

# SUMMARY DOCUMENT FOR FROM PIPELINE TO PRODUCT: **MALARIA** R&D FUNDING NEEDS INTO THE NEXT DECADE



# REPORT SUMMARY

## Introduction

Malaria is a major public health challenge that threatens approximately half of the world's population.<sup>1</sup> Malaria claims the life of a child in Africa each minute<sup>1</sup> and the life of a pregnant woman worldwide each hour.<sup>2</sup> In 2010, there were more than 219 million cases globally.<sup>3</sup>

However, the situation is now far better than it was even ten years ago. Thanks to increased funding for malaria programmes, better tools, and increased control efforts, worldwide malaria deaths have decreased by 26% since 2000.<sup>3</sup> Between 2001 and 2010, there were 274 million fewer cases and 1.1 million fewer malaria deaths.<sup>3</sup> New tools have made an important contribution to this progress and are the outcome of increasing investment in research and development (R&D) over the past two decades. The 2011 global investment of US\$610 million in malaria R&D is nearly five times larger than the \$131 million invested in 1993, and almost double the 2004 total of \$320 million.<sup>i</sup>

With improvements in tools and coverage, and a comprehensive global framework for action—the Global Malaria Action Plan<sup>6</sup>—it has become possible to speak not only of controlling malaria, but also of eliminating and eradicating malaria. Whereas malaria control focuses on reducing malaria to a level where it is no longer a public health problem, malaria elimination seeks to reduce the incidence of malaria infection to zero through deliberate efforts within a defined geographical area. Malaria eradication goes further still, aiming for the permanent reduction to zero of the worldwide incidence of infection caused by malaria parasite species, reaching a state where intervention measures are no longer needed.<sup>3</sup> Reaching these goals will require a sustained, long-term, and well-planned effort, and ongoing R&D will be critical to this.

There are, however, emerging issues that threaten the efficacy of current control methods. Resistance to first-line malaria drug treatment has emerged in the Greater Mekong Subregion and early resistance to insecticides has been reported in two-thirds of malaria-endemic countries. The *Plasmodium vivax* form of malaria is also growing as a problem, affecting adult males as well as the children and pregnant women traditionally targeted by the *Plasmodium falciparum* strain of malaria. Control, elimination, and eradication programmes will fail in the face of these emerging threats without continued R&D to improve existing tools and to develop new ones.

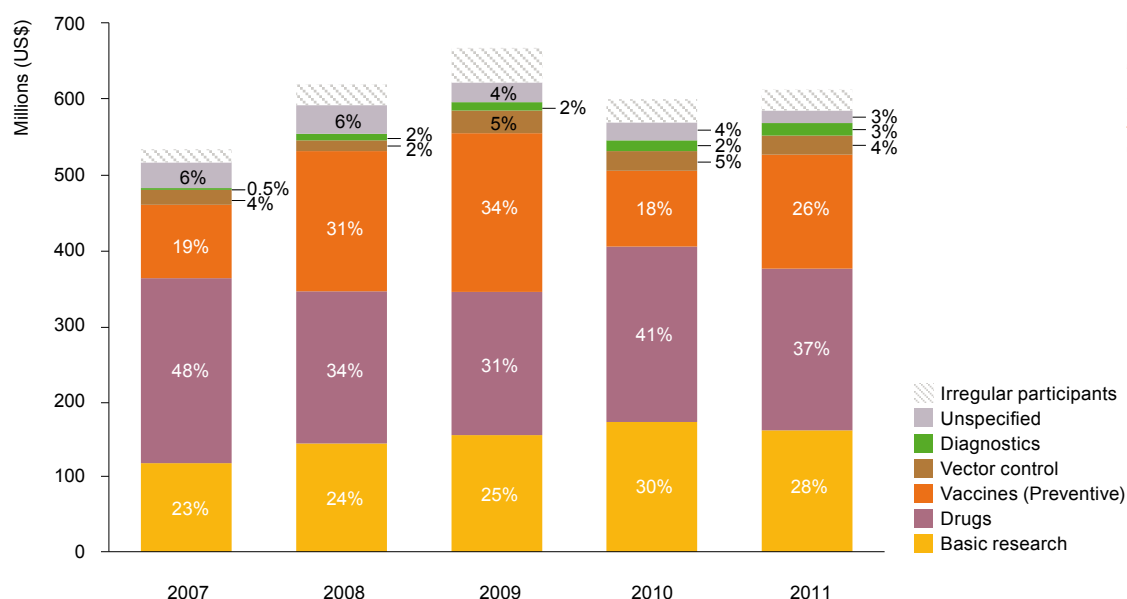
*From Pipeline to Product: Malaria R&D funding needs into the next decade* serves as a resource to inform policymakers' investment in new tools to control malaria, contain emerging threats, and move toward the goal of eradicating malaria from the world. It looks at the estimated funding needed for R&D of new malaria tools until 2022, including for basic research, drugs, vaccines, diagnostics, and vector control agents. The report provides an update to the 2011 *Staying the Course* report, which estimated R&D cost and R&D investments for all malaria R&D activities. All figures presented in *From Pipeline to Product: Malaria R&D funding needs into the next decade* have been adjusted for inflation and are reported in 2011 US dollars.<sup>ii</sup>

<sup>i</sup> The 1996 Wellcome Trust report put malaria R&D funding in 1993 at \$84 million.<sup>4</sup> In 2004, total malaria R&D funding (including implementation research) was \$323 million, according to the 2005 Malaria R&D Alliance report.<sup>5</sup> These figures have been converted into constant 2011 US dollars and implementation research removed from the 2004 total for purposes of comparison.

<sup>ii</sup> This represents a change from the *Staying the Course* report, where figures were reported in 2007 US dollars.

## Key findings

### Overall funding landscape



**Malaria R&D funding trended upward between 2007 and 2011, increasing from \$531 million in 2007 to \$610 million in 2011.** The dominant areas of investment over the five-year period were drugs (\$1 billion, 38% of total malaria R&D funding), basic research (\$745 million, 26%), and vaccines (\$742 million, 26%). Vector control products and diagnostics received, respectively, just 4% (\$114 million) and 2% (\$53 million) of malaria R&D funding in 2007-2011, although the amount each area received per year generally increased.

The five-year period (2007-2011) saw a trend away from funding of product development and toward basic research. Product development accounted for 76% of total malaria R&D funding in 2007, decreasing to 72% in 2011, although both basic research and product development experienced funding increases and the total funding pie became around \$85 million larger. These trends were largely driven by public funders, which accounted for around half (51%) of all malaria R&D funding in 2007-2011. The philanthropic sector accounted for a third (32%) and industry for a fifth (17%). Philanthropic funding fluctuated substantially from year to year, as funding from this sector is particularly responsive to changes in the pipeline. However, at an individual funder level, malaria R&D funding is highly concentrated, with the top 12 organisations accounting for 90% of the funding over the 2007-2011 period.

### Overall funding need

**The overall funding need for malaria R&D in the next decade is projected at between \$5.5 billion and \$8.3 billion, with the midpoint averaging around \$700 million on an annual basis.** Of the total funding needed over the next decade, vaccines make up around 32%, drugs and basic research around 27% each, vector control products around 11%, and diagnostics just more than 3%. Funding needs by each product area are explained below, followed by a snapshot of funding history, need, and investment priorities for malaria R&D product areas in Table 1.



- **Drugs:** Due to a focus on two new types of drug profiles that are key to elimination and eradication goals (Single Exposure Radical Cure and Prophylaxis and Single Exposure Chemoprevention), drug R&D funding can be reduced sooner than was previously projected. Current projections indicate that funding can decrease by 23% in 2013-2014 to around \$180 million in 2015, but then funding will need to be maintained at that level until at least 2022.
- **Vaccines:** Funding for vaccine R&D will account for approximately 32% of funding needs over the next decade and will need to increase from the 2011 level of \$150 million to \$200 million in 2013. Steady increases thereafter to \$250 million per year by 2017, and sustained through 2022, will be required to make substantial progress toward all the Malaria Vaccine Technology Roadmap targets.
- **Diagnostics:** There has been only a doubling of funding since 2009 instead of the quadrupling previously recommended. Now funding needs to double again immediately to around \$34 million per year. Thereafter, diagnostic funding will gradually decrease and remain steady at around \$15-20 million per year post-2018.
- **Vector control:** Like diagnostics, vector control funding needs to almost double immediately to \$52 million per year in 2013 and will increase steadily to a peak of \$100 million in 2018.

**TABLE 1**  
Past and future:  
snapshot of funding  
history, need, and  
investment priorities  
for malaria  
R&D product areas

Product area	Investments in 2007-2011	Investments needed in the next decade (2013-2022)	Investment priorities
Drugs	\$1 billion	\$1,364-2,333 million	<p><b>Two new types of drugs</b> will be key to achieving malaria control, elimination, and eradication goals:</p> <ul style="list-style-type: none"> <li>• <i>Single Exposure Radical Cure and Prophylaxis (SERCaP)</i>, a combination therapy able to radically cure all malaria lifecycle stages and species, whilst providing post-treatment prophylaxis in a single dose. <b>Six new chemical entities (NCEs)</b> will be required to feed into SERCaP therapies.</li> <li>• <i>Single Exposure Chemoprevention (SEC)</i>, a compound ideal for prevention that provides month-long protection against all species of malaria with a single dose, suitable for mass administration and has a different mechanism of action to medicines used for treatment. <b>One NCE will be required for SEC.</b></li> </ul>
Vaccines	\$742 million	\$1,488-2,942 million	<p>By 2015, a <b>first-generation <i>P falciparum</i> vaccine with 50% protective efficacy</b> of at least one year duration against severe disease and death.</p> <p>By 2030, a <b>second-generation <i>P falciparum</i> vaccine with a protective efficacy of at least 75%</b> against clinical malaria or asymptomatic malaria infection that lasts for at least two years.<sup>7</sup></p> <p>By 2030, <b>two transmission-blocking vaccines</b> that target infection by blocking the transmission of malaria between humans and mosquitoes, one against <i>P falciparum</i> and one against <i>P vivax</i>.</p>
Diagnostics	\$53 million	\$175-288 million	<p><b>Improved rapid diagnostic tests</b>, particularly for <i>non-falciparum</i> species.</p> <p><b>A highly sensitive field test that can rapidly detect even low levels of parasites from blood samples</b> and can be used to help reach elimination by detecting asymptomatic infections.<sup>8</sup></p> <p><b>Screening tools that can identify areas where transmission is continuing.</b></p> <p><b>A field test to identify patients with <i>P vivax</i> malaria who are glucose-6-phosphate-dehydrogenase deficient</b> and may thus have severe side effects when treated with the frontline drug.</p> <p><b>A test that conducts microscopy automatically</b>, omitting the need for a highly trained medical practitioner.</p> <p><b>A diagnostic test that does not require blood samples to be taken.</b></p>
Vector control	\$114 million	\$676-773 million	<p><b>New active ingredients</b> (chemicals).</p> <p><b>Supportive research activities</b> to identify promising molecules, develop stable and suitable preparations for new insecticides, identify new non-insecticide-based ways to control mosquitoes, and develop information systems.</p>

### **Research and development of global health products is a smart and effective area in which to invest money in order to save lives.**

Past investment in malaria R&D has produced tools—including long-lasting insecticide-treated bednets, a drug suitable for children, and more reliable diagnostic tests—that have contributed to an estimated 26% decrease in malaria deaths worldwide since 2000. In the last decade, at least nine malaria products were registered, including two insecticide formulations for vector control, seven drugs, and multiple diagnostics.

The current malaria R&D pipeline is very healthy, with at least 96 malaria products in development, including 13 new vector control active ingredients and new formulations, 37 drug candidates, and 46 vaccine candidates. The development of new malaria tools will be critical to ensuring that control strategies are effective, particularly in the face of resistance and other threats, and that the goals of elimination and eradication can be met.

## RECOMMENDATIONS

This is a critical time for malaria R&D funding. The landscape is shifting to align with new global priorities for malaria control, elimination, and eradication; new research discoveries; and the challenge of resistance. Just as current malaria interventions must work together, the efforts around R&D—in drugs, vaccines, diagnostics, and vector control—need to be equally synergistic. With this in mind, we recommend the following:

1. Funding for malaria R&D must address the full continuum of control, elimination, and eradication.
2. Annual malaria R&D funding should increase to an average of just less than \$700 million per year in order to satisfy the projected malaria funding need, estimated at between \$5.5 billion and \$8.3 billion over the next decade (through 2022). This equates to a relatively modest increase over current annual funding. Funding for vector control and diagnostics should double over the ten-year period.
3. Basic research needs to be better aligned with product development to maximise public health impact. Current donors can assist by working more closely with new donors to ensure that funding from research ministries results in increased funding for research in the service of product development. Public funders can also increase their commitments to product developers, including product development partnerships.
4. There should be a more coordinated approach to funding to maximise effectiveness and minimise delivery time. Indeed, the projected resource needs in this report assume a higher level of coordination than currently exists.
5. Funding should be flexible to support optimal portfolio management and diverse partnerships, and to maximise resources from endemic countries and emerging economies.
6. In order to broaden the funding base, more funders need to become engaged in malaria R&D, including more donor governments, philanthropic donors, and research and science and technology agencies.

# METHODOLOGY SUMMARY

A detailed analysis of malaria R&D funding over the period 2007-2011 was conducted using five years of G-FINDER survey data. For a full overview of this survey's methodology and scope, please refer to the G-FINDER 2012 report, *Neglected disease research and development: A five year review*, available at: <http://polycycures.org/g-finder2012.html>. Malaria funding totals in this report are not directly comparable with G-FINDER, however, as all funding has been converted to constant 2011 US dollars, and any core funding provided to product development partnerships and other multi-disease research groups has been apportioned to malaria (where appropriate) based on identified expenditure patterns.

Total funding figures for 1993 and 2004—taken from past surveys of malaria R&D funding<sup>4,5</sup>—were used for the purpose of long-term comparison. Both previous surveys also involved active collection of malaria R&D funding data and we consider their scope fully aligned with G-FINDER, with the exception of the 2004 total, from which implementation research has been removed to allow direct comparison. The totals have also been converted into 2011 US dollars.

Cost projections for malaria R&D funding need over the next decade (until 2022) have been modelled independently for each product area using inputs derived from expert consultations (a full list of the model inputs and experts involved appears in Annexe 2 in the full report).

Key variables used in the model were:

- All products in the pipeline for malaria, including their current stage of development.
- Ideal portfolio targets (number of products needed in the next decade for each product development goal—determined through extensive consultations with experts in each area).
- Total direct cost per phase (excluding cost of failure).
- Phase duration.
- Probability of technical success (defined as percentage of candidates successfully reaching the next phase).

For a full list of how these variables were used when modelling different research categories, please see Annexe 2 in the full report. All cost projections include minimum and maximum values to reflect the uncertainty range in the estimates provided by the experts, with the estimated average future funding need representing the midpoint of these two values. Total cost projections also include cost of capital and multipliers to account for uncertainty.

The methodology followed in this report, including the modelling exercise, is complementary and aligned with the methodology used in *Estimating costs and measuring investments in malaria R&D for eradication*.<sup>9</sup> One difference, however, is that historical funding data and cost projections in *From Pipeline to Product*—consistent with G-FINDER methodology—exclude health systems and operational research, as well as modelling and harmonised data systems.

All figures in the report are in 2011 US dollars.

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