Community health worker	50	US$
Logistics	200	US$
Travel Costs		
Travel cost per village via motorbike	25	US$
Travel cost per village via rented car	100	US$
Parameters for community engagement (CE)		
Number of days spent in a village for CE	1	Day
Staff involved in CE		
Team leader	0	Person
Program manager assistant	1	Person
Helpers/CHWs/ volunteers	2	Person
Equipment		
Equipment cost per village for one community engagement activity	0	US$
Consumables		

Consumables cost per village for community engagement	18	US$
Incentives		
Refreshment costs per village during community engagement activity	19	US$
Costs of community incentives	4 828	US$
Number of villages provide with community incentives	3	Village
Out of all villages, the percentage of villages visited for community engagement	22	Percentage
Training		
Number of training sessions for CE activities	7	Session
Number of participants for CE training	10	Person
Number of trainers for CE training	2	Person
Duration of a training session for CE activities	2	Day
Parameters specific to uPCR		
Percentage of villages surveyed to identify villages for MDA	22	Percentage
Personnel		
Number of days spent in a village for MDA activity to identify MDA villages	1	Day
Team leader/program manager/supervisor	0	Person
Program manager's assistant/logistics assistant	2	Person
Laboratory staff	0	Person
Helper/CHW	2	Person
Incentives		
The incentive for a participant to donate blood	1	US$
Equipment		
The equipment cost per village for mass blood survey activities	5	US$
Consumables		
Consumables costs for uPCR tests	1	US$
uPCR analysis cost per test	25	US$

Training		
Number of training sessions for the uPCR method	8	Session
Number of participants for uPCR training	15	Person
Number of trainers for uPCR training	2	Person
Duration of a training session for uPCR	2	Day
Monitoring and supervision		
Number of trips for monitoring uPCR activity	1	Trip
Number of days spent monitoring uPCR activity	5	Day
Parameters for mass drug administration		
Percentage of villages offered MDA activity	21	Percentage
Number of MDA rounds in a year	3	Round
Average population coverage for MDA in a round	85	Percentage
Personnel		
Number of days spent in a village for MDA activity	7	Days
Incentives		
The incentive for one participant in a round of MDA activity (US$)	1	US$
Travel		
Number of a trips to a village for MDA activity (1 round)	1	Trip
Number of trips for car rental during MDA activity (1 round)	15	Trips
Equipment		
Equipment cost per village for MDA activity	25	US$
Consumables		
Consumables cost per village for MDA activity	20	US$
Cost of DHA+ PQP, blister pack child	0·93	US$
Cost of DHA + PQP, blister pack youth	1·46	US$
Cost of DHA + PQP, blister pack adult	1·98	US$
Cost of primaquine base 7.5 mg tablet	0·01	US$

Cost of medicine for the treatment of side-effects	39	US$
Antimalarial drug wastage	5	Percentage
Training		
Number of training sessions for MDA	8	Session
Number of participants for MDA training	10	Person
Number of trainers for MDA training	3	Person
Duration of a training session for MDA	3	Day
Monitoring and supervision		
Number of monitoring trips for MDA (1 round)	1	Trip
Duration of monitoring trips for MDA (1 round)	10	Day

CHW, community health worker; MDA, mass drug administration; uPCR, ultrasensitive polymerase chain reaction; DHA, dihydroartemisinin; PQP, piperaquine phosphate