Global **Malaria** Programme

WHO Strategic Advisory Group
on Malaria Eradication

Malaria eradication: benefits, future scenarios and feasibility

Executive summary

World Health Organization

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Executive summary

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The past leads us forward . . .

“Malaria control should not be a campaign, it should be a policy, a long-term program. It cannot be accomplished or maintained by spasmodic effort. It requires the adoption of a practicable program, the reasonable continuity of which will be sustained for a long term of years.”

Mark F. Boyd (1939)

SUMMARY AND INTRODUCTION

A world free of malaria is a major goal of global health, unequivocally embraced by the World Health Organization (WHO) soon after its founding in 1948. This aspiration has energized and inspired generations of health workers, malaria experts and global health leaders alike. The WHO's Global Malaria Eradication Programme (GMEP; 1955–1969) was an ambitious attempt to achieve a malaria-free world. While the GMEP led to the elimination of malaria in many countries, it failed to achieve global eradication and the plan was not implemented in sub-Saharan Africa where the greatest burden of malaria was found (Nájera et al., 2011). Falling short of eradication led to a sense of defeat, the neglect of malaria control efforts and abandonment of research into new tools and approaches. Malaria came back with a vengeance; millions of deaths followed. It took decades for the world to be ready to fight back against malaria.

Almost 50 years later, the world once again began to consider the feasibility of eradicating malaria. Significant declines in the global malaria mortality rate and case incidence between 2000 and 2015 and an increasing number of countries certified malaria-free generated renewed enthusiasm for tackling one of the main causes of death and disease in the world. In 2015, the Sixty-eighth World Health Assembly unanimously endorsed a bold plan - the *Global technical strategy for malaria 2016–2030* - to rid the world of 90% of the burden of death and disease due to malaria by 2030 and to eliminate this infection from at least 35 more countries (WHO, 2015). These ambitious yet achievable targets are considered essential stepping stones on the path to achieving a world free of malaria, the vision that was reaffirmed in the plan.

In 2016, at the request of the WHO Director-General, a group of scientists and public health experts from around the world were brought together to advise WHO on future scenarios for malaria, including whether eradication was feasible. Over three years, we, the members of the Strategic Advisory Group on Malaria Eradication (SAGme), analysed trends and reviewed future projections for the factors and determinants that underpin malaria.

KEY TERMS

Control: Reduction of disease incidence, prevalence, morbidity or mortality to a locally acceptable level as a result of deliberate efforts. Continued interventions are required to sustain control.

Elimination: Interruption of local transmission (reduction to zero incidence of indigenous cases) of a specified malaria parasite in a defined geographical area as a result of deliberate activities. Continued measures to prevent re-establishment of transmission are required.

Eradication: Permanent reduction to zero of the worldwide incidence of infection caused by human malaria parasites as a result of deliberate activities. Interventions are no longer required once eradication has been achieved.

Source: *WHO malaria terminology (WHO 2016)*

Our analysis and discussions reaffirmed that eradication will result in millions of lives saved and a return on investment of billions of dollars. We did not identify biological or environmental barriers to malaria eradication. In addition, our review of models accounting for a variety of global trends in the human and biophysical environment over the next three decades suggest that the world of the future will have much less malaria to contend with. However, even with our most optimistic scenarios and projections, we face an unavoidable fact: using current tools, we will still have 11 million cases of malaria in Africa in 2050 (Gething P, University of Oxford, unpublished data, 2018). In these circumstances, it is impossible to either set a target date for malaria eradication, formulate a reliable operational plan for malaria eradication or to give it a price tag.

Our priority now should be to establish the foundation for a successful future eradication effort while guarding against the risk of failure that would lead to the waste of huge sums of money, frustrate all those involved, national governments and malaria experts alike, and cause a lack of confidence in the global health community's ability to ever rid the world of this disease.

We need a renewed drive towards research and development on vector control, chemotherapy, and vaccines to develop the transformative tools and knowledge base that will help achieve eradication in the highest burden areas. We need political leadership that makes effective and efficient use of increased domestic and international funding. We need bespoke national and subnational strategies guided by improved use of data and stronger delivery systems to provide the appropriate mix of services to all those in need, without financial hardship. We need strengthened cross-border, regional, and international cooperation to coordinate malaria control and elimination efforts worldwide. When these critical foundations are laid, we believe the world will be in a much stronger position to make the final and credible push for eradication.

As we complete our work in 2019, we recognize that the world stands at a crossroads in the fight against malaria. Despite huge progress in reducing malaria cases and deaths between 2000 and 2015, the last two years have witnessed the stalling of global progress. The world is not on track to meet the 2020 milestones that will lead us to lower case incidence and mortality by 90% from the 2015 level by 2030 (WHO, 2018a). Without massive concerted and coordinated action, we are unlikely to meet these targets.

In this document, we have articulated the investments and progress that are needed to achieve eradication. The methods and results of our analyses will be published before the end of 2019, but we are releasing the report's executive summary in advance to share the key conclusions and recommendations developed over this three-year effort.

While we are certain that eradication by a specific date is not a promise we can make to the world just yet, there is a clear agenda, beginning with getting back on track to achieve the goals of the *Global technical strategy for malaria 2016-2030*, that should be pursued at present to make eradication possible.

THE CASE FOR ERADICATION

Malaria is a disease of the most vulnerable: the very young and the poor. Every year, there are about 219 million cases of the disease, and more than 400 000 deaths. Children under 5 years of age account for 61% of all malaria deaths while over 90% of malaria deaths occur in sub-Saharan Africa (WHO, 2018a). Eradicating malaria would have the greatest beneficial impact on the world's most vulnerable populations.

As well as saving millions of lives and improving health and health equity, eradication is an investment that offers a return that lasts indefinitely. Endemic countries would no longer suffer from their enormous malaria burden, and countries that had previously eliminated malaria would avoid the risk of re-establishing the disease. The economic case for eradication is strong, so long as the chances of an eradication effort succeeding are high.

Malaria eradication would save millions of lives and generate significant economic benefits

The social benefits of eradication can be demonstrated in part by conventional economic statistics. Analysis of data on malaria and gross domestic product (GDP) from 180 countries between 2000 and 2017 shows that each 10% reduction in malaria incidence is associated with an average rise of 0.3% in GDP per capita and faster GDP growth (Sarma N, Graduate Institute of Geneva, unpublished data, 2019). High-burden and low-income countries had higher than average gains: in these countries, the same reduction in malaria incidence was associated with an increase in the level of GDP per capita of nearly 2%. There is no question that eradicating malaria would make the world healthier, more productive and more prosperous.

While we do not yet have a way to eliminate the last pockets of malaria transmission, we do have a plan to get 90% of the way there: the *Global technical strategy for malaria 2016-2030*. Additional analyses show that scaling up current malaria interventions between 2016 and 2030 to reach 90% of the population in the 29 countries that accounted for 95% of the global burden in 2016 would prevent an additional 2 billion malaria cases and 4 million deaths over that period compared to sustaining current intervention levels (Patouillard E, WHO, unpublished data, 2019). This would be an astonishing humanitarian triumph. Within these 29 countries, the cost of scaling up is projected to be US$ 34 billion, but the economic gain, calculated only with respect to market data and not social benefits, is estimated at US$ 283 billion in total GDP during this period. As the social benefits of these scaled-up interventions are likely to be even higher, this calculation indicates that malaria control should be strengthened, independent of the decision to eradicate.

LEARNING FROM HISTORY

We reviewed the history of the GMEP and took away several important lessons:

- eradication strategies need to account for the hardest places from the outset to avoid failing before launching;
- eradication cannot be promised too early in order to use it as a resource mobilization strategy or there is a risk of donor and political fatigue when goals are not reached on time;

- national malaria elimination strategies must be designed to fit the country context and retain flexibility to adjust to short- and long-term changes;
- research and development are critical until eradication is achieved, and even beyond that, to limit any post-eradication risks;
- the outcome of a second malaria eradication attempt will have profound implications not only for malaria but also for other diseases under consideration for eradication.

The history of the Global Malaria Eradication Programme (1955–1969) demonstrates that eradication efforts must include the hardest areas from the outset

Rarely do we get a second chance to make something right. Learning from the past malaria eradication effort will help avoid the same mistakes and will give the world a better chance to achieve the ultimate goal of malaria eradication.

GLOBAL TRENDS THAT WILL AFFECT MALARIA ERADICATION IN AFRICA

Over the past three years, we have assessed the evolving malaria landscape, considering the biological, technical, financial, socioeconomic, political and environmental factors that affect the disease, particularly in Africa where we know we face the highest burden of malaria in the world. We have examined trends in poverty and population growth, mobility, agricultural use and urbanization that interact with the spread and intensity of malaria. We have considered, among other factors, the role of climate change, land use change and human migration in determining who will have malaria where in the future. We refer to these long-term sociodemographic and environmental changes as megatrends.

The combined effect of megatrends in Africa is likely to benefit the eradication effort

Our analyses show that megatrends will introduce unpredictability in the distribution of malaria, but overall are likely to lead to reduced malaria transmission and therefore benefit the drive to eradication. Socioeconomic development is likely to accelerate elimination in many countries of Africa by improving housing conditions, nutrition, education, and access to preventive and curative health care. Climate change affects malaria transmission by altering temperature, humidity and rainfall, potentially shifting the geography and seasonality of transmission. Changes in land use, particularly expansion of agriculture, will bring about further changes in malaria distribution in ways that are difficult to predict.

Population growth and the movement of populations from rural to urban settings will also affect malaria transmission. The global population of 7.7 billion in 2019 is set to grow to 9.7 billion by 2050 (UN, 2019a), by which time more than two-thirds of the world's population is likely to live in cities (UN, 2019b). Most of the growth projected in the next 20 years will occur in sub-Saharan Africa and Asia. Urbanization has typically reduced malaria transmission due to increasing living standards, destruction of mosquito breeding sites and improved access to health care. However, with urban areas expected to grow at unprecedented rates in conjunction with equally important new population dynamics of short and longer-term peri-urban migration, the historical association between urban migration and rising living standards may break down.

While there is significant variation in the potential impact of changing human and biophysical environments on malaria in time and space, the analytical framework that we used suggests that the world will have much less malaria in 30 years than it does now. Even under the most optimistic scenario, however, with current tools and approaches fully implemented everywhere, our analyses do not show that malaria eradication can be achieved within the next several decades: the model that we reviewed showed 11 million malaria cases remaining in Africa in 2050 even after current interventions (insecticide-treated mosquito nets, artemisinin-based combination therapy and indoor residual spraying) are maximised (Gething P, University of Oxford, unpublished data). The areas left behind in that future scenario are the parts of Africa where malaria is currently the most entrenched.

POTENTIAL THREATS TO ERADICATION

The world has only ever eradicated two diseases: smallpox and rinderpest (cattle plague). Polio and dracunculiasis (guinea worm) are at the last stages of long eradication campaigns, but success is not yet guaranteed. Eradication efforts are complex undertakings, and unexpected roadblocks or deviations can threaten at each turn in the road. Malaria is no different. We evaluated several potential threats to malaria eradication, using lessons learned from the GMEP and other eradication efforts to inform our analyses, but we recognize that new threats that we have not considered might someday occur.

Potential threats are risks to monitor and manage but do not render eradication impossible

Potential biological threats to malaria eradication include development of insecticide and antimalarial drug resistance, vector population dynamics and altered vector behaviour. For example, *Anopheles* vectors might adapt to breeding in polluted water, and mosquito vector species newly introduced to Africa, such as *Anopheles stephensi*, could spread more widely into urban settings.

Financial threats include lack of sufficient and continued commitment from countries and international donors, insufficient political commitment and failure to engage opinion leaders, political leaders, and the private sector. From the ongoing efforts to eradicate polio, we considered the impact of complex emergencies, while recent developments in the eradication of dracunculiasis pointed to the need to evaluate the potential for non-human primate malaria to generate sustained transmission among humans.

We concluded that although complex emergencies are likely to cause disruptions of progress towards elimination and eradication, these effects, which tend to be time-limited, can be overcome and should not deter the world from attempting to eradicate malaria. The effects of these serious events can be mitigated by robust and resilient health systems with strong surveillance capacity and emergency preparedness plans. Malaria risk should be included in the broader global and local discussions regarding disaster risk reduction and response.

The existence of a non-human reservoir of infection has always been considered a major barrier to eradication of any disease. Transmission of simian malaria to humans has been described in several parts of the world, with the highest numbers of cases recently observed in Malaysia. So far, there has been no clear evidence of sustained human-mosquito-human transmission among any of the simian malaria species.

Continued surveillance and research is vital to gain a deeper understanding of the zoonotic reservoirs and the vectors involved. Additionally, clear control strategies for simian malaria should be implemented to reduce the risk of parasites becoming more transmissible between humans and the mosquito vector. The existence of non-human malaria species is a concern, but not a reason to reconsider the malaria eradication agenda at this stage. Rather, this is a risk to be monitored and managed.

A PRAGMATIC WAY FORWARD

We clearly need to get the world back on track to achieving important public health goals that are on the pathway to eradication, and then to cover the last mile to eradication at that time. Based on our analyses, we do not believe that this is the time to push for an eradication date. We must not set the world up for another failed malaria eradication effort that could derail attempts to achieve our vision for decades.

With a clear strategy and better estimate of the likely duration of effort to be maintained over the last mile, particularly in high-burden countries, it will be possible to estimate both the costs of global eradication and the vast economic and social benefits that can be attained. To avoid repeating mistakes of the previous malaria eradication campaign, estimated costs should be calculated only when a final plan has been determined and details of requirements are clear enough for a full cost calculation to be undertaken. To move ahead without this is to risk donor fatigue at funding an effort that has spiralling costs.

> When a clear strategy to eradicate malaria can be articulated, a full calculation of the likely costs of eradication can be undertaken

GETTING BACK ON THE PATH TO ERADICATION

The promise of a malaria-free world has driven great progress, and we have come a long way since 2000. The rapid decline in malaria mortality from 2000 to 2015 can truly be described as a triumph of modern public health. While the number of malaria cases declined globally by 22% (from 271 to 212 million), deaths due to malaria decreased by a remarkable 50% (from 864 000 to 429 000) (WHO, 2016b). Similarly encouraging is the increasing number of countries that have eliminated malaria: since 2010, 10 countries have been certified as being malaria-free, a remarkable achievement given that, between 1987 and 2007, no country was certified as having eliminated malaria. In 2016, WHO identified 21 countries with the potential to achieve zero indigenous cases of malaria by 2020 and formed the E-2020 initiative (WHO, 2016c). China, the most populous country in the world, and El Salvador, one of the smallest, both interrupted malaria transmission in 2017, and are on track to be certified as malaria free by 2021. Including these two countries, at least 10 countries are on track to have zero cases in 2020, meeting the elimination goal in the *Global technical strategy for malaria 2016-2030*.

These achievements are tributes to the outstanding performance of the public health workforces of countries throughout the world, assisted by the contributions of national partners and international donors and organizations. While socioeconomic development and implementation of other life-saving interventions such as

immunizations must be credited with substantially contributing to general reductions in morbidity and mortality, millions of lives have been saved through implementation of effective methods to prevent and treat malaria.

Despite the success in reducing malaria burden between 2000 and 2015, progress in malaria control overall has since stalled, with malaria incidence and mortality relatively unchanged since 2015 (WHO, 2018a). Of great concern to us all is that the world is significantly off track to be able to meet the target of a 90% decrease in malaria incidence and mortality by 2030 agreed to in the *Global technical strategy for malaria 2016–2030*. This is probably the most important and urgent threat to realizing our vision of a malaria-free world.

Getting back on track to meet global goals for reductions in malaria cases and deaths is a critical step on the path to eradication

In response to the worsening malaria situation, WHO and the RBM Partnership to End Malaria have catalysed the country-led High Burden High Impact (HBHI) approach (WHO, 2018b), providing a renewed focus on making a durable impact in countries with the highest burden of malaria and getting back on track to achieve the 2030 targets in the *Global technical strategy for malaria 2016–2030*. The approach will initially focus on getting the 11 highest burden countries back on track, 10 of which are in Africa.

By taking the HBHI approach, countries will establish an enabling environment for increasing and maximizing the use of resources for malaria impact. Four mutually reinforcing response elements feed into tangible actions and concrete outcomes:

- political will translated into better use of resources and action;
- information used more strategically;
- technical guidance improved;
- response efforts better coordinated.

The approach will be rolled out to all malarious countries in Africa as we progress towards a malaria-free continent.

WHAT SHOULD A SUCCESSFUL APPROACH TO MALARIA ERADICATION LOOK LIKE?

A logical way to approach eradication is to focus on burden reduction and sequential elimination in malaria-endemic countries and regions. To help countries reduce malaria burden, eliminate malaria from within their borders and then push towards the end goal of eradication, we call for focused effort in four areas.

1. Research and development for new tools

One of the highest priorities is a renewed research and development agenda that improves the knowledge base and products without which eradication will not be achieved. Over the last decade, a large, collaborative effort (the Malaria Eradication

Research Agenda, malERA) has produced consensus on the tools, strategies and enabling technologies that need to be developed (Rabinovich et al., 2017). Effectively, malERA has become a blueprint for the research and development (R&D) community. The current tools for vector control – principally insecticide-treated mosquito nets and indoor residual spraying – are old and imperfect and do not attack outdoor biting. Therefore, continued R&D is a high priority for identifying novel interventions to reduce mosquito biting in the areas with the greatest underlying environmental suitability for transmission. R&D is also needed for improved vaccines and better insecticides, to identify markers of drug resistance, and to develop new genetic technologies that can alter mosquitoes' ability to transmit the parasite. Basic research should exploit advances in molecular biology and continue the discovery of the new tools, including drugs and insecticides, that will be required to push to eradication.

We call for better tools and approaches; universal access to affordable, quality, people-centred health services; flexible, rapid and reliable surveillance and response systems; effective, tailored subnational, regional and national elimination strategies; and direct engagement of communities in local elimination efforts

As demonstrated in campaigns against polio and smallpox, implementation research is required until the very end of the programme for adaptation of strategies to suit local conditions or assessment of new tools.

2. Access to affordable, quality people-centred health services

To eliminate malaria and prevent the re-establishment of transmission, a country will require strong political commitment and investment in universal health coverage, with a well-functioning primary health care system at its base. Health system quality is strongly correlated with malaria progress across the spectrum of malaria-endemicity. A strong governance framework will need to bring together health systems infrastructure, service delivery, civil society and communities.

Global funding for malaria has remained relatively stagnant since 2010. Increases in domestic financing need to be complemented by increases in international financing.

3. Surveillance and response

A reliable, rapid and accurate surveillance and response system will be fundamental for dealing with changes in transmission likely to result from the global megatrends of urbanization, climate change and population growth. A multisectoral approach to development in urban settings and elsewhere should require malaria in all policies, to ensure that risks for malaria transmission can be alleviated or prevented in relevant areas of housing, road building, land use planning, and general urban design.

4. Subnational, national and regional strategies

Interrupting transmission and preventing the reestablishment of malaria can only be achieved if there are national and subnational strategies tailored to local conditions. Strategies are needed to accurately define populations at risk, ensure that populations at risk are covered with effective interventions to prevent infections, and guarantee that all malaria patients get the care needed in a timely and comprehensive fashion. This will require the provision of safe and effective services to all those in need without them incurring any financial hardship. Achieving this requires extending

strategies beyond malaria by integrating within the broader health system to ensure close-to-community networks of people-centred primary care services. Additionally, eradicating malaria will require inclusion of other sectors, including the private health care sector, agriculture, tourism, military and police, in a multisectoral approach to include malaria eradication aspects in all policies.

At a regional or subregional level, there is need for strategies that approach malaria holistically, ensuring that malaria interventions do not stop at international borders but extend throughout areas at risk. Bilateral and multilateral cooperation will be essential to working across borders.

Other important enabling factors

In pushing towards a malaria-free world, the role of communities is essential. Developing field-tested approaches to improving community engagement will be vital. Eradicating malaria will require a combination of top-down, expert-led approaches with those that are bottom-up and community driven. Public institutions will have to earn the trust of their populations through co-planning and adapting malaria interventions and elimination strategies, co-monitoring the quality of programme services and interventions, and co-evaluating achievements and lessons learnt. Communities need to be given the opportunity to play a central role in the establishment and management of quality, people-centred and resilient health services.

STAYING ON TARGET FOR ERADICATION

Eradication must remain the global vision. This goal can only be achieved through the reduction of the global burden of malaria and progressive elimination of malaria in countries and regions as laid out in the *Global technical strategy for malaria 2016-2030*. It is therefore an absolute priority to bring progress towards the milestones of the Strategy rapidly back on target to drive down the mortality and morbidity of malaria. New initiatives to support the *Global technical strategy for malaria 2016-2030* goals such as the HBHI approach and further innovative research must be pursued aggressively. Crucially, however, even if the ambitious targets of the *Global technical strategy for malaria 2016-2030* are achieved, there will still be much more to be done, with an estimated 32 million cases remaining in 55 endemic countries in 2030 (Noor A, WHO, unpublished data, 2019).

Reinforcing the *Global technical strategy for malaria 2016-2030* with a dynamic series of rolling five- and ten-year plans will establish the platform from which a successful eradication effort can be launched

Getting back on track to achieve the milestones and goals of the *Global technical strategy for malaria 2016-2030* is not an alternative to eradication but an essential step towards eradication. The gaps (including tailored national and subnational strategies, increased national and international funding, capacity-building and surveillance systems) between the actions taking place at country level, and the requirements for successful implementation of the *Global technical strategy for malaria 2016-2030* must be bridged as a matter of urgency. The communities at risk need to be the central focus of these efforts.

We must harness opportunities presented by global developments, such as the Sustainable Development Goals and the WHO push for primary health care and universal health coverage, both of which ensure people-centred, equitable care, to further advance towards a world without malaria.

We recommend reinforcing the *Global technical strategy for malaria 2016-2030* with a dynamic series of rolling 5-year and 10-year plans leading out of the 2025 and 2030 targets, which we need to get back on track to achieve. These rolling plans would have clear targets and rigorous review, to give the opportunity for responsive modifications of strategy guided by an evolving risk-assessment and decision-making framework for eradication. With such a high-profile renewed and sustained effort, we will establish the platform from which a successful and time-limited eradication effort can be launched.*

* This report contains the view of the majority of the SAGme members. One member disagreed with the conclusion that a time-bound commitment to malaria eradication was premature.

“We must dream a bit, not beyond the feasible but to the limits of the feasible, so that we inspire.”

Jeffrey Sachs (2001), from the report of the Commission on Macroeconomics and Health

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ANNEX

A full accounting of the contributions to the work packages of the Strategic Advisory Group on Malaria Eradication will be provided when the complete report is published.

The following individuals made substantial contributions to the evidence reviewed by the SAGme and the discussions of the Group:

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