Global messaging briefing kit

World malaria report 2022

8 December 2022

World Health Organization

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Briefing kit | Global messaging

This year's *World malaria report* is organized around four themes: response, risks, resilience and research. As the WHO Director-General notes in the report foreword: "By strengthening the response, understanding and mitigating the risks, building resilience and accelerating research, there is every reason to dream of a malaria-free future."

1 Response

Despite COVID-related disruptions to malaria prevention, testing and treatment services, and the often-devastating impacts of the pandemic on health, social and economic systems, national malaria programmes and their partners largely held the line against further setbacks to malaria control in 2021.

2 Risks

Efforts to curb malaria continue to face a convergence of threats, particularly in the African Region, which carries the heaviest burden of the disease. Disruptions during the pandemic together with other humanitarian crises, health system challenges, restricted funding, rising biological threats and a decline in the effectiveness of core disease-cutting tools are undermining progress towards global malaria goals.

3 Resilience

Despite these challenges, national malaria programmes have demonstrated their resilience through the worst of times. Targeted new strategies, restored funding and strengthened health systems could help countries regain lost ground and build an even more resilient response to malaria.

4 Research

A promising R&D pipeline is poised to bring next-generation malaria control tools that could help accelerate progress towards global targets.

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Goals and milestones of the *Global technical strategy for malaria 2016-2030*

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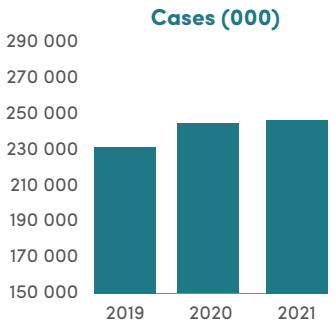
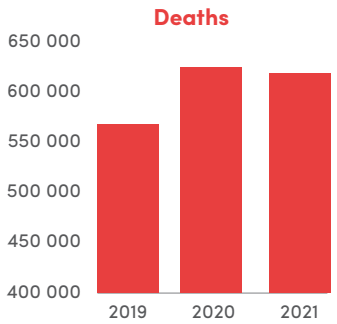
1 Response

Despite COVID-related disruptions to malaria prevention, testing and treatment services, and the often-devastating impacts of the pandemic on health, social and economic systems, national malaria programmes and their partners largely held the line against further setbacks to malaria control in 2021.

» **No further increase in malaria deaths in 2021:** in 2019, before the pandemic struck, there were an estimated 568 000 deaths worldwide. This estimate rose to 625 000 in the first year of the pandemic (2020) and then fell to 619 000 in 2021.

» **Malaria cases continued to rise between 2020 and 2021, although at a much slower rate than from 2019 to 2020:** cases stood at an estimated 247 million in 2021, compared to 245 million in 2020 and 232 million in 2019.



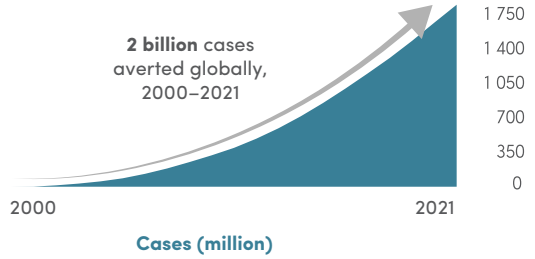


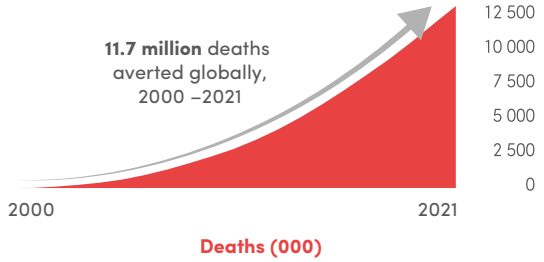
» **The African Region shoulders the heaviest malaria burden:** with an estimated 234 million cases and 593 000 deaths in 2021, the WHO African Region continues to be hardest hit by the disease (95% of cases and 96% of deaths globally).

» **Two-year impact of COVID disruptions on malaria cases and deaths:** during the two peak years of the pandemic (2020 and 2021), COVID-related disruptions led to an additional 63 000 malaria deaths and an additional 13 million cases. The impact of disruptions on the delivery of key malaria services and interventions varied for different tools and contexts.

- **Disruptions in the delivery of insecticide-treated nets (ITNs):** in 2021, global distribution of ITNs remained strong overall. However eight countries – Benin, Eritrea, Indonesia, Nigeria, Solomon Islands, Thailand, Uganda and Vanuatu – distributed less than 60% of their ITNs; while seven countries – Botswana, Central African Republic, Chad, Haiti, India, Pakistan and Sierra Leone – did not distribute any of the planned ITNs. India, Nigeria and Uganda, supported by the High Burden High Impact (HBHI) approach, distributed 0%, 53% and 26%, respectively, of the ITNs planned for distribution in 2021.
- **Disruptions in diagnosis and treatment:** globally, an estimated 435 million diagnostic tests were performed in 2021 compared to 398 million in 2020 and 450 million in 2019. WHO surveys have shown that disruptions in diagnosis and treatment in the African Region eased considerably in the latter part of 2021, with seven countries reporting disruptions, compared to 16 in the second quarter of 2020.

» **Millions of malaria cases and deaths averted:** an estimated 177 million cases and 949 000 deaths were averted in 2020, and a further 185 million cases and 997 000 deaths in 2021, compared with the estimated burden if case incidence and mortality rates had remained at the levels of 2000.





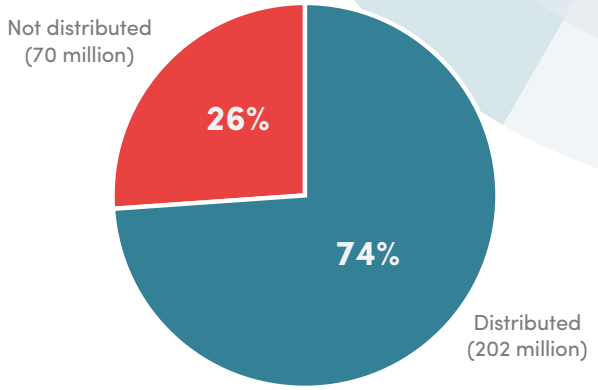
» **Strong national commitment to malaria control was key:** This commitment was reflected in the intensive efforts to deliver vital interventions for prevention, diagnosis and treatment of malaria:

- **Insecticide treated bednets (ITNs)** are the primary vector control tool used in most malaria-endemic countries. In 2020, national malaria programmes distributed more ITNs than in any year on record. All told, 74% of the 272 million ITNs planned for distribution had been distributed by the end of 2020. In 2021, ITN distributions maintained similar levels to the pre-pandemic year of 2019; of the 171 million ITNs planned for distribution, 128 million (75%) were distributed.

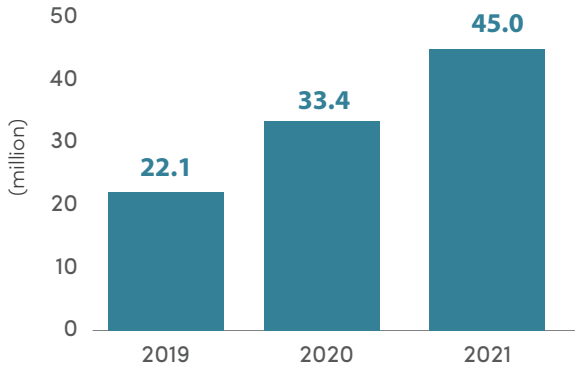
- **Seasonal malaria chemoprevention (SMC)** is recommended for children living in areas with highly seasonal malaria transmission in Africa. In 2021, nearly 45 million children were treated, on average, per SMC cycle in 15 African countries, up from 33.4 million in 2020 and 22.1 million in 2019. About 92% of the increased SMC distributions in 2021 were in Nigeria. Uganda and Mozambique delivered SMC for the first time in 2021.

- **The RTS,S/AS01 malaria vaccine** was recommended by WHO in 2021 to prevent malaria in children living in regions with moderate-to-high *P. falciparum* malaria transmission. In 2021, approximately 364 000 children were reached with at least 1 dose of the vaccine through pilot introductions in Ghana, Kenya and Malawi, compared to 344 000 in 2020 and 189 000 in 2019. Results from the pilots have affirmed that the malaria vaccine is safe and reduces childhood malaria, hospitalizations and deaths. At least 27 countries in Africa have expressed interest in adopting the malaria vaccine as part of their national malaria control strategies; additional countries will begin introducing the vaccine in 2023.

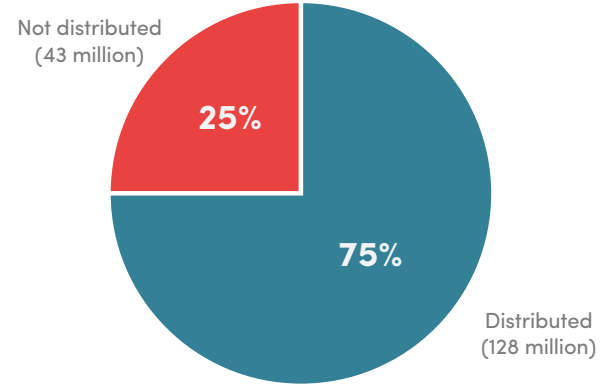
Distribution of ITNs worldwide in 2020



Average number of children treated with SMC, per cycle, by year, in 15 African countries, 2019–2021



Distribution of ITNs worldwide in 2021

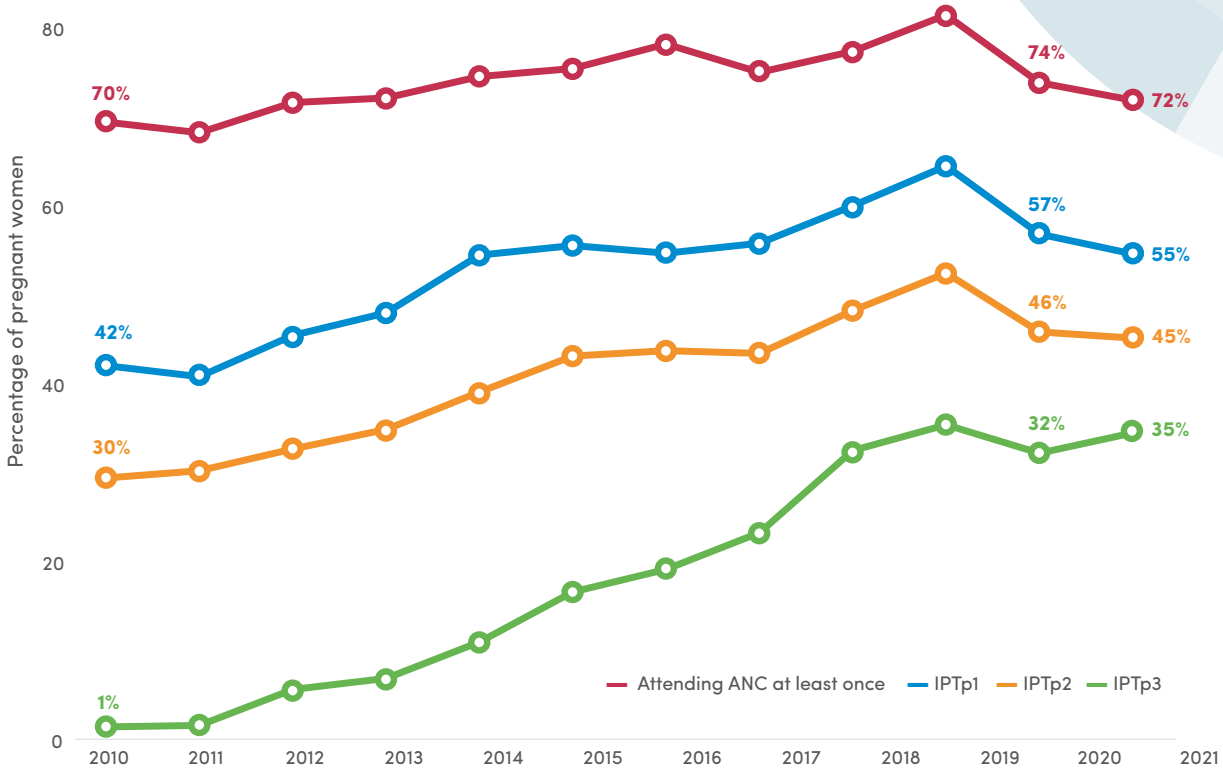


- **Intermittent preventive treatment of malaria in pregnancy (IPTp)**: to prevent malaria among pregnant women living in areas of moderate-to-high malaria transmission in Africa, WHO recommends three or more doses of IPTp with the quality-assured medicine sulfadoxine-pyrimethamine. To date, 35 African countries have adopted IPTp nationally to reduce the burden of malaria in pregnancy. Overall, IPTp coverage remained stable during the pandemic: in 2021, the percentage of pregnant women receiving a full three-dose regimen of IPTp was 35% compared to 32% in 2020 and 35% in 2019.

- **Rapid diagnostic tests (RDTs)** enable health providers to swiftly distinguish between malarial and non-malarial fevers, facilitating appropriate treatment. Despite supply chain and logistical challenges during the pandemic, malaria-endemic countries distributed a record number of RDTs to health facilities in 2020 (262 million). In 2021, countries distributed 223 million RDTs, a similar level reported before the pandemic.

- **Artemisinin-based combination therapies (ACTs)**, which combine artemisinin with a partner drug, are the most effective treatment for *P. falciparum* malaria. During the pandemic, malaria-endemic countries held the line in delivering ACTs for people in need: an estimated 242 million ACTs were distributed worldwide in 2021 (97% in sub-Saharan Africa) compared to 239 million ACTs in 2019.

Percentage of pregnant women attending an antenatal care clinic at least once and receiving IPTp, by number of sulfadoxine-pyrimethamine doses, sub-Saharan Africa, 2010–2021

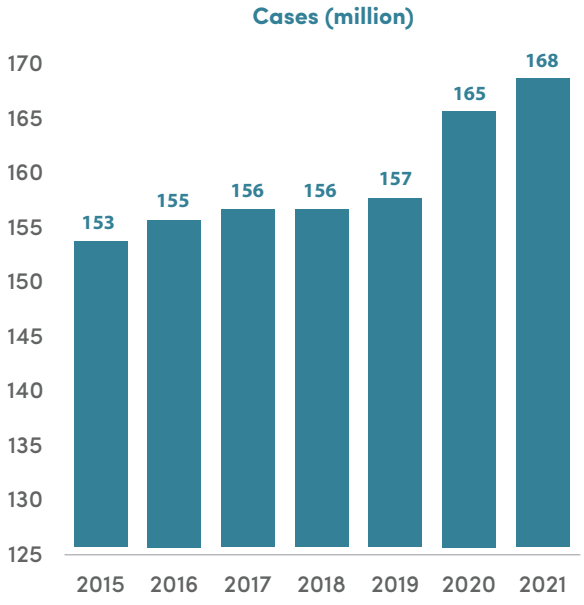


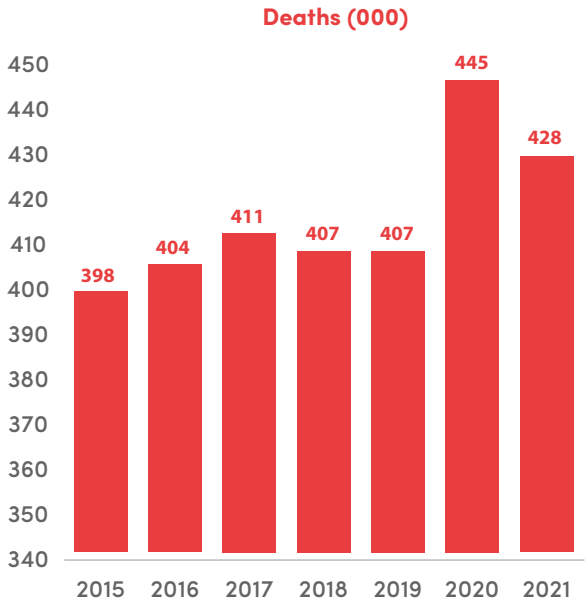
» **Gaps in access to equitable and quality treatment and care remain an important challenge in the malaria response.**

- Household surveys conducted in 20 countries in sub-Saharan Africa between 2005 and 2021 were used to analyse the coverage of treatment seeking, diagnosis and use of ACTs for children under the age of 5. The survey found that:
  - Treatment seeking for febrile children changed very little between the baseline surveys in 2005–2011 and more recent survey from 2015–2021 (65% vs. 67%). Approximately one third of febrile children in sub-Saharan Africa do not seek any treatment for their illnesses.
  - For those for whom care was sought, the proportion of children under 5 who received a diagnosis with a finger or heel prick increased from about 30% at baseline to 57% in the latest surveys.
  - For those for whom care was sought, the use of ACTs increased from a median of 39% at baseline to 55% in the latest surveys.

- **Countries with a high burden of malaria** largely held the line against malaria during the pandemic: in the 11 "High Burden to High Impact" (HBHI) countries – Burkina Faso, Cameroon, the Democratic Republic of the Congo, Ghana, India, Mali, Mozambique, Niger, Nigeria, Uganda and the United Republic of Tanzania – malaria deaths fell from about 445 000 in 2020 to 428 000 in 2021, and there was an increase in cases in this same timeframe from 165 million to 168 million; some, though not all, of these case increases can be attributed to disruptions during the COVID-19 pandemic.
- Five of the 11 HBHI countries showed a decline in deaths in 2021 compared to 2020: the Democratic Republic of the Congo, Ghana, India, Niger and the United Republic of Tanzania. However, their contribution to the malaria burden is still substantial.

Trends in malaria cases and deaths in 11 high burden countries, 2015-2021





» **Many countries with a low burden of disease maintained effective malaria responses during the pandemic and continued their drive towards elimination**

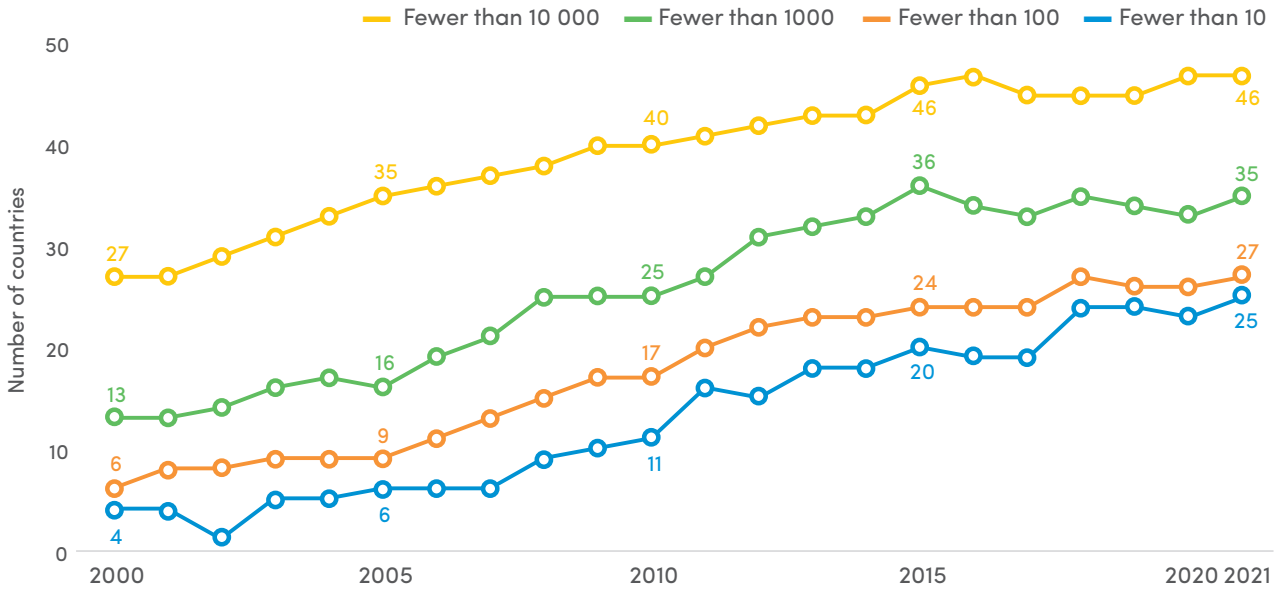
- The number of malaria-endemic countries with fewer than 1000 indigenous malaria cases increased from 33 in 2020 to 35 in 2021. During the same period, the number of countries that reported fewer than 10 indigenous cases increased from 26 to 27, while countries that reported fewer than 10 indigenous cases increased from 23 in 2020 to 25 in 2021.

- **E-2025 initiative:** WHO launched the E-2025 initiative in 2021 to support 25 countries and one territory identified as having the capacity to eliminate malaria by 2025. Although pandemic challenges underlay a 30% increase in cases in E-2025 countries in 2021 compared to 2020, 61.5% of reporting countries continued their progress towards elimination. Between 2020 and 2021: Belize, Cabo Verde, the Islamic Republic of Iran and Malaysia maintained zero indigenous cases of the four main human malaria parasites. In this same timeframe:

  - **case reductions were observed in:** Bhutan (59.1%), Botswana (20.5%), the Dominican Republic (65.6%), Mexico (32%), Nepal (56.2%), the Republic of Korea (23%), Saudi Arabia (100%), South Africa (33.7%), Suriname (85.9%), Thailand (22.3%), Timor-Leste (100%) and Vanuatu (36.7%).

  - **case increases were observed in:** the Comoros (56.9%), Costa Rica (52.4%), the Democratic People's Republic of Korea (22.8%), Ecuador (11.1%), Eswatini (53.9%), French Guyana (2.1%), Guatemala (16.9%), Honduras (47.4%), Panama (55.3%) and Sao Tome and Principe (28.9%).

Number of countries that were malaria endemic in 2000 and had fewer than 10, 100, 1000 and 10 000 indigenous

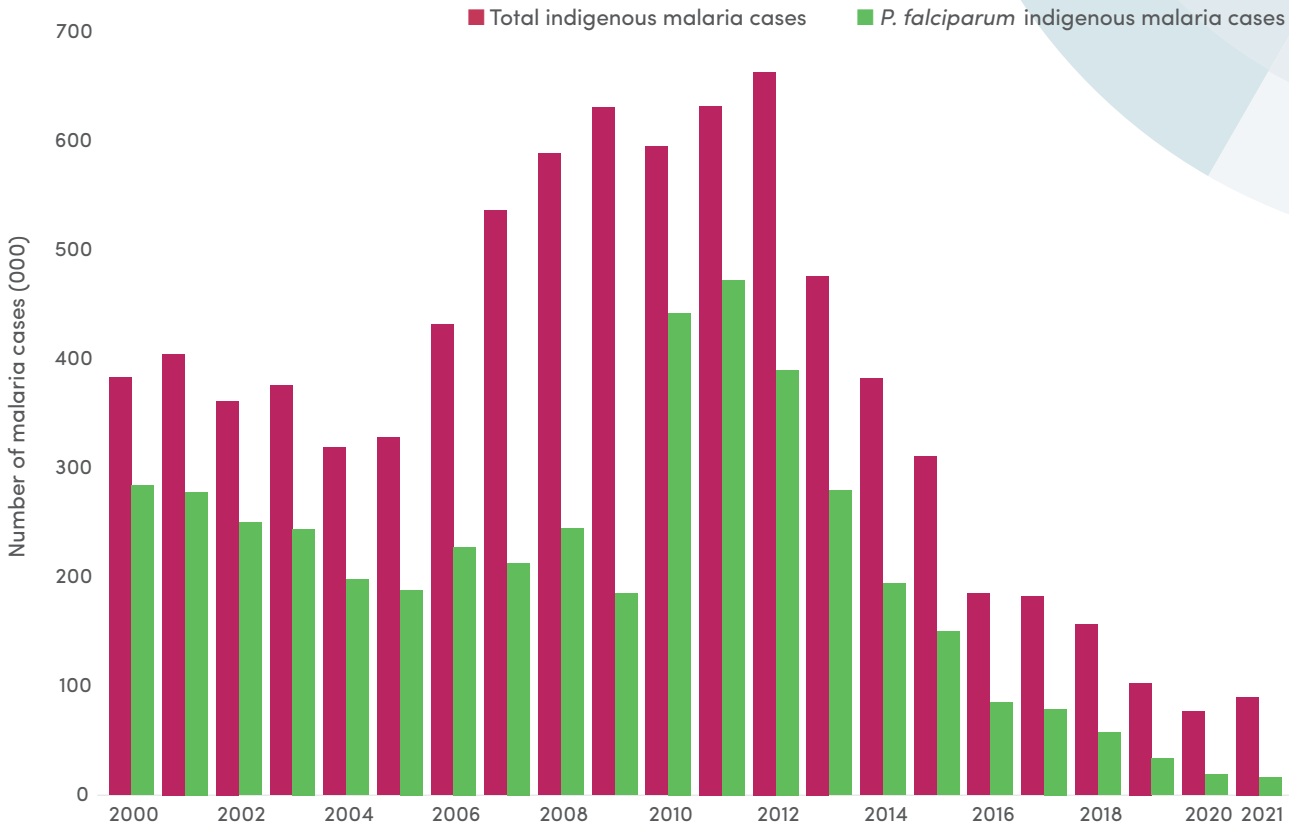


[a] *Plasmodium knowlesi* and introduced cases are not included.

» **Countries in the Greater Mekong subregion (GMS) continued to successfully battle antimalarial drug resistance through lowering the case burden of *P. falciparum***. Across the region, *P. falciparum* malaria parasites have developed partial resistance to artemisinin, the most effective medicine to treat malaria. In some areas, parasites have also developed resistance to the drugs that are commonly combined with artemisinin. Importantly, such resistance has not spread beyond the GMS, although it has emerged independently in parts of Africa.

- **Long-term trend in the GMS:** Between 2000 and 2021, the six GMS countries (Cambodia, China, the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam) reported a 76.5% decrease in all indigenous malaria cases and a 94.1% decline in indigenous *P. falciparum* malaria cases.
- **Pandemic peak years:** Between 2020 and 2021, although there was a 17.3% increase in indigenous malaria cases overall (90 082 cases), nearly all of this increase was in cases of *P. vivax* malaria. In this same period, cases of *P. falciparum* malaria declined by 12.2% (16 484 cases).
- **Hot spot in Myanmar:** In 2021, Myanmar continued to account for most of the indigenous malaria cases (87.7%) and indigenous *P. falciparum* malaria cases (80.9%) in the subregion. These developments are mainly due to disruptions in the malaria response caused by political instability.
- ***P. vivax* rising:** Across the subregion, as *P. falciparum* has declined, *P. vivax* has emerged as the dominant species.

Total indigenous malaria and *Plasmodium falciparum* indigenous cases in the GMS, 2000–2021



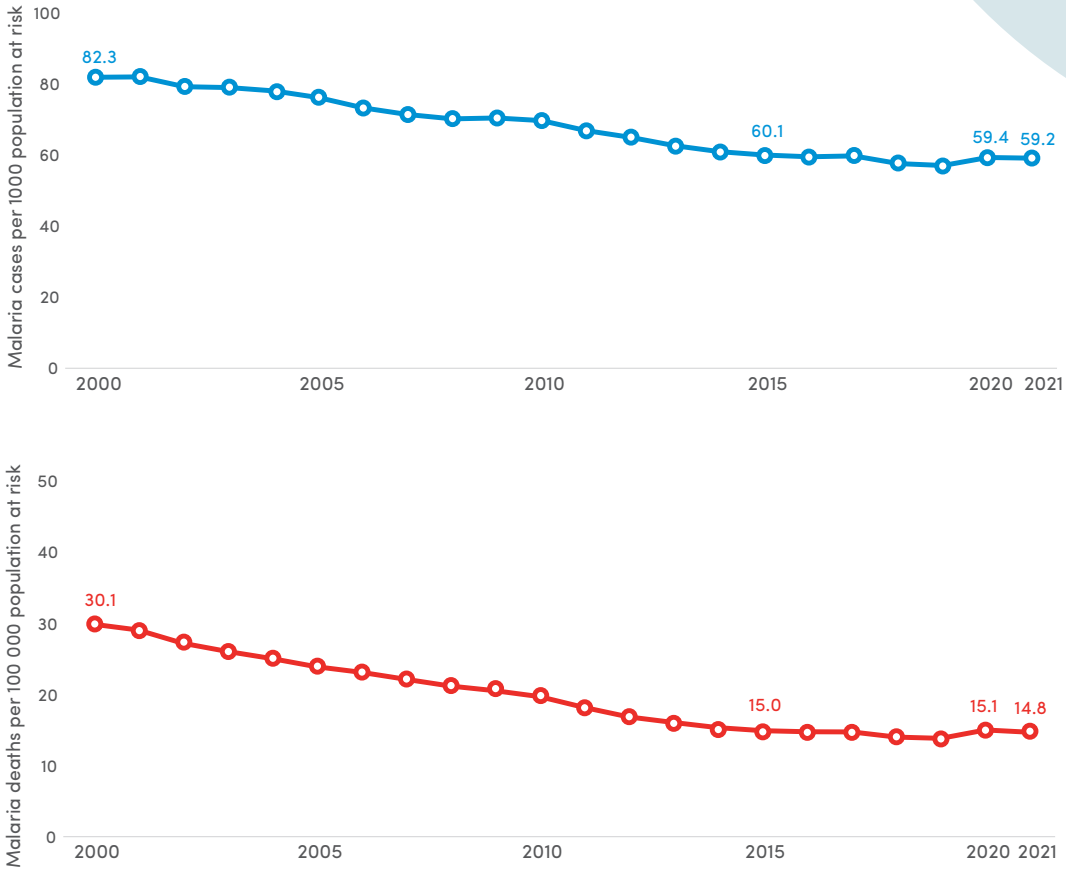
2 Risks

Efforts to curb malaria continue to face a convergence of threats, particularly in the African Region, which carries the heaviest burden of the disease. Disruptions during the pandemic together with other humanitarian crises, health system challenges, restricted funding, rising biological threats and a decline in the effectiveness of core disease-cutting tools are undermining progress towards global malaria goals.

» **Between 2000 and 2015, a substantial expansion of malaria interventions contributed to a 27% reduction in global malaria case incidence and a 50% decline in malaria mortality rates, averting millions of deaths.** But by 2017, the case incidence rate was again rising, and the decline in malaria deaths had stalled.

» **By 2020, key milestones for reducing malaria cases and deaths had not been achieved.** The *Global technical strategy for malaria 2016–2030* (GTS) calls for a reduction in malaria case incidence and mortality rates of at least 40% by 2020, at least 75% by 2025 and at least 90% by 2030.

Global trends in malaria case incidence (cases per 1000 population at risk) and mortality rate (deaths per 100 000 population at risk), 2000–2021

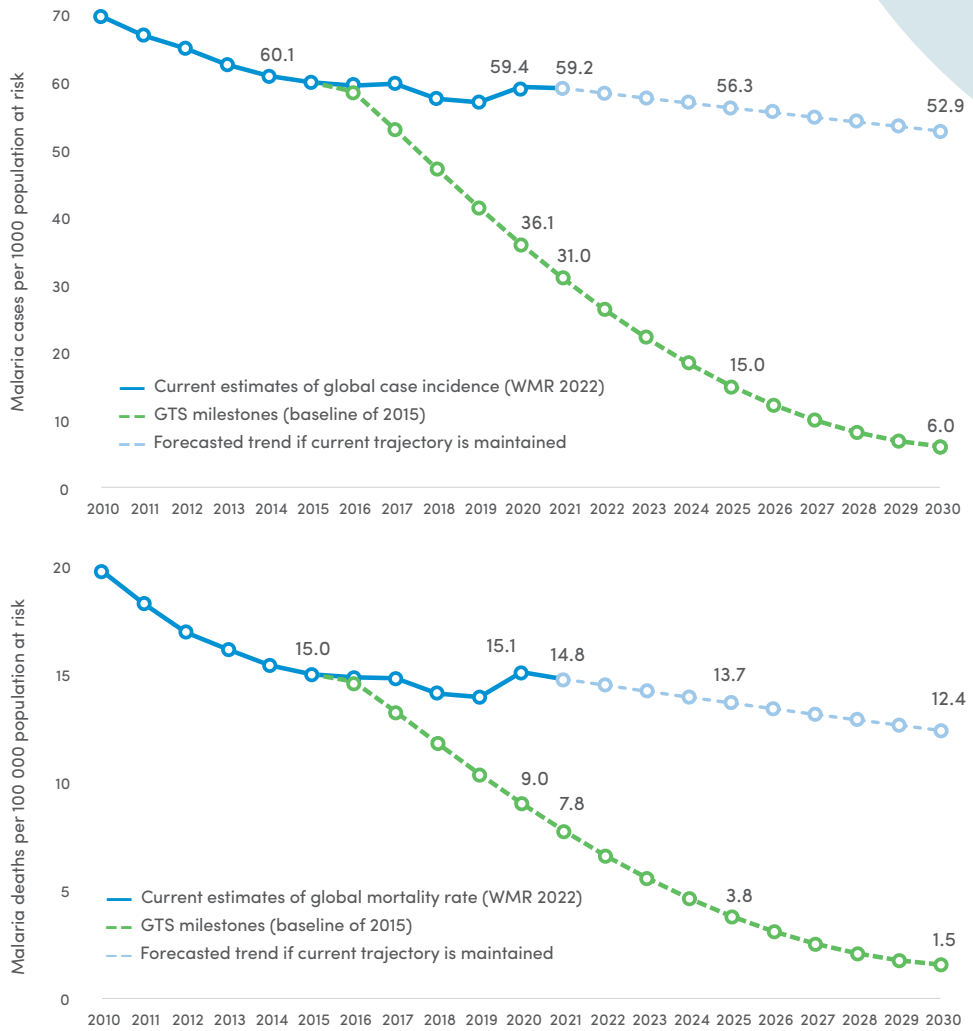


- **Status in 2021:** Global malaria case incidence was 59 cases per 1000 population at risk, against a target of 31 cases per 1000 – off track by 48% (i.e. the GTS target is 48% lower than the current case incidence). Also in 2021, malaria deaths per 100 000 population at risk stood at 14.8 against a target of 7.8 – off track by 48%. In 2021, the WHO African Region was off track for both the morbidity and mortality GTS milestones, by 45% and 47%, respectively.

» **Socio-economic impacts of the COVID-19 pandemic and converging crises have limited countries' fiscal space to address multiple pressing concerns.** The pandemic, climate-related events, a rise in infectious diseases, and conflict led the global economy to contract by 3.4% in 2020. In 2020, 70% of low- and middle-income, malaria-endemic countries experienced a shock in their annual real Gross Domestic Product (GDP). The GDP of 34 of these countries, half in Africa, shrank by more than 1%. However, in 2021, there were signs of recovery of GDP growth in most malaria-endemic low- and middle-income countries, except in Chad, Bhutan, Haiti, Myanmar, Solomon Islands and Yemen.

» **In 2019, 2020 and 2021, humanitarian crises due to conflicts, famine, flooding and other health emergencies in 37 malaria-endemic countries affected an estimated 148 million, 301 million and 268 million people, respectively.** In each of these countries, malaria increases occurred above what could be attributed to the COVID-19 pandemic alone.

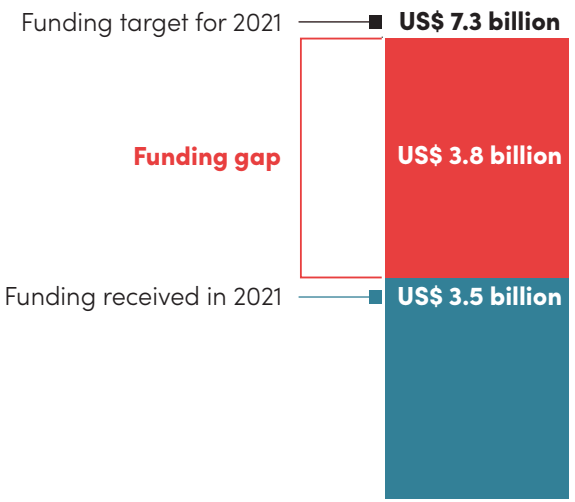
Comparison of global progress in malaria case incidence and mortality rate, considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)



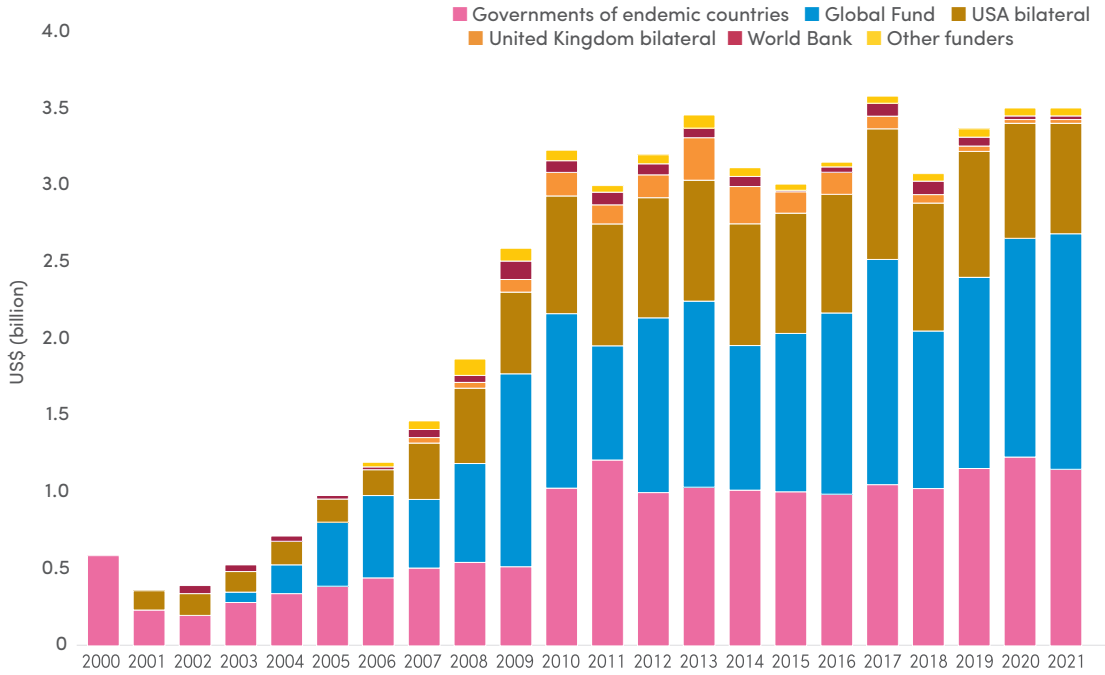
» **Funding reductions coupled with rising costs are increasing pressure on national malaria programmes.** Total funding in 2021 was estimated at US$ 3.5 billion, an increase from US$ 3.3 billion in 2020 and US$ 3.0 billion in 2019. However, investments in 2021 were well below the estimated US$ 7.3 billion that was required globally to stay on track for the GTS milestones. The funding gap between the amount invested and the resources needed has continued to widen, particularly over the past 3 years, increasing from a gap of US$ 2.6 billion in 2019 to US$ 3.5 billion in 2020 and US$ 3.8 billion in 2021.

- Since the COVID-19 pandemic and the war in Ukraine, national malaria programmes are being hit by rising costs associated with fuel, local distribution, and supply chain logistics. In addition, the cost of commodities used for malaria control are anticipated to increase.
- Despite the historic contributions by countries and partners, the Seventh Global Fund replenishment raised US$ 15.7 billion against an expected target of at least US$ 18 billion. With the changing economic environment, the funding space for the malaria response has become increasingly challenging.
- While more efficient procurement processes and market priming will help keep global commodity prices within an affordable range, better targeting of resources and greater implementation efficiencies in countries will also be needed.

Funding gap in 2021



Funding for malaria control and elimination, 2000–2021, by channel (constant 2021 US$)



» **A decline in the effectiveness of core malaria control tools, most crucially ITNs, threatens progress against malaria.** Not only are pyrethroid-only ITNs becoming less effective in controlling the disease, but other risks are also rising from the weakened sensitivity of diagnostic tests due to parasite mutations; parasite resistance to antimalarial drugs; and an urban-adapted invasive mosquito in Africa.

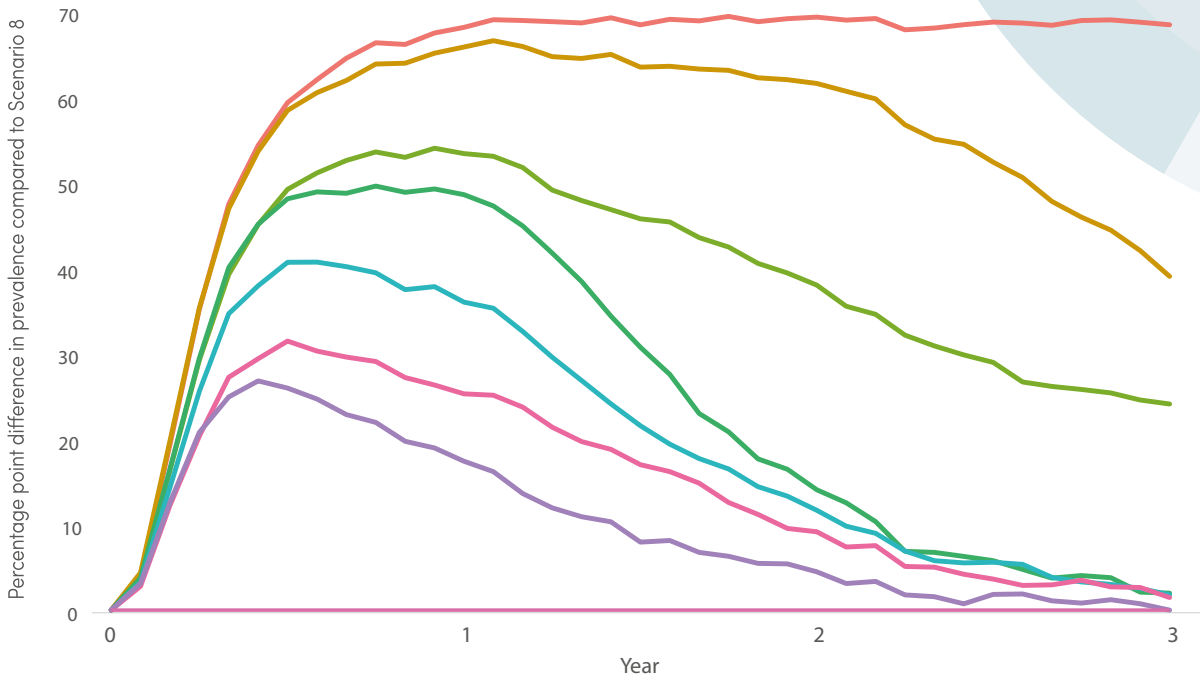
- **Declining effectiveness of ITNs:** Since 2005, over 2 billion ITNs have been distributed for malaria prevention globally. Most of these nets were treated with insecticides from one class: the pyrethroids. In 2015, a modelling analysis published in *Nature* suggested that ITNs drove most of the declines in malaria seen from 2005–2015, especially in moderate-to-high transmission areas. However, progress since 2015 has slowed. This year's *World malaria report* describes threats to this key prevention tool, including:
  - **Insecticide resistance:** The emergence and wide geographic spread of pyrethroid resistance among malaria-transmitting mosquitos is the most recognized threat to the effectiveness of long-lasting pyrethroid-only ITNs. Of 38 countries that have reported data on the intensity of pyrethroid resistance, high-intensity resistance was detected in 27 countries at 293 sites, moderate-to-high intensity resistance in 34 countries at 406 sites, and moderate-intensity resistance in 21 countries at 78 sites. High-intensity resistance to pyrethroids has been detected most frequently in western Africa.
  - **Physical durability of the nets:** ITNs would ideally last for at least three years and withstand 20 washes. However, net fabric and construction, as well as how nets are handled in households, affect their physical durability and effectiveness.
  - **Chemical durability** refers to the availability of the active insecticide on the surface of the net over time. In addition to insecticide resistance, evidence shows that the insecticidal retention of nets also wanes over time.
  - **Allocation and household coverage:** There is often a gap between the number of people within a household who need ITNs and their availability. The most efficient way to increase equitable access to ITNs is to better define populations that will benefit most, identify coverage gaps at the local level and expand distribution to these areas. Better microplanning approaches with strong community involvement is essential.
  - **Household retention of ITNs:** There is growing evidence that nets are discarded on average much sooner than they can be replaced by mass distribution campaigns. Nets that have developed holes are most likely to be discarded. They may also be given to relatives who may not have been reached by campaigns or other distribution channels. In most countries, households hold on to their nets for an average of 1 to 2.7 years, with a median retention time of about 1.9 years, leaving significant gaps in protection between campaigns. However, this varies between and within countries, with nets retained for as long as 6 years in some settings.
  - **Changing behaviour of mosquitoes:** Mosquitoes are adapting their behaviour to avoid ITNs, with changes to when and where they bite, feed and rest. Evidence points to mosquitoes biting early, before people go to bed, and spending more time resting outdoors or feeding on livestock rather than humans.

- Insecticide resistance and challenges associated with net allocation, retention and use collectively reduce the impact of ITNs in real-life settings. In this year's *World malaria report* the results of a modelling analysis are presented to describe the interaction of these factors and their impact on overall pyrethroid-only ITN effectiveness. The analysis considered the impact that each of these constraints could have on the potential effectiveness of ITNs over a period of 3 years after net distribution in a simulated high transmission setting across several scenarios.

- For example, Scenario 7 offers the most realistic picture of the current effectiveness of ITNs. It considers the estimated impact of insecticide resistance, the waning insecticidal effect and physical durability of nets over time, a median net retention time of 1.9 years, and net use above 80%. Under this scenario, the starting effectiveness of the ITN is relatively low and wanes quickly until it is near zero by end of the third year.

- This analysis is illustrative and demonstrates that, in relative terms, ITNs suffer an important decline in effectiveness that impairs their impact in preventing malaria. It should be interpreted with the understanding that the results carry important uncertainties and represent a simulated scenario. The actual effectiveness of ITNs will vary between and within countries, and WHO recommends their continued use across malaria-endemic settings.

Sequential decomposition of LLIN effectiveness over 3 years (modelling pyrethroid-only ITNs)



Scenario 1: "Ideal" nets, perfect campaigns, perfect net use rate, nets retained forever
Scenario 2: "Ideal" nets except that insecticide wanes; perfect campaigns, net use rate, and net retention
Scenario 3: "Ideal" nets except that insecticide wanes and vectors are not fully susceptible; perfect campaigns, net use rate, and net retention
Scenario 4: "Realistic" nets: net durability wanes, insecticide wanes, and vectors are not fully susceptible; perfect campaigns, net use rate, and net retention
Scenario 5: "Realistic" nets, realistic campaigns (87% coverage), perfect net use rate and net retention
Scenario 6: "Realistic" nets, realistic campaigns, realistic net use rate (83%), perfect net retention
Scenario 7: "Realistic" nets, realistic campaigns, realistic net use rate, realistic net retention (50% of nets discarded after 1.9 years)
Scenario 8: No LLINs in use in the population

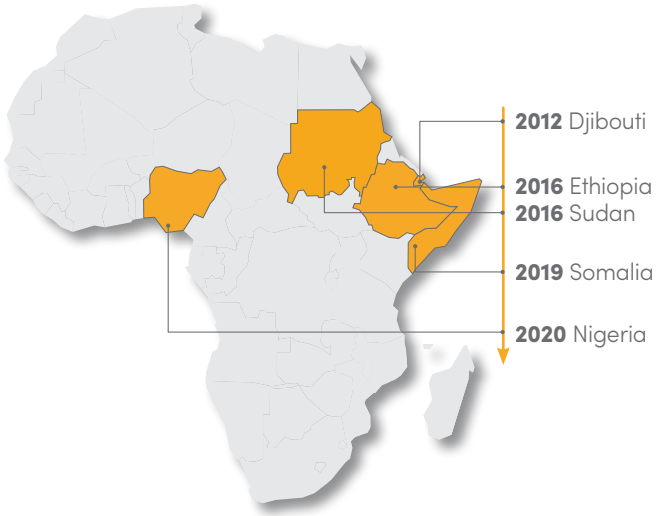
- **Challenges to effectiveness of indoor residual spraying (IRS):** IRS is the second most widely implemented vector control intervention by national malaria programmes. When carried out diligently and at high coverage, it has been shown to be a powerful way to reduce malaria transmission.
  - Many factors influence the effectiveness of IRS such as insecticide resistance and the timing of insecticide spraying as well as the level of training of spray operators, which can impact the quality of spraying.
  - At a large scale, the costs of delivering IRS are high. Over recent years, these costs have increased as the emergence of pyrethroid resistance has required a switch to more expensive insecticides.
  - The logistics of running multiple IRS campaigns are the biggest driver of costs associated with this intervention. The best way to reduce these costs is to have longer-lasting insecticides that will, in turn, require fewer campaigns.

- **Decreased sensitivity of rapid diagnostic tests (RDTs):** an increasing proportion of *P. falciparum* parasites no longer express the protein most widely used to detect malaria through RDTs. This protein is known as histidine-rich protein 2 (HRP2). Parasites that no longer produce HRP2 or the related HRP3 protein can escape detection by RDTs, presenting a major threat to early diagnosis and treatment. In 2021, nearly 80% of RDTs in use were based on HRP2 detection.
  - **Parasite mutations:** deletions in the genes for HRP2/3 proteins were first reported in 2010 in the Peruvian Amazon basin, and have since been documented in Asia, the Middle East, and Central, East, Southern and West Africa. Prevalence has reached 80% among symptomatic patients in Djibouti, Eritrea and Peru, demonstrating that these parasites can become dominant in a population, and increasing the risk that missed cases will progress to severe disease and death.

- **Rising resistance to artemisinin-based combination therapy (ACT) drug regimens used to treat malaria:** on a global scale, partial resistance to artemisinin, the core compound of ACTs, has been confirmed in the Greater Mekong subregion and in three countries in Africa – Eritrea, Rwanda and Uganda. While such resistance alone rarely leads to treatment failure, resistance to both artemisinin and the partner drug within ACT drug regimens can lead to high rates of treatment failure, as seen in recent years in parts of the Greater Mekong subregion. This has prompted changes in first-line treatment of *P. falciparum* malaria in many countries of the Greater Mekong subregion.
  - In Africa, resistance to ACT partner drugs has not been confirmed, and the treatment remains highly efficacious. However, data are lacking for several countries, and contradictory findings on ACT efficacy need to be further assessed. Given the heavy reliance on ACTs in Africa, widespread treatment failure, particularly of artemether-lumefantrine, the first-line treatment in most countries, could have very serious consequences.

- **Spread of an urban-adapted mosquito species in Africa:** *Anopheles stephensi* can transmit both *P. falciparum* and *P. vivax* parasites and is posing an added challenge to disease control efforts in Africa. It can thrive in urban environments and is resistant to many of the insecticides used in public health.
  - Originally native to parts of South Asia and the Arabian Peninsula, *An. stephensi* has now been reported in Djibouti (2012), Ethiopia and Sudan (2016), Somalia (2019) and Nigeria (2020). It is seen as a particular threat in Africa, which is rapidly urbanizing and where 40% of the population already lives in urban areas.

Spread of *Anopheles stephensi* in Africa



3 Resilience

Despite these challenges, national malaria programmes have demonstrated their resilience through the worst of times. Targeted new strategies, restored funding and strengthened health systems could help countries regain lost ground and build an even more resilient response to malaria.

» **Through their actions during the COVID-19 pandemic, malaria-endemic countries and global partners provided valuable examples of resilience in health systems, effectively managing unforeseen events during a crisis while also maintaining essential health services.**

- WHO and partners collaborated at the start of the pandemic to coordinate a malaria and COVID-19 response and provide guidance to countries. Additional funding followed, leading to the provision of US$ 3.7 billion emergency contribution by the United States Government to the Global Fund and the launch of the COVID-19 Response Mechanism (C19RM).

- C19RM supported COVID-19 related adaptation of programmes to fight HIV, TB and malaria. Delivery of COVID-19 supplies such as masks and gloves also became an opportunity to deliver malaria medicines and ITNs, in some cases with masked health workers delivering supplies door-to-door. C19RM funds used to make urgent improvements in health and community systems helped fight HIV, TB and malaria as well, including by reinforcing supply chains, laboratory networks and community lead responses.

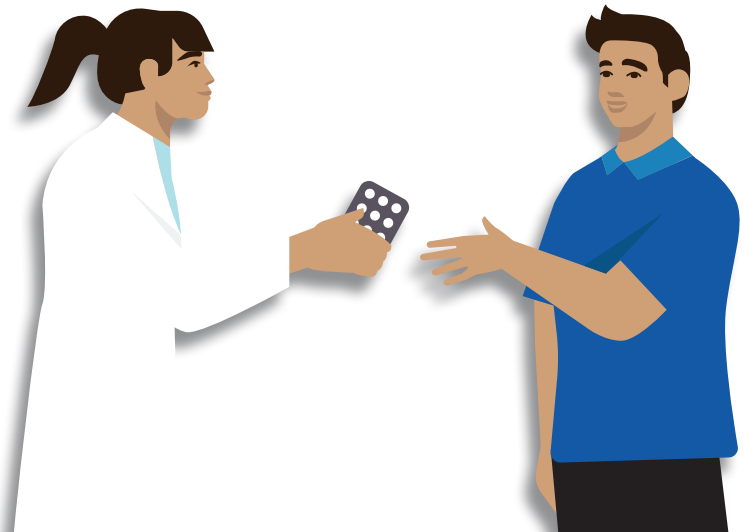
- The US President's Malaria Initiative, which invests over US$ 700 million annually in malaria control, has worked with countries to ensure funding and flexibility to minimize disruptions to essential malaria services.

» **Resilience also means the ability to withstand and advance in the face of more predictable and chronic threats to malaria responses, including climate change. This requires a multidisciplinary and multisectoral response with trusted national leadership and well-functioning, equitable and strong health systems.**

- The World Bank recently established a Financial Intermediary Fund (FIF), with technical leadership by WHO. The fund aims to support low- and middle-income countries in pandemic prevention, preparedness and response. Building stronger and more resilient health systems is an important part of the FIF's work programme and, to this end, major killer diseases such as malaria are likely to benefit from their support.

- To support a unified approach to recovery and to build resilience, WHO outlined seven policy recommendations in position paper. These included, for example, building a strong primary health care foundation and creating an enabling environment for research and innovation.

- The increasing frequency of natural and human-made disasters coupled with the threat of climate change and future disease pandemics will demand a more predictable and systematic approach to building resilience – particularly at a time when global financial resources for health and malaria are constrained.



- Climate change will affect the geographical range, intensity and seasonality of vector borne diseases such as malaria, in ways that cannot be precisely predicted, highlighting the need for evidence-based and flexible responses.

- Even more broadly, however, climate change is impacting human health, particularly in poor, rural communities where the loss of agricultural livelihoods is exacerbating food and nutritional insecurity. In malaria-endemic countries, rural poverty and malnutrition go hand-in-hand, rendering children, in particular, more vulnerable to the devastating consequences of malaria.

- WHO's *Operational framework for building climate resilient health systems* provides guidance to support countries on health adaptation to climate.

» **WHO has recently launched a number of strategies to help countries build a more resilient response to malaria**

- **Tackling antimalarial drug resistance in Africa:** In November 2022, WHO launched a new strategy to curb antimalarial drug resistance in the African continent.
  - The strategy builds on lessons learned from past global plans and complements existing strategies, including broader efforts to respond to antimicrobial resistance.
  - It aims to tackle drug resistance through four pillars: (1) strengthen surveillance of antimalarial drug efficacy and resistance; (2) optimize and better regulate the use of diagnostics and therapeutics; (3) limit the spread of antimalarial drug-resistant parasites; and (4) stimulate research and innovation to better leverage existing tools and to develop new tools against antimalarial drug resistance.
  - The strategy's 20 recommended interventions include, for example, generating standardized data on drug efficacy, promoting equitable access to quality diagnostics and drugs, ensuring optimal vector control coverage in priority areas, and developing innovative tools to limit malaria infection and transmission. Interventions should be tailored to the local context, with the support of global and regional stakeholders.

- **Stopping the spread of *Anopheles stephensi* in Africa:** In September 2022, WHO launched a new initiative to stop the spread of the *An. stephensi* malaria vector – an invasive, urban-adapted mosquito in Africa.
  - The initiative aims to support an effective regional response on the African continent through a five-pronged approach: increase collaboration across sectors and borders; strengthen surveillance to determine the extent of the spread of *An. stephensi* and its role in transmission; improve information exchange on the presence of *An. stephensi* and on efforts

to control it; develop guidance for national malaria programmes on appropriate ways to respond to *An. stephensi*; and prioritize research to evaluate the impact of interventions and tools against *An. stephensi*.

- Where feasible, national responses to *An. stephensi* should be integrated with efforts to control malaria and other vector-borne diseases, such as dengue fever, yellow fever and chikungunya. The WHO *Global vector control response 2017–2030* provides a framework for investigating and implementing such integration.

- **Responding to malaria in urban areas:** In October 2022 WHO and UN-Habitat launched the *Global framework for the response to malaria in urban areas*. The framework provides guidance for city leaders, health programmers and urban planners as they work to control and eliminate malaria in a rapidly urbanizing world.
  - By 2050, nearly 70% of people globally will live in cities. While well-planned urbanization is expected to reduce malaria transmission overall, unplanned urbanization will likely result in a malaria disease burden that is disproportionately high among the urban poor.
  - Effective approaches for reducing malaria in rural areas may not work in urban settings, or may need to be implemented at a smaller, more targeted scale.
  - For each urban context, the strategic use of data can inform effective, tailored responses and help build resilience against the threat of malaria and other vector-borne diseases.
  - The invasion of mosquito species that adapt easily to urban environments, such as *Anopheles stephensi*, may heighten the risk of malaria and other vector-borne diseases in urban areas.

- **Using data to drive impact:** In recent years, WHO has worked with partners around the world to strengthen malaria surveillance systems. To date, over 40 countries have been supported to establish electronic malaria surveillance solutions using District Health Information System 2 (DHIS2), the most widely used Health Information Management System (HMIS) globally.
  - Under the HBHI approach, WHO, the RBM Partnership to End Malaria, global donors and partners have supported countries with data-driven and locally tailored approaches to develop national strategic plans and to identify an optimal mix of interventions at the local level.
  - However, more investment is needed to strengthen surveillance systems, not only in digital solutions and analytics, but also in greater health workforce capacity and synergies across disease and health programmes.
  - WHO has launched a malaria surveillance assessment toolkit to help countries assess their systems and identify areas for investment.

» **To support malaria-endemic countries, WHO has also increased the transparency, flexibility and access to its malaria recommendations. In recent years, WHO malaria guidance has been made available through two new digital platforms.**

- The consolidated *WHO guidelines for malaria* are now accessible through the MAGICapp platform in English, French, Arabic and Spanish. All of WHO's most up-to-date recommendations can also be found in the Malaria Toolkit app.
- In June 2022, WHO published a package of new and updated recommendations across a number of technical areas, including intermittent preventive treatment of malaria in pregnancy (IPTp), perennial malaria chemoprevention (PMC), seasonal malaria chemoprevention (SMC), intermittent preventive treatment of malaria in school-aged children (IPTsc), post-discharge malaria chemoprevention (PDMC), mass drug administration (MDA) and elimination.
- In November 2022, WHO released several recommendations related to the treatment of malaria cases, including on the use of an additional ACT, artesunate-pyronaridine, and on the use of artemether-lumefantrine to treat pregnant women with uncomplicated *P. falciparum* malaria.
- In March 2022, WHO incorporated the RTS,S malaria vaccine into the *WHO guidelines for malaria* for prevention of malaria illness and death in children living in areas of moderate-to-high transmission.
- WHO is encouraging countries to tailor the recommendations to local disease settings, using local data, for maximum impact.

MAGICapp

Malaria Toolkit app

4 Research

A promising R&D pipeline is poised to bring next-generation malaria control tools that could help accelerate progress towards global targets.

» **Despite recent setbacks, investment in R&D has played a crucial role in successes against malaria since 2000. The development and massive roll-out of RDTs, ACTs and ITNs have been the backbone of the malaria response over the past 20 years.**

» **Looking ahead, new types of vector control technologies, diagnostics, malaria medicines and vaccines hold promise.** Future R&D will benefit from new WHO guidance on target product profiles (TPPs) and preferred product characteristics (PPCs). Product development partners such as the Foundation for Innovative New Diagnostics (FIND), Unitaid, Medicines for Malaria Venture (MMV) and the Innovative Vector Control Consortium (IVCC) have also played a critical role in catalysing malaria R&D and bringing various products to markets.

» **Key opportunities:**

Long-lasting bednets with new insecticide combinations that overcome the limitations of pyrethroid-only nets

- **Scaling up of pyrethroid-PBO nets:** Recent studies in areas with high pyrethroid resistance have shown that ITNs treated with both pyrethroid and piperonyl butoxide (PBO) are more effective than pyrethroid-only nets in lowering parasite prevalence. PBO disrupts the function of the enzyme in the mosquito that makes it resistant to pyrethroids. Based on such findings, use of PBO nets is already increasing: in 2021, 44% of the 220 million ITNs delivered were PBO nets (more than double the deliveries in 2020), with plans for further scale-up.

- **Promising results from ITN trials:** A recent large trial in the United Republic of Tanzania tested nets treated with both a pyrethroid and chlorfenapyr, a repurposed insecticide with a different mode of action. The new ITNs showed a marked improvement in preventing malaria over pyrethroid-only nets. This evidence was recently presented to WHO; a formal assessment and the development of a recommendation is ongoing.

» **Other innovations in vector control:** In addition to new ITNs, researchers are pursuing a range of new vector control products; there are 28 vector control products in the R&D pipeline. These include, for example, targeted baits that attract mosquitoes, spatial repellents, lethal house lures (eaves tubes) and genetic engineering of mosquitoes.

» **Vaccines in development:** A number of vaccine candidates are in development. Like RTS,S, many of them target the parasite before it enters the human liver where it would quickly multiply.

- The most advanced of these candidates is R21 which has completed Phase 3 clinical trials. WHO looks forward to reviewing the results of those trials to confirm the vaccine's safety profile and efficacy. A second malaria vaccine that is approved for use in the future could be highly beneficial to malaria control, particularly because it could increase supply to meet high demand, resulting in more access and more lives saved.

- Other malaria vaccines are in development, including those that target later stages in the parasite's life cycle or *P. vivax* malaria. Some vaccine candidates seek to stop transmission of the malaria parasite, and still others to protect women during pregnancy.

» **Passive immunization with monoclonal antibodies is a promising area of prevention.** A recent study suggests that human antibodies to malaria can be used to provide short-term protection to populations at high risk of clinical malaria.

- In November 2021, WHO convened a scientific development group to develop PPCs and address clinical development considerations for monoclonal antibodies for malaria prevention. The most immediate public health priority is the reduction of morbidity and mortality in infants and children due to *P. falciparum*.

» **New diagnostics on the way:** The most widely used rapid diagnostic test, which detects the parasite's HRP2/3 protein, is becoming less effective as the malaria parasite mutates. WHO recommends a shift to non-HRP2-based tests in countries where more than 5% of symptomatic *P. falciparum* infections have the genetic mutation that allows them to escape detection.

- **Researchers are pursuing the development of diagnostics that use alternate biomarkers**, and three products are approved for donor-funded procurement by the Global Fund and Unitaid. In addition, non-invasive diagnosis using saliva and urine is a growing area of investigation, with potential for rapid screening outside of conventional medical settings. Other efforts seek to improve diagnostic tools related to *P. vivax*, which would allow the safe use of medical treatments for radical cure of the disease.

- **Global health organizations and donors are supporting diversification of the diagnostic pipeline.** Before 2020, only two suppliers of RDTs shared over 80% of the market. Procurement strategies by the US President's Malaria Initiative and the Global Fund diversified this landscape, leading to seven new tests being approved in 2020. Currently, there are 19 prequalified RDTs from seven manufacturers, with a further eight tests from five suppliers under prequalification review.

» **Innovations in malaria medicines for case management:** Delivering non-ACT treatment options, as a contingency against the emergence of artemisinin resistance, is a priority for researchers. The current focus for malaria medicine R&D is on the development of next-generation life-saving medicines for pregnant women and children, who are at elevated risk from the consequences of malarial infection. The Medicines for Malaria Venture and its partners have been catalysing the development of such antimalarial medicines. Medicines under development include:

- **Triple artemisinin-based combination therapy** relies on a combination of the short-acting artemisinin with two long-acting partner drugs to mitigate the risk of resistance.
- **Next-generation antimalarial treatments** use different chemical entities as an alternative to artemisinin and its derivatives. Four novel drug combinations are now in clinical trials, and a host of candidate molecules are in early development.
- **New treatments to prevent malaria, particularly in pregnant women and children at risk of infection.** In December 2020, WHO endorsed a new approach that involves using currently approved treatments in new ways, with different schedules; recombining approved antimalarial drugs in novel ways; and a longer-term strategy of developing novel drugs for chemoprevention.

» **Globally, funding for malaria basic research and product development is still falling short of the estimated US$ 851 million needed to stay on track towards the GTS milestones. In 2021, an estimated US$ 626 million was invested in malaria R&D, a decline of US$ 54 million over 2020 and the third consecutive year of a funding decline since 2018.**

- The decline in malaria R&D funding has been driven by reductions in research in vaccines and other products. With the threats faced by current malaria interventions, and the need for new and improved tools, there is an urgent need to ramp up investments in this area.

Graphs drawn from the *World malaria report 2022*. For more information on sources, please see the report.

Global messaging briefing kit: World malaria report 2022

WHO/UCN/GMP/2022.07