# MALARIA

HALFTIME FOR THE SUSTAINABLE DEVELOPMENT GOALS

# BEST INVESTMENTS FOR THE SDGs

## EXCELLENT BENEFIT COST RATIO: 48

### Investment

Scale up coverage of **long-lasting insecticidal bed nets** coverage to 10 percentage points above the 2019 level. Use of chlorfenapir to offset insecticide resistance and social and behavioral change communication to increase the usage including hang-up campaigns.


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# Benefits and Costs of Scaling up Coverage and Use of Insecticide Treated Nets

## *An Investment Case for the Scale up of Insecticide Treated Nets and the use of all nets, halfway into the SDG targets*[1]

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## Introduction

Between 2000 and 2015, malaria case incidence decreased by 37% globally, and malaria mortality rates decreased by 60%. Investments in malaria interventions have played a large part in achieving these reductions. However, financing for malaria has plateaued since 2015 with a corresponding flattening of progress. The year 2023 marks the halfway point to the 2016–2030 United Nations Sustainable Development Goals and the WHO Global Technical Strategy for malaria 2016–2030 pledge period. Given the recent setbacks, including funding declines and the more recent COVID-19 pandemic, progress towards reaching the targets has stalled. As a result, the Copenhagen Consensus has launched a research and advocacy project to encourage the world to focus on interventions that deliver the highest health and economic value per dollar spent. The purpose of this study is to identify the most cost-effective malaria policy and quantify its socio-economic return, using the cost-benefit analysis guidelines from Copenhagen Consensus. The literature and the academic advisory group of the Copenhagen Consensus Center identify increasing distribution of long-lasting insecticide treated nets (LLINs) as the most effective malaria policy currently available. This article therefore specifically examines a policy of scaling up LLINs by 10 percentage points from 2020 levels with a 90% cap in the 29 highest burden countries in Africa along with social and behavioral change (SBC) and information education and communication (IEC) campaigns to increase the use and effectiveness of LLINs. The costs and epidemiological benefits of the intervention are generated using the SPPf transmission model that projects both costs and the decline of malaria cases and deaths with a scale up of 1.25 percentage points per year over 8 years (2023 to 2030), along with information campaigns to ensure better use of nets.

The incremental cost of this scenario compared to a baseline of maintaining malaria interventions at 2020 levels has a present day (2023) value of 5.7 billion US$ 2021 discounted at 8% over the period 2023–2030 (undiscounted starting at US$ 416 million in 2023 increasing to US$ 1.4 billion in 2030). This investment will prevent 1.07 billion clinical cases and save

1,337,069 lives. With standardized Copenhagen Consensus Center assumptions, the mortality benefit translates to a present value of US$ 225.9 billion. The direct economic gain is also substantial: the incremental scenarios lead to US$ 7.7 billion in reduced health system expenditure from reduced treatment of cases, a reduction in cost of delivering malaria control activities, and reduced household out-of-pocket expenses for malaria treatment. The productivity gains from averted employee and caretaker absenteeism and presenteeism add benefits with a present value of US$ 41.7 billion. Each dollar spent on the incremental scenario delivers US$ 48 in social benefits.

The evidence documented by this study can be used within a resource mobilization strategy to facilitate advocacy actions for increased investments in LLINs and social and behavior change communication (SBCC) for better usage of the nets towards reducing the burden of malaria.

## Background

Between 2000 and 2015, the malaria case incidence decreased by 37% globally and malaria mortality rates by 60%. Investments in malaria interventions have played a large part in achieving these reductions, accounting for approximately 70% of the decline observed in sub-Saharan Africa between 2000 and 2015 (Cibulskis et al. 2016; Bhatt et al. 2015). Despite this progress, there were an estimated 247 million malaria cases and 619 000 malaria deaths worldwide in 2021 with 90% of all deaths occurring in the high-burden countries in Africa (WHO 2022). According to the *World Malaria Report* (2022), four countries — Nigeria (27%), the Democratic Republic of the Congo (12%), Uganda (5%), and Mozambique (4%) — accounted for almost half of all malaria cases globally with children under five-years of age and pregnant women being the most vulnerable (WHO 2022). In addition, malaria has societal and economic consequences beyond the direct costs of prevention and treatment and has been shown to be both a consequence and cause of poverty (Sachs and Malaney 2002). Efforts to prevent, control, and eliminate malaria both contribute to and benefit from sustainable

development. The objectives of reducing the disease burden and eliminating malaria are intrinsically linked to most of the Sustainable Development Goals (SDGs) and are central to SDG 3: *Ensure healthy lives and promote well-being for all at all ages* and its Target 3.3: "By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases" (UN 2015). The Global Technical Strategy (GTS) for malaria 2016–2030 developed in the same year, called for a 90% reduction in global malaria incidence and deaths by 2030 and estimated that to achieve these targets, an annual additional malaria investment of an estimated total of US$ 7.14 billion per year by 2025 and US$ 8.32 billion by 2030 is needed (WHO 2015).

The year 2023 marks the halfway point to the 2016–2030 SDGs and GTS pledge period. However, financing for malaria has plateaued since 2015, commensurate with a leveling of the progress achieved. In addition, the COVID-19 pandemic, in particular COVID-19 mitigation measures and people's fears around contracting it, made the implementation of malaria prevention and treatment activities more expensive: countries were unable to implement malaria prevention activities and many households did not seek (or were not able to receive) treatment. These combined setbacks have stalled the progress towards reaching both the SDG and GTS targets (WHO 2022). The Copenhagen Consensus Center has launched a research and advocacy project to encourage the world to focus on the smart things first, in other words, programs that deliver the most per dollar spent.

Economic evaluations have shown that long lasting insecticide treated nets (LLINs) and social and behavior change communication (SBCC) for the prevention of malaria are among the most cost-effective malaria control interventions currently available (Conteh et al. 2021; Kolaczinski et al. 2010; Morel et al. 2013; Meuller et al. 2008; Renggli et al. 2013; Smith et al. 2014; Stevens et al. 2005; YukYuich et al. 2009). However, there are increasing concerns about pyrethroid resistance (Sovi et al. 2020) and an acknowledgement that next generation nets will be more expensive than those that are currently used. In addition, there are concerns about the

durability of nets with reports that in some areas, they do not last for the full three years under field conditions (Killian et al. 2020). For the purposes of this analysis, we have assumed that 30% of the standard LLINs are replaced with chlorfenapir LLINs and that the intervention remains effective. We have used the average price of US$ 2.68 for a distributed standard LLIN and US$ 3.90 for a distributed chlorfenapir LLIN, and the upper bound of the modelled-cost range for LLIN and SBCC.

This paper outlines the evidence for scaling up existing coverage of LLINs by 10 percentage points with a cap of 90% and presents an investment case for greater investment in this area in the 29 highest-burden countries in Africa: Nigeria, Democratic Republic of Congo (DRC), Tanzania, Mozambique, Uganda, Burkina Faso, Mali, Niger, Angola, Cote d'Ivoire, Cameroon, Chad, Kenya, Ghana, Benin, Guinea, Ethiopia, Madagascar, Zambia, Sierra Leone, South Sudan, Sudan, Malawi, Burundi, Central African Republic (CAR), Liberia, Senegal, Togo, and Rwanda. Ten of these countries have been identified as high-burden to high-impact countries in which aggressive new approaches that will jumpstart progress against malaria will be supported by WHO, the RBM Partnership to End Malaria, amongst other partners (WHO 2018).

## Methodology

### Literature review

A rapid literature review was initially conducted to summarize and update available cost-effectiveness evidence data for malaria control and elimination. Several literature reviews have previously been conducted on economics of malaria prevention and treatment (Conteh 2021; Shretta, Avanceña, and Hatefi 2016). This review therefore focused on new articles published after 2019. Details on the literature review can be found in Annexure 1.

### Transmission model

The fundamental epidemiological and basic economic model used here is the Single Patch Plasmodium falciparum (SPPf) tool. This spatially explicit, compartmental, nonlinear,

ordinary differential equation transmission model is an extension of previously published models and has been implemented in R and C++ (Silal et al. 2014, 2019a, 2019b; White 2009). The economic evaluation presented here uses the outputs of this transmission model as described below.

Key features of the model include four infection classes representing infections that are severe, clinical, asymptomatic and detectable by microscopy, and asymptomatic and undetectable by microscopy, with each infection class having an associated infectiousness based on infectivity data. The probability of individuals entering each class of infection is dependent on their immunity status. It is assumed that untreated individuals will transition from higher to lower severity infection classes as they recover and that they can be boosted to higher severity classes through superinfection. It is assumed that treated individuals test positive for histidine-rich protein 2 (HRP2) after clearance of asexual parasitaemia for different durations depending on the detection limit of the test used. Other additional features were subnational climatic variation (seasonality) and importation of infection. More details on the model and the parameters driving the model can be found on GitHub (2020).

**Data**

The data used to calibrate the model was obtained from several sources. The main estimates for cases and deaths stem from the latest updated *World Malaria Report 2022*, covering the period 2000–2021. To mitigate skewing, the model outputs with the malaria program disruptions caused by COVID-19; data points beyond 2019 were not used for the model. When unavailable in the newest update, we have also extracted specific information from *World Malaria Reports* for the period 2001 to 2021. The data collected covers: Non-community cases; Community cases; Number of LLINs sold or delivered; Number of people protected by IRS; Reported fatalities due to malaria; Population at risk (high, low transmission, and active foci); Coverage of first-line treatment; and Coverage of RDT (years available).

Owing to differing reporting standards and interpretations of community cases, both community and non-community cases were grouped together. Where parameters driving the model could not be estimated from available data, they were sourced from existing literature.

The scenarios modelled including the assumptions are shown in Table 1.

**Table 1: Scenarios modelled.**

| Description | Assumptions |
|---|---|
| **Baseline scenario (business as usual)** | |
| Malaria control activities maintained throughout 2023–30 at their 2019 levels.<br>Passive testing and treating of positive malaria cases (community and facility-based) maintained at 2019 levels<br>Distribution of LLINs with coverage* and usage levels maintained at 2019 levels<br>IRS (Indoor Residual Spraying) coverage continued at 2019 levels<br>Seasonal malaria chemoprophylaxis continued at 2019-coverage levels<br>IPTp (intermittent preventive treatment of malaria in pregnancy) continued at 2019 levels<br>Distribute routine LLINs to participants of IPTp<br>30% of LLINs distributed 2023–30are chlorfenapir LLINs, 70% standard LLINs | No cost and service differences between community and facility-based treatment avenues<br>Routine distribution of LLINs through antenatal clinics and well-childcare<br>Mass distribution of LLINs every 3 years, at coverage levels consistent with current data<br>Proportion of participants who take IPTp remains constant<br>Net durability: 3 years<br>30% of LLIN were chlorfenapir and are effective throughout 2023–30 |
| **LLIN scale-up scenario** | |
| Baseline +<br>Scale up of LLIN coverage to:<br>Scale up of LLIN coverage to 10 percentage points above the 2019 level (capped at 90%) between 2023–2030<br>These additional LLINs will consist of 30% chlorfenapir LLINs, 70% standard LLINs<br>SBCC (social and behavioral change communication) increase the usage of LLINs | Mass distribution of LLINs every 3 years.<br>Net durability: 3 years<br>SBCC costs applied to cover 1/3 of the country per year, allowing for full coverage with every mass distribution<br>Costs applied annually at 1/3 coverage per population at risk<br>Impact of SBCC, hang-up campaigns and other interventions to enable increase in effective coverage by 10 percentage points |

*Notes:* *LLIN effectiveness = usage x proportion of bites averted

In all countries, interventions to increase use beyond the estimated proportions implemented in 2019 were added to simulate increased net *use*. The interventions modelled were a combination of activities of a "hang-up campaign" as well as SBC and IEC (Information Education and Communication) where LLIN coverage and use increased by 10 percentage points by 2030.

## Economic evaluation of avoided cases and deaths

Various sources were used for cost estimates. Country-level data were used when available either directly from countries or literature sources. Where country-specific data were unavailable, proxies were used. The cost inputs used are outlined in Annexure 2. This evidence formed the basis for estimating the unit costs and benefits of scaling up coverage with LLINs and SBCC.

The investment case projects the financial requirements for the two scenarios through 2030 and values the social, economic, and financial returns of reducing malaria transmission compared to the baseline scenario maintaining the coverage level of 2019.

Using a societal perspective and cost of illness approach (Drummond et al. 2002), the economic burden of malaria was evaluated. A reduction in malaria illness leads to costs averted that would have otherwise occurred. Three types of costs were estimated: (a) direct health costs, (b) direct household costs, and (c) indirect costs to households and the health system (see Table 2; Drummond et al. 2002). All monetary figures are expressed in 2021 constant US$.

**Table 2: Framework for estimating the benefits of reduced burden of malaria.**

| Direct health system cost savings | Direct household cost savings | Indirect benefits |
|---|---|---|
| National and subnational expenditures on malaria treatment | Out-of-pocket expenditures | Productivity losses among malaria patients and caregivers<br>Value of life years lost due to premature death |

## Direct cost savings to the health service

The total direct-cost savings resulting from fewer malaria cases was estimated using data from published literature at the national level (see Annexure 2). Where no data were available, proxies were used from other countries or the literature. The findings reflect the vertical costs to the malaria program and the publicly funded system costs of implementing the malaria intervention. Cost estimates expressed in international (PPP) US$ value were converted to 2021 constant US$ values.

**Direct cost savings to households**

Malaria exerts a significant financial burden on households. Malaria patients often pay for transportation to access health facilities, diagnostic services, and medicines. In many countries in Africa, although testing and treatment for malaria and antimalarials are free, prepaid, or covered by capitation of the National Health Insurance Schemes, malaria patients still incur out-of-pocket expenditures (OOP) (RBM 2015). To estimate direct household costs for malaria, the number of reported out-patient (OP) and in-patient (IP) malaria cases was multiplied by the mean OOP spending, which included the cost of transportation (separately for OP and IP cases).

**Indirect benefits to society**

The economic impact of malaria extends beyond the health system. Patients forego income while recovering from malaria, caregivers looking after ill children and the elderly also lose out on potential earnings, and children missing out on school affect human capital accumulation. Premature deaths also cost society through losses in lifetime productivity and in the value that people place on living longer, healthier lives.

To evaluate the economic impact of malaria-related morbidity, the income lost for malaria patients and caregivers was estimated. The estimated income per worker was derived from GDP per capita adjusted for labor force participation and labor share of GDP. The resulting figure was used as a proxy for lost worker income, the time value of non-working adults (15 years and older) was reduced by 50%, and a zero value of time was assigned to children under 15 years old. The incidence of malaria for each country reported in Global Burden of Disease for 2019 (IHME 2021) was used to estimate the share of children and adults respectively. For each age group, the value of the lost productivity was multiplied by the duration of OP and IP illness from published literature and the number of reported OP and IP cases. In addition, the effect of reduced productivity from “presenteeism” was calculating by assuming that adults returning to work after malaria illness would be 50% less productive for an additional three days.

Averted mortality is valued using a standardized approach across all *Halftime SDG* papers, which follows the recommendations of Robinson et al. (2019).

To estimate the value of averted mortality, we use the U.S. Value of Statistical Life (VSL) US$ 9.4 million (2015 US$) as reference, which represents approximately 160 times income as measured by income per capita PPP. The relationship is transferred to the entire low- and lower–middle-income population via the ratio of GDP per capita, using an income elasticity of 1.5.

To estimate these values, we take the population weighted GDP per capita figure in 2020 Int$ for the group of LLMCs and the United States of America, and estimate the VSL at time $t$ = 0, 2020.

$$VSL_t = (\frac{GDP\ pc_{LLMC,t}}{GDP\ pc_{USA,t}})^{e-1} * 160 * GDP\ pc_{LLMC,t}$$

Following Cropper et al. (2019), we estimate each subsequent VSL in the time series according to the following formula:

$$VSL_{t+1} = VSL_t * (1 + g_t)^e$$

where $gt$ is the real GDP per capita growth rate between period $t$ and $t$ + 1 (SSP Database, IIASA GDP Model, Scenario SSP2_v9_130219) and e = 1.5. The value per statistical life year (VSLY) is calculated by dividing the VSL with half the life expectancy at birth.

The GDP growth in this group of countries outpaces population growth so that VSLY grows rapidly over time. In constant 2021 US$ values, the benefit of averting a life year lost (VSLY) is US$ 3,732 (2023), US$ 5,049 (2025), US$ 6,062 (2030).

Using the distribution of malaria deaths between age groups by country reported in Global Burden of Disease (GBD 2019), and assuming 2.5 years as the average death amongst children under 5 years, 12 years amongst children aged 5–19, and half the remaining life expectancy for adults over 20 years. The average life expectancy of males and females was used to estimate the number years of life lost and then multiplied by the value of an additional life

year (VSLY) for low-income and low–middle-income countries (all deaths valued equal). Data on life expectancy was retrieved from World Bank data.

## Cost projections

Unit costs (see Table 3) were used in the SPPf model to calculate the cost of the scenarios and the additional costs of the LLIN and SBCC scale up scenario compared to the baseline scenario.

**Table 3: Unit costs used for estimating intervention scale-up costs.**

| Item | US$ constant 2021 |
|---|---|
| A distributed standard LLIN | average price US$ 2.68 |
| A distributed chlorfenapir LLIN | average price US$ 3.90 |
| Cost of SBCC per distributed LLIN | average price US$ 0.10 |

## Benefits estimation

The benefits of each scenario were estimated as the sum of the direct cost savings to the health system from reduced use of outpatient and inpatient health services and reduction in cost of delivering malaria control activities, the direct cost savings to households, and the indirect cost savings of reduced morbidity and mortality from malaria calculated above. These were computed using the outputs of the transmission model: the malaria cases and deaths averted in the scale up scenario compared to the baseline scenario were calculated and valued using the same methods described previously for estimating the economic burden of malaria (see Table 2).

***Each of these were estimated for each of the 29 countries and added together to obtain the total cases and deaths averted, the total costs, and the total benefits.***

The Net Present Value (NPV) was calculated to obtain the present value of the future revenue generated from reducing the burden of malaria using standard economic techniques. The purpose was to give a true picture of the financial value of an investment today. The timeframe used for calculating the NPV was 7 years (2023–2030) and an 8% discount rate was applied.

### Benefit-cost ratio (BCR)

The BCR is interpreted as the economic return from every additional dollar spent on malaria above the baseline scenario. To calculate the BCR, the NPV of the incremental benefits of the scale up scenario compared to baseline was divided by the NPV of the incremental cost of the scale up scenario (compared to the baseline).

### Sensitivity analysis

A stochastic sensitivity analysis on the epidemiological and cost outputs of the malaria transmission model was performed. The minimum, median, and maximum malaria cases and deaths predicted by the model for each scenario were used to calculate the minimum, median, and maximum costs. Three hundred random samples were drawn, which generated a range of costs. From the range of costs generated, the minimum, maximum, and median percentiles are presented.

### Limitations

This report has several limitations. Due to time and resource constraints, the transmission model generated national transmission-based estimates based on the *World Malaria Report*. Higher levels of spatial heterogeneity would need to be modelled to enable more accurate subnational estimates of benefits and costs. The costs of interventions have been estimated based on available published data and proxies when data were unavailable. For example, the costs of outpatients and in-patients were derived from WHO/CHOICE. As countries move closer to elimination, the impact of active surveillance on both the epidemiology and cost will also need to be included. This was not included due to a lack of historical data to enable fitting the model for impact or cost.

While employee absenteeism was included in the estimates of benefits, the analysis did not include the economic benefits conferred by reductions in school absenteeism and subsequent improvements in cognitive development due to the limited empirical evidence to enable converting these estimates to wages earned (Kuecken, Thuilliez, and Valfort 2020).

Other benefits not included include potential benefits on tourism and the impact of economic development and housing improvements on malaria transmission, as well as regional or cross-border externalities.

Households spend substantial amounts of money on malaria preventive tools such as insecticide sprays and repellants. These costs were not included in this study, thereby possibly underestimating direct household costs of malaria. In addition, infection with malaria is likely to result in a higher likelihood of death from other causes such as HIV and newborn mortality. These additional impacts are not included.

Last, the effectiveness of LLINs at reducing bites is assumed to be 40%. However, this may be an overestimate given recent concerns with pyrethroid resistance and net durability (Killian et al. 2021). New, more costly nets are likely to be needed in the future and resistance management strategies will need to be deployed. To accommodate additional costs of maintaining effectiveness, we calculated the average price of an LLIN assuming 30% of the standard nets are replaced with chlorfenapir nets, and in addition, adopted the higher end range of the ITN and SBCC scale-up cost estimate.

## Findings

### Rapid Literature review

In total, 53 articles were screened for eligibility. After screening, 48 articles were included in the analysis, with majority of articles published in 2020 and 2021 (19 and 16 respectively). Reasons for exclusion were opinion paper (1), discrete choice experiment (1), protocol (1), severe malaria incidence (1), *Plasmodium vivax* (1). The total number of countries included in all studies was 24, with majority of countries being in sub-Saharan Africa. Majority of the studies were cost-effectiveness analyses (80.9%), with the least being cost saving analyses and investment cases (4.3% each). Some 83% of studies were focused on malaria control, while 17% were focused on malaria elimination. The number of studies with more than one economic outcome reported was just 18. The studies employed heterogeneous inputs and

methodologies preventing cross-comparisons and an overall synthesis of all the outputs. Summaries of the review are presented in Annexure 1.

These and previously published studies affirm that interventions to prevent malaria, particularly the use of LLINs, are highly cost-effective across different settings using different distribution channels. The use of LLINs in combination with improved SBCC is therefore considered in this paper to be amongst the most cost-effective policies for scaling up in the control setting at the present time.

## Transmission model predictions and projections

### i. Baseline response:

Maintaining the interventions (LLIN distribution, IRS, SMC) and health-system access and performance at 2019 levels does not change the transmission intensity. Figure 1 shows that malaria is predicted to continue unabated, with no further decrease expected until 2030 (the end point of the model). The slight upward trend in cases and deaths reflects a growing population, rather than increased incidence of malaria.

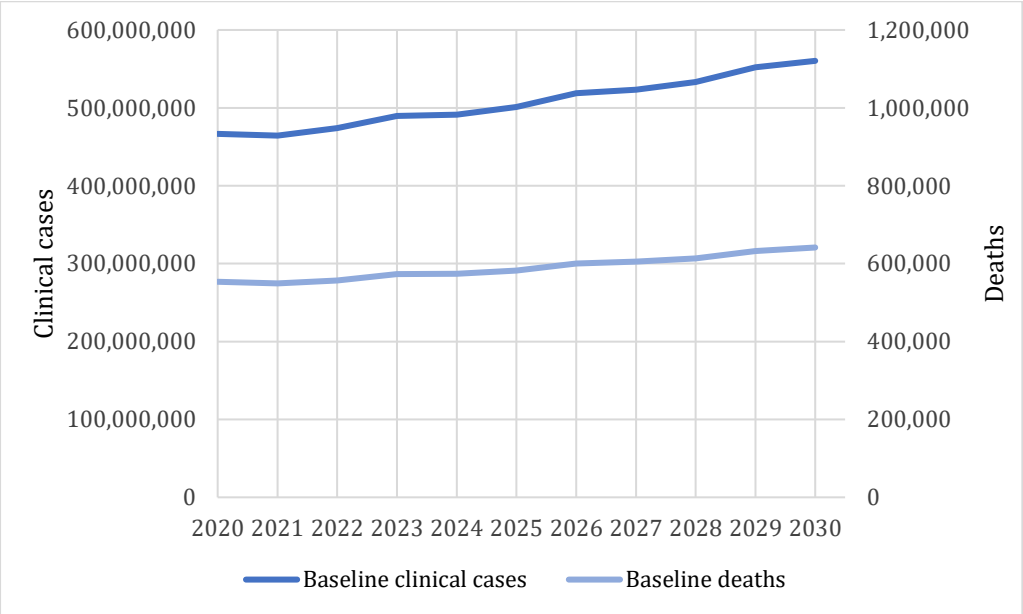


**Figure 1: Baseline clinical cases and deaths per year.**

### ii. Scale-up LLIN and SBCC coverage by 10 percentage points

Figure 2 illustrates the projected clinical cases and deaths with scaled up LLIN and SBCC with the baseline (where other interventions were held constant). In the LLIN and SBCC scenario, clinical cases fell from 4.17 billion to 3.10 billion, and deaths from 4,823,000 to 3,486,000. Scale-up and better use of LLINs resulted in a projected 1.07 billion clinical cases and 1,337,000 deaths averted cumulatively over eight years.

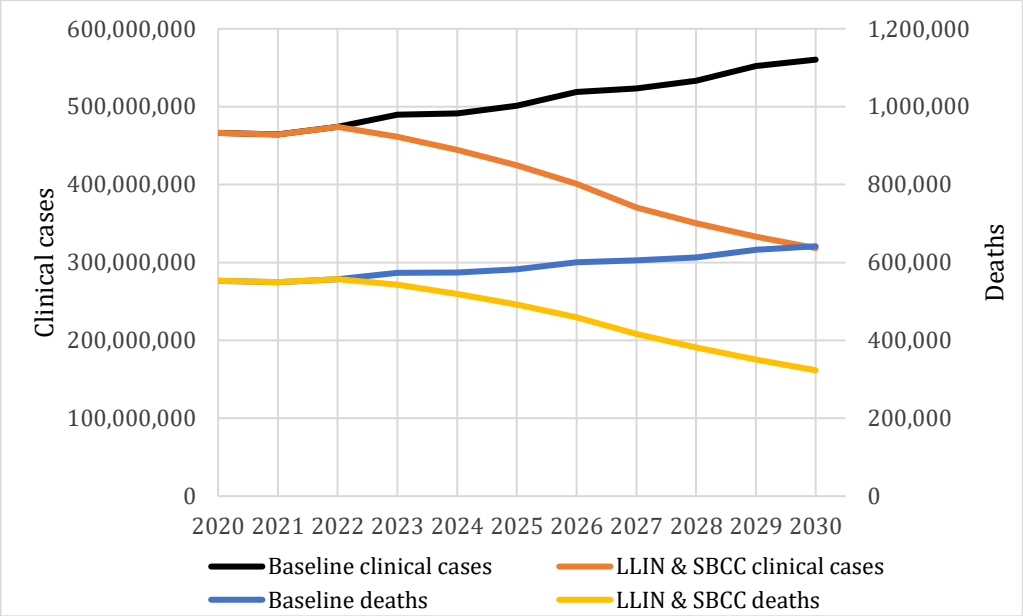


**Figure 2: LLIN and SBCC scenario *vs*. baseline scenario.**

## Cost projections

To account for potential underestimation of the cost of combating pyrethroid resistance and maintain the effectiveness of LLINs throughout the period the upper bound range of the cost estimate for the LLIN and SBCC program produced by the SPPf model is used for reporting the main scenario. The medium cost was used for all other cost estimates.

Adding up all the cost of malaria interventions for maintaining the 2019 levels and the resulting costs of treatment to the health system and out-of-pocket expenses for households, the total estimated present value for 2023 to 2030 discounted at 8% is US$ 53.1 billion (min-max range US$ 51.7–54.4 billion). The total cost of the LLIN and SBCC scenario was estimated to US$ 49.3 billion (min-max range US$ 47.1–50.6 billion) between 2023–2030.

Comparing the two scenarios, the incremental costs of scaling up the LLIN and SBCC program is US$ 5.7 billion in total over 7 years discounted at 8%. The undiscounted costs gradually increase by year as more nets are purchased and distributed with social and behavior change communication (see Figure 3).

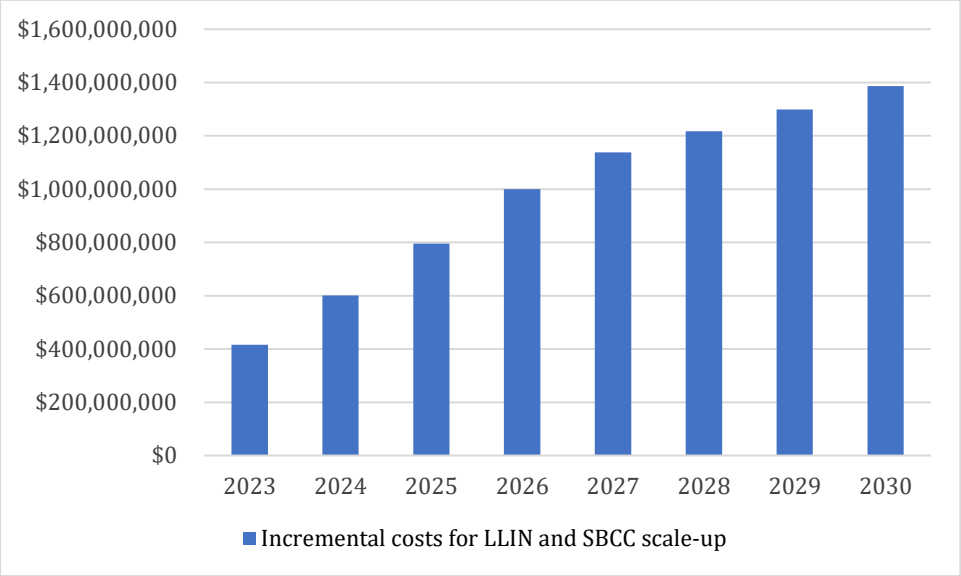


**Figure 3: Total incremental costs of increasing the coverage of LLINs and SBCC.**

The incremental costs for treating malaria cases for the health system and out-of-pocket for households decrease as LLIN and SBCC scale-up reduces the number of malaria cases. Therefore, the total net cost of the LLIN and SBCC scenario is lower than the cost of the baseline scenario.

In the cost-benefit analysis, the costs savings obtained from reduced outpatient and inpatient health-system expenditures due to diminishing cases and reduced out-of-pocket household expenses are added to the benefits. These financial benefits of scaling up LLINs and SBCC will outweigh the expenses for additional LLINs and SBCC in year 2026. Figure 4 illustrates the total costs of increasing the coverage of LLINs (same as Figure 3) and the total financial cost savings. Costs rise throughout the period of scale-up due to increased investments for LLIN purchase, distribution, and use, while healthcare cost savings increase even more over the entire period as fewer and fewer people get sick.

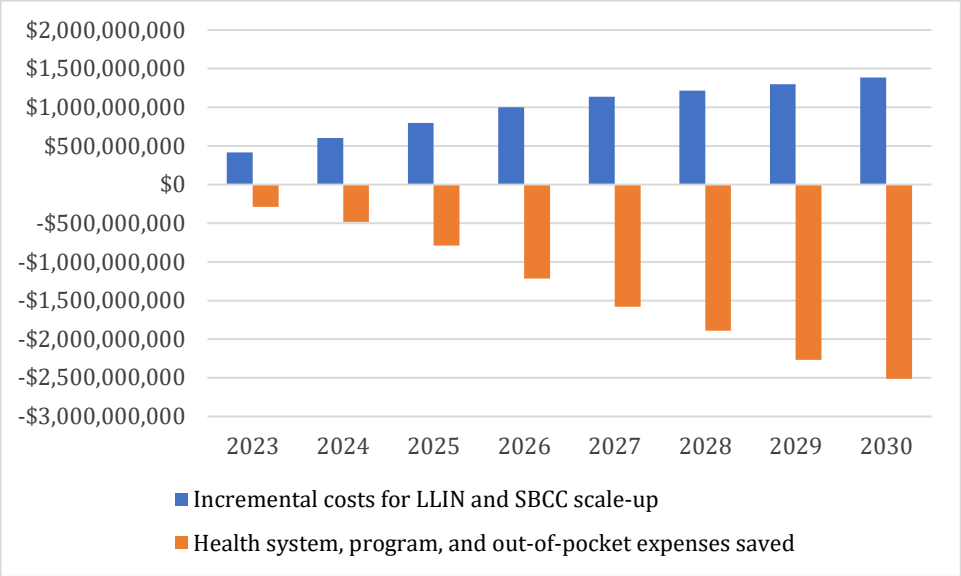


**Figure 4. Year by year comparison of incremental costs for LLIN and SBCC, and expenses saved due to reduction in malaria cases.**

## Benefits estimation

In 2023–2030, the LLIN and SBCC scenario will generate economic benefits of US$ 275.4 billion (NPV 8%). Majority of the benefit is derived from life years saved US$ 225.9 billion, the avoided productivity loss for patients and caregivers adds US$ 41.7 billion in economic benefits, and the avoided healthcare system spending and out-of-pocket expenses for malaria treatment adds financial benefits of US$ 7.7 billion (NPV 8%).

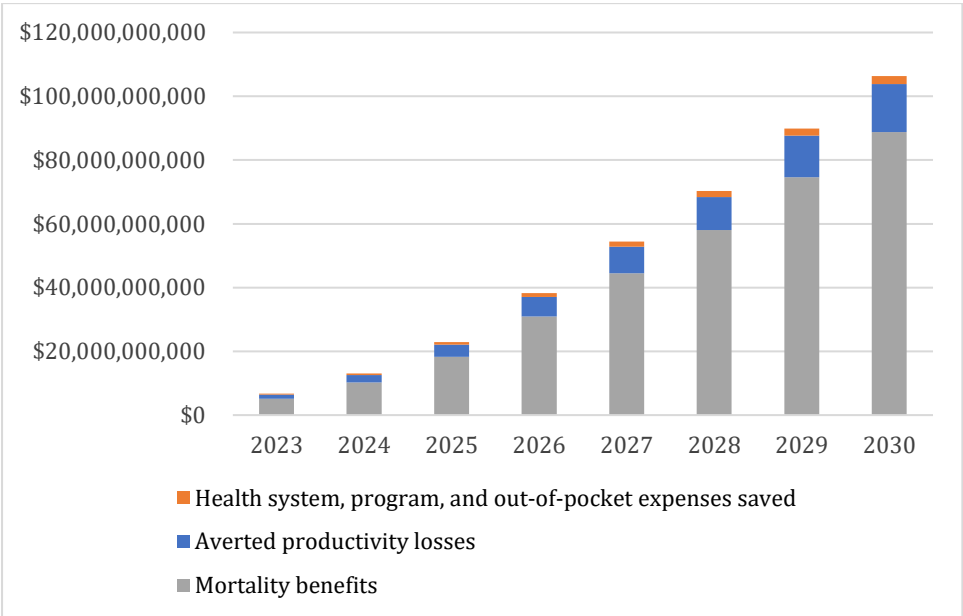


**Figure 5. Mortality benefits, averted productivity losses, and expenses saved due to reduction in malaria cases from scale-up in LLIN and SBCC compared to baseline.**

### Benefit cost ratio

Implementing the LLIN and SBCC scenario (in addition to the baseline scenario of maintaining coverage) over the period 2023–2030 is estimated to produce a return on investment (BCR) of 48:1 (the high-end model cost range for ITNs was used for a moderate estimate due to the pyrethroid resistance challenges, therefore the BCR range is 48–57). The BCR estimates for the 29 individual countries range from 9 to 128 (see Annexure 3).

**Table 4: Summarized results incremental costs and benefits of the LLIN and SBCC scale-up scenario compared to baseline (2023–2030).**

| | |
|---|---|
| Incremental clinical cases averted | 1,066,316,189 |
| Incremental deaths averted | 1,337,069 |
| Incremental benefits | US$ 275 billion (NPV 8%)<br>US$ 7 billion in 2023 rising to US$ 106 billion in 2030 |
| Incremental cost | US$ 5.7 billion (US$ 4.9–5.7) (NPV 8%)<br>US$ 416 million in 2023 rising to US$ 1.4 billion in 2030 |
| BCR | 48 (48–57) |

## Conclusion

The findings indicate that the interventions implemented in 2019 are not likely to lower malaria transmission substantially. Scaling up the coverage and use LLINs while maintaining the baseline 2019 interventions will have an incremental cost of US$ 5.7 billion (discounted at 8%) and generate estimated economic benefits of US$ 275 billion with a BCR of 48:1. This analysis can be used by partners needing to increase their resource mobilization efforts to achieve the global malaria goals.

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## ANNEXURE 1: Literature review.

Databases searched were MEDLINE via PubMed and Google Scholar. The following MeSH terms were used: 'malaria' was combined with 'control,' 'elimination,' and 'eradication,' and the following search terms were employed: 'economics,' 'cost,' 'cost analysis,' 'economic evaluation,' 'economic burden,' 'cost-effectiveness,' and 'cost-benefit.' Studies were classified based on their scope and were analyzed according to three major categories: cost effectiveness of malaria control, cost effectiveness of malaria elimination, and cost benefit studies.

### Cost-effectiveness analyses of malaria control

| Country or region | Study period | Study type | Perspective | Intervention | Control/standard of care | Cost | Incremental ratio | Net benefit | Source |
|---|---|---|---|---|---|---|---|---|---|
| **Multicountry** | 2007–2018 | CEA: Systematic review | Provider | RDTs | Microscopy/ presumptive diagnosis | n/a | n/a | n/a | Ling et al. (2019) |
| | 15 years | CEA + budget impact analysis | Provider | RTS,*S* (child + infant doses) | No malaria vaccination | 2015 US$ 697,345,540 for child vaccination | ICER for child vaccination: US$ 200/DALY averted | n/a | Sauboin et al. (2019) |
| | | Static Markov cohort model | | | | 2015 US$ 729,228,602 for infant vaccination | ICER for infant vaccination: US$ 225/DALY averted | | |
| | | | Societal | | | | ICER for child vaccination: US$ 187/DALY averted | | |
| | | | | | | | ICER for infant vaccination: US$ 212/DALY averted | | |
| | 2010–2017 | Cost analysis and CEA: systematic review & meta-analysis | Provider | Insecticide-treated nets | n/a | n/a | n/a | n/a | Wisniewski et al. (2019) |
| | | | Societal | | | | | | |
| | Unspecified | CEA | Healthcare | Subsidized RDTs in retail sector | No retail sector RDT | US$ 2017 | Cost per DALY averted in Nigeria: US$ 482 (5% PfPR); US$ 44 (PfPR) | n/a | Bath, Goodman, and Yeung (2020) |
| | | Decision-analytical model | | | | | Cost per DALY averted in Tanzania: US$ 115 (5% PfPR); US$ 45 (PfPR) | | |
| | | | | | | | Cost per DALY averted in Uganda: dominated (5% PfPR); dominated (PfPR) | | |
| | 1 year | CEA | Healthcare | 3 sex-based | Usual care | n/a | ICER Ethiopia: US$ 466 per DALY | n/a | Devine et al. (2020) |

| Country or region | Study period | Study type | Perspective | Intervention | Control/standard of care | Cost | Incremental ratio | Net benefit | Source |
|---|---|---|---|---|---|---|---|---|---|
| | | | provider | treatments for P. vivax | | | averted | | |
| | | Decision tree model | | | | | ICER Afghanistan: US$ 1,089 per DALY averted | | |
| | | | | | | | ICER Indonesia: US$ 4,443 per DALY averted | | |
| | | | | | | | ICER Vietnam: US$ 127 per DALY averted | | |
| | Lifetime horizon | CEA | Healthcare provider | IPTp-DP | IPTp-SP | n/a | ICER US$ 8 per DALY averted | n/a | Fernandes et al. (2020) |
| | | Decision tree model | | | | | | | |
| | 5 years | Cost analysis | n/a | Rapid reporting (RR) | n/a | 2014 US$ cost per capita: US$ 0.18 for RR | n/a | n/a | Galactionova et al. (2020) |
| | | | | Reactive case detection (RACD) | | Cost per capita: US$ 0.75 for RACD | | | |
| | | | | MDA | | Cost per capita: US$ 4.28 for MDA | | | |
| | | | | IRS | | Cost per capita: US$ 1.79 for IRS | | | |
| | 1990–2018 | CEA: Systematic review | n/a | Pregnancy-associated malaria | n/a | n/a | ACER: US$ 2 per DALY averted in IPTp-SP | n/a | Restrepo-Posada Carmona-Fonseca, and Cardona-Arias (2020a) |
| | | | | | | | ACER: US$ 14.2 per DALY averted in IPTp-SP in pregnant women with HIV | | |
| | Unspecified | Cost analysis | Government | RTS,S/ASO1E | n/a | 2017 US$ Incremental financial costs per fully vaccinated child | n/a | n/a | Baral et al. (2021) |
| | | | | | | US$ 11.50 (Ghana) to US$ 13.69 (Malawi) | | | |
| | 2016 | CEA and cost-savings analysis | Programmatic | SMC | n/a | 2016 US$ Economic cost of 4 monthly SMC per child: US$ 3.63 | US$ 18.66 to US$ 78.91 per DALY averted | n/a | Gilmartin et al. (2021) |
| | 2000–2020 | CEA: Systematic review | Provider | Mass screen and treat | No mass screen and treat | n/a | varied | n/a | S. Kim et al. (2021) |
| | 2023–2027 | CEA | n/a | MDA with Ivermectin | n/a | US$ 112.1 million – US$ 597.2 million | US$ 1,460 – US$ 4,374: Cost per death averted | n/a | Marathe et al. (2022) |
| | 2017 | CEA | Program | IRS + standard malaria control interventions + LLINs | Standard malaria control interventions | US$ cost per person targeted US$ 5.33 | US$ 48 – US$ 1,593 per DALY averted | n/a | Yukich et al. (2022) |
| **Africa** | | | | | | | | | |
| Cote d'Ivoire | 2016–2019 | CEA | Societal | Screening + Eave | LLINs only | Economic cost per house | US$ 210.29 per year per DALY | n/a | Sternberg et al. (2021) |

| Country or region | Study period | Study type | Perspective | Intervention | Control/standard of care | Cost | Incremental ratio | Net benefit | Source |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Tubes+ LLINs | | covered US$ 239.46 | averted | | |
| | | | Provider | | | Economic cost per house covered US$ 215.38 | US$ 192.30 per year per DALY averted | | |
| Ethiopia | Unspecified | Extended CEA | n/a | ACT | n/a | 2016 US$ 5.7 million | 358 deaths averted; US$ 1,560,000 OOP expenditures reduced | | Assebe et al. (2020) |
| | | Static model | | LLIN | | US$ 16.5 million | 188 deaths averted; US$ 13,000 OOP expenditures reduced | | |
| | | | | IRS | | US$ 32.6 million | 107 deaths averted; US$ 3,700 OOP expenditures reduced | | |
| | | | | Vaccine | | US$ 5.1 million | 38 deaths averted; US$ 2,800 OOP expenditures reduced | | |
| Ghana | 2018 | Cost-savings analysis (CEA included) | n/a | Partial IRS | Full IRS | Cost per person of partial IRS US$ 4.94 | US$ 0.87 per clinical case averted | n/a | Coleman et al. (2021) |
| | | Transmission model | | | | | | | |
| Kenya | Unspecified | Cost analysis and CEA | n/a | LLIN distribution channels A | LLIN distribution channels B | 2015 US$ Unit cost US$ 10.56 LLIN distribution channel A | US$ 86.44 | n/a | Worral et al. (2020) |
| | | | | | | Unit cost US$ 7.17 LLIN distribution channel B | US$ 69.20 | | |
| Malawi | 3 years | CEA | n/a | RTS,S + Bed nets | Control vaccine | n/a | RTS,S: US$ 23.86 per case averted | n/a | Bell et al. (2020) |
| | | | | | | | RTS,S + bed net: US$ 38.91 per case averted | | |
| Malawi | 2014–2019 | Cost analysis | Program | NMCP interventions + HI | NMCP interventions | 2017 US$ Incremental economic cost US$ 25.06 – US$ 33.44 per person per year | n/a | n/a | Phiri et al. (2021) |
| | | | | NMCP interventions + LSM | | | | | |
| | | | | NMCP interventions + HI +LSM | | | | | |
| Mali | 2014 | CEA | Provider | SMC | n/a | 2016 US$ economic cost per child receiving SMC: US$ 3.43 | ICER: US$ 144 per DALY averted | n/a | Diawara et al. (2021) |
| | | Transmission model | | | | Economic cost per child fully adherent: US$ 6.38 | | | |
| Mozambique | 2015 | CEA | Provider | LLIN (new delivery model) | LLIN (standard delivery model) | Financial cost Intervention: US$ 231,237.30 | ICER per LLIN: US$ 0.68 | Positive | Arroz et al. (2019) |
| | | | | | | Financial cost Control: US$ 174,790.14 | ICER per household UC: US$ 2.24 | | |
| | | | | | | | ACER per LLIN: US$ 0.76 | | |

| Country or region | Study period | Study type | Perspective | Intervention | Control/standard of care | Cost | Incremental ratio | Net benefit | Source |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | intervention | | |
| | | | | | | | ACER per LLIN: US$ 0.8 control | | |
| | | | | | | | ACER for HH achieving UC: US$ 2.38 intervention | | |
| | | | | | | | ACER for HH achieving UC: US$ 2.43 control | | |
| Mozambique | 3 years | Cost analysis and CEA | Project implementer | MDA + intensified malaria control | Routine malaria control activities | 2015 US$ 4.83 million | ICER US$ 987 | n/a | Cirera et al. (2020) |
| Mozambique | 2016–2018 | Cost analysis and CEA | Provider | IRS + LLINs | LLINs alone | IRS cost per person protected US$ 8.26 | ICER in under 5 cohort: US$ 400 per DALY averted | n/a | Alonso et al. (2021) |
| | | | | | | | ICER in all-age cohort: US$ 1,860 per DALY averted | | |
| Mozambique | 2014 | Cost analysis | Provider | IRS | n/a | 2014 US$ Economic cost per household sprayed: US$ 16.35 | n/a | n/a | Canana et al. (2021) |
| | | | | | | Economic cost per person protected: US$ 4.09 | | | |
| Nigeria | 2010–2014 | CEA | Prevention | PBO | Conventional LLINs | 2019 US$ | ICER US$ 11 per DALY averted | n/a | Shepard Odumah, and Awolola. (2020) |
| | | | Health system | | | | ICER: PBO nets were cost-saving compared to conventional LLINs | | |
| Nigeria | Unspecified | Extended CEA | n/a | Subsidies of direct and indirect costs | n/a | 2020 US$ 254.4 million | 76 deaths averted per US$ 1 million invested | n/a | Dasgupta, Mao, and Ogbuoji et al. (2022) |
| | | Decision tree model | | | | | | | |
| South Africa | 2015–2017 | CEA | Health services | Reactive, targeted IRS | Standard IRS | 2017 US$ Economic cost US$ 88,258 per 100,000 population for targeted IRS | ICER: US$ 7,845 saved by targeted IRS for each additional DALY incurred | n/a | Bath et al. (2021) |
| Tanzania | 2015–2016 | CEA | n/a | ITWL + LLINs | IRS + LLINs | 2019 US$ ITWL cost per person per year US$ 10.11 | ICER: US$ 490 per DALY averted | n/a | Mpangala et al. (2021) |
| Tanzania | 2-year time horizon | CEA | Provider/ Donor | Three dual-active-ingredient LLINs | Pyrethroid-only LLINs | Cost per net: US$ 2.07 – US$ 3.68 | Chlorfenapyr: US$ 19 more per DALY averted to public providers (or US$ 28 more to donors); PBO: US$ 130 (136 to donors) more per DALY averted | n/a | Mosha et al. (2022) |
| | | | Household | | | | | | |
| | | | Societal | | | | | | |
| Uganda | 2013–2015 | CEA | Societal | iCCM interventions via drug sellers | iCCM interventions via CHWs | 2018 US$ Cost per 100 treated under 5 children: US$ 298.42 for iCCM drug seller arm | ICER: US$ 33.86 per appropriately treated under 5 patient | n/a | Lubogo et al. (2021) |
| Zambia | Unspecified | CEA | Provider | SoC + Focal MDA | Standard of care malaria interventions | 2015 US$ 2 million total cost | ICER: US$ 6,353 per case averted for fMDA | n/a | Yukich et al. (2020) |

| Country or region | Study period | Study type | Perspective | Intervention | Control/standard of care | Cost | Incremental ratio | Net benefit | Source |
|---|---|---|---|---|---|---|---|---|---|
| | | | | SoC + MDA | | | ICER: US$ 1,872 per case averted for MDA | | |
| Zambia | 14-year time horizon | CEA | Healthcare provider | Artesunate | Quinine | 2020 US$ 23.45 | US$ 91 per death averted | n/a | Mtalimanja et al. (2022) |
| | | Markov model | | | | | | | |
| **Americas** | | | | | | | | | |
| Brazil | 2020 | CEA | Public health system | Real-life quantitative G6PD screening | Routine strategy | 2020 US$ 7.86 | US$ 495 per hospitalization avoided | n/a | Brito-Sousa et al. (2022) |
| | | Decision tree | | | | | | | |
| Colombia | Less than 1 year | CEA | Institutional | RDTs | Microscopy | US$ 66,936 for RDTs | ICER: US$ 101.2 per DALY averted | n/a | Restrepo-Posada et al (2020b) |
| | | Decision tree | | | | US$ 50,838 for Microscopy | | | |
| **Asia** | | | | | | | | | |
| Bangladesh | 5-year time horizon | CEA | Health system | RTS,S/AS01 | Usual care | Cost per fully vaccinated child: US$ 0.84 | ICER: US$ 2,629 per DALY averted from the health system perspective | n/a | Sarker and Sultana (2020) |
| | | Decision model | Societal | | | | ICER: US$ 2,583 per DALY averted from the societal perspective | | |
| Indonesia | 2013–2016 | CEA | Provider | IPTp-DP | Screening and treatment DP | 2016 US$ Cost per screening and treatment if positive: US$ 4.69 | ACER: US$ 53 per DALY averted | n/a | Paintain et al. (2020) |
| | | Decision tree model | | | | Cost per screening and treatment if negative: US$ 1.92 | | | |
| | | | | | | Cost per administration of IPTp: US$ 2.76 | | | |
| Lao DPR | 5-year time horizon | CEA + Budget impact analysis | Provider | Six portable screening devices | Visual inspections alone | 2017 US$ 0.04 – US$ 3.06 unit-cost per sample | ICER high prevalence scenario: US$ 391–US$ 1,514 per DALY averted | n/a | Luangasanatip et al. (2021) |
| | | | | | | | ICER low prevalence scenario: US$ 436 – US$ 4,496 per DALY averted | | |
| Myanmar | 2015–2016 | CEA | Provider | Topical repellent | No repellent | 2015 US$ 76,138 | US$ 256 per PCR-detected infection averted | n/a | Agius et al. (2020) |
| Myanmar | 1-year time horizon | CEA + Budget impact analysis | Payer | G6PD diagnosis test + Primaquine treatment | Unsupervised Primaquine treatment | 2020 US$ 811.69 –US$ 1,838.5 | ICER: US$ 96.72 unsupervised test; US$ 184.86 supervised test | n/a | Aung et al. (2022) |
| | | Decision tree model | | | | | | | |

## Cost-effectiveness analyses of malaria elimination

| Country or region | Study period | Study type | Perspective | Intervention | Control/standard of care | Cost | Cost-effectiveness ratio | Net benefit | Source |
|---|---|---|---|---|---|---|---|---|---|
| **Africa** | | | | | | | | | |
| Senegal | 2014–2015 | Cost | n/a | Mass test and treat (MTAT) + PECADOM++ | PECADOM++ | US$ 14.3 per person MTAT | n/a | n/a | Conner et al. (2020) |
| | | | | | Case investigation | | | | |
| **Asia** | | | | | | | | | |
| Cambodia | 2015–2018 | CEA | Provider | Malaria elimination program | | US$ 883,096 | ICER US$ 28 per Pf or Pv/Pf case averted | n/a | Por et al. (2020) |
| | | Decision tree model | Societal | | | US$ 926,000 | | | |
| China | 2018–2019 | CEA | Societal | RDT | RDT + microscopy | 2018 US$ 4.47 million RDT | ICER: US$ 69,856.70 | n/a | Du et al. (2020) |
| | | Decision tree model | | Microscopy | | US$ 3.63 million Microscopy | ICER: US$ 49,514.29 | | |
| | | | | | | US$ 2.75 million RDT + Microscopy | | | |
| Myanmar | n/a | Cost analysis | Program-matic | MDA | n/a | US$ 2.5 per person reached | n/a | n/a | Kyaw et al. (2021) |
| **Europe** | | | | | | | | | |
| Serbia | 10 years | Cost utility | Healthcare provider | Tafenoquine | Primaquine | Cost per patient TQ: 58,474.97 +/- 1,575.16 RSD | ICER: 54,162.52 +/- 330,452.21 RSD | 20,713.84 +/- 7,167 RSD | Kostic et al. (2019) |
| | | Markov model | | | | Cost per patient PQ: 65,903.05 +/- 1,769.69 RSD | | | |
| | 4 years | | | | | Cost per patient TQ: 29,376.64 +/- 1,341.37 RSD | ICER: 79,673.43 +/- 403,380.79 RSD | 12,846.31 +/- 4,936.29 RSD | |
| | | | | | | Cost per patient PQ: 35,039.13 +/- 1,614.82 RSD | | | |

**Cost-benefit analyses**

| Country or setting | Study period | Focus (control or elimination) | Benefit-cost ratio | Source |
|---|---|---|---|---|
| **Africa** | | | | |
| South Africa | 2018–2030 | Elimination | 7.42 (Total ROI) | Njau et al. (2021) |
| **Asia** | | | | |
| Nepal | 2016 | Elimination | 1.58 | Paudel and Pant (2020) |
| South Korea | 2014–2018 | Elimination | 2.5 | J. H. Kim et al. (2021) |
| Thailand | 2017–2036 | Elimination | Cost saving (BCR >1) | Sudathip et al. (2019) |

## ANNEXURE 2: Cost assumptions (US$ 2021).

| Cost | Source | Angola | Benin | Burkina Faso | Burundi | Cameroon | CAR | Chad | Cote d'Ivoire | DRC | Ethiopia | Ghana | Guinea | Kenya | Liberia | Madagas-car |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cost per LLIN | PMI Technical guidance 2021 (56) | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 |
| Average cost of each CHW per year | Country average | 744 | 1.32 | 0.36 | 372 | 0.72 | 0.72 | 0.72 | 1.32 | 0.72 | 1,260 | 720 | 516 | 1,884 | 720 | 372 |
| Unit cost RDT | Global Fund | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Unit cost slide | Countries | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Cost per person protected by IRS | PMI IRS Country programs: comparative cost analysis 2020, 2021 | 7.04 | 3.70 | 6.12 | n/a | n/a | n/a | n/a | n/a | n/a | 6.40 | 5.46 | n/a | 4.59 | 7.04 | 5.39 |
| Average cost of drug per Pf case | Global Fund | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Inpatients average cost of drug per case | Global Fund | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 |
| Inpatients average cost of treatment per case | WHO-CHOICE estimates of cost for inpatient and outpatient health service delivery: Results in 2008 International Dollars (PPP Int$) | 54.44 | 11.61 | 10.60 | 2.28 | 18.40 | 5.04 | 10.17 | 12.97 | 1.81 | 6.07 | 11.33 | 7.68 | 12.14 | 2.33 | 7.63 |
| Outpatients average cost of treatment per case | WHO-CHOICE estimates of cost for inpatient and outpatient health service delivery: Results in 2008 International Dollars (PPP Int$) | 10.55 | 3.44 | 3.22 | 1.05 | 4.80 | 1.88 | 3.12 | 3.73 | 0.89 | 2.15 | 3.38 | 2.55 | 3.55 | 1.07 | 2.53 |
| Cost per person enrolled in SMC | ACCESS SMC partnership 2020 | n/a | n/a | 3.05 | n/a | 3.05 | n/a | 3.05 | n/a | n/a | n/a | 3.05 | 3.05 | n/a | n/a | n/a |
| Cost per drug for SMC | Global Fund | n/a | n/a | 1.4 | n/a | 1.4 | n/a | 1.4 | n/a | n/a | n/a | 1.4 | 1.4 | n/a | n/a | n/a |
| Cost per person enrolled in IPTp | Global Fund | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |
| Cost per drug for IPTp | Global Fund | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 |
| Average cost of training per capita | Country documents and proxies | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Average cost IEC per capita | Country documents and proxies | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |

| Cost | Source | Malawi | Mali | Mozam-bique | Niger | Nigeria | Rwanda | Senegal | Sierra Leone | South Sudan | Sudan | Tanzania | Togo | Uganda | Zambia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cost per LLIN | PMI Technical guidance 2019 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 | 2.68 |
| Average cost per CHW per year | Country documents and proxies | 372 | 0.72 | 372 | 0.72 | 1.32 | 372 | 156 | 156 | 1,884 | 1,884 | 1,884 | 156 | 372 | 372 |
| Unit cost RDT | Global Fund | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Unit cost slide | Country documents and proxies | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Cost per person protected by IRS | PMI IRS country programs: comparative cost analysis 2020, 2021 | n/a | 9.03 | 5.13 | n/a | 7.04 | 5.71 | 7.55 | n/a | n/a | n/a | 4.17 | n/a | 3.45 | 2.87 |
| Average cost of drug per Pf case | Global Fund and others | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Inpatients average cost of drug per case | Global Fund and others | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 | 8.76 |
| Inpatients average cost of treatment per case | WHO-CHOICE estimates of cost for inpatient and outpatient health service delivery: Results in 2008 International Dollars (PPP Int US$) | 5.25 | 8.47 | 5.82 | 4.58 | 18.16 | 7.90 | 14.44 | 5.37 | 17.68 | 17.68 | 9.51 | 8.96 | 10.17 | 10.33 |
| Outpatients average cost of treatment per case | WHO-CHOICE estimates of cost for inpatient and outpatient health service delivery: Results in 2008 International Dollars (PPP Int$) | 1.93 | 2.74 | 2.08 | 1.75 | 4.76 | 2.60 | 4.03 | 1.97 | 4.67 | 4.67 | 2.98 | 2.85 | 3.12 | 3.16 |
| Cost per person enrolled in SMC | ACCESS SMC partnership 2020 | n/a | 3.05 | n/a | 3.05 | 3.05 | n/a | 3.05 | n/a | n/a | n/a | n/a | 3.05 | n/a | n/a |
| Cost per drug for SMC | Country documents and proxies | n/a | 1.40 | n/a | 1.40 | 1.40 | n/a | 1.40 | n/a | n/a | n/a | n/a | 1.40 | n/a | n/a |
| Cost per person enrolled in IPTp | Country documents and proxies | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |
| Cost per drug for IPTp | Country documents and proxies | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 |
| Average cost of surveillance per capita | Country documents and proxies | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Average cost of training per capita | Country documents and proxies | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Average cost IEC per capita | Country documents and proxies | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |

## ANNEXURE 3: Cost-benefit ratios by country for the incremental investment of raising LLIN and SBCC coverage by 10 percentage points from 2023–2030.

| | |
|---|---|
| Angola | 15 |
| Benin | 51 |
| Burkina Faso | 40 |
| Burundi | 18 |
| Cameroon | 25 |
| CAR | 20 |
| Chad | 82 |
| Cote d'Ivoire | 30 |
| DRC | 128 |
| Ethiopia | 10 |
| Ghana | 36 |
| Guinea | 17 |
| Kenya | 45 |
| Liberia | 24 |
| Madagascar | 11 |
| Malawi | 11 |
| Mali | 34 |
| Mozambique | 28 |
| Niger | 34 |
| Nigeria | 87 |
| Rwanda | 9 |
| Senegal | 33 |
| Sierra Leone | 16 |
| South Sudan | 19 |
| Sudan | 9 |
| Tanzania | 64 |
| Togo | 26 |
| Uganda | 35 |
| Zambia | 23 |