# 1 | MAKING THE DECISION

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## 1.1 | Introduction

Malaria elimination, according to the WHO definition, is "the interruption of local mosquito-borne malaria transmission in a defined geographical area," which implies that imported cases may occur and that continued interventions will be required after elimination has been achieved.[1] For the MEG, a "defined geographical area" does not necessarily imply national boundaries, as the epidemiological zones where malaria elimination might be feasible from a technical perspective do not always follow administrative borders.

The MEG global strategy for malaria elimination, as set out in this *Prospectus*, encourages countries at the current global boundaries of malaria transmission, and countries that benefit from other geographical characteristics that favor elimination (for example islands), to explore the option of pursuing an elimination strategy.[2] Depending on the malaria epidemiology within the country or region, countries may want to target specific zones at the subnational level or participate in wider regional initiatives, including cross-border collaborations toward elimination. This chapter identifies considerations that countries may wish to take into account as they address the elimination decision.

### THE ELIMINATION UNIT

As shown in Figure 1.1, there are currently 39 countries that are either planning for elimination or already in the pre-elimination or elimination phase.[3-10] These

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## BOX 1.1 | Main Messages

The Malaria Elimination Group (MEG) makes the following recommendations:

- All countries unsure about the appropriateness and timing of moving to an elimination program should conduct a rigorous and structured feasibility assessment, taking into account technical, operational, and financial feasibility.
- Mathematical modeling of outbreak risk and importation risk is an integral part of the methodology to assess technical feasibility. When both are estimated to be low, countries should seriously consider elimination. From a technical point of view, elimination should not only be assessed on a regional or country level but, rather, be based on ecological zones and their malaria epidemiological contexts.
- The assessment of operational feasibility takes into account the commitments a government can or is willing to make to fulfill the necessary programmatic requirements and to create an enabling environment to facilitate the elimination process.
- Donors and governments interested in elimination need to rethink financing and probably adopt new financial mechanisms. Financial feasibility requires institutional change as well as long-term and reliable monetary resources.
- Countries should pursue a multinational elimination target based on epidemiological factors rather than arbitrary national borders. Regional and/or international bodies should not only provide the institutional structure to encourage and assist in achieving this goal but also financially reward countries that adopt and contribute to achieving regional and global targets.
- The importance of benefits such as expected reduction in morbidity and mortality, a better climate for foreign direct investment, satisfaction resulting from a national accomplishment, and the fact that elimination is potentially a cost-reducing investment should be factored into the overall judgment about whether to commence explicit elimination efforts.

The MEG, while supporting ambitious future strategic thinking, also places high value on honest feasibility assessments and rigorous operational planning. These key elements, in combination with novel approaches to guarantee sustainable financing, will determine the success of any elimination effort. The MEG also strongly supports the idea that broad regional targets and collaborations are often the most effective approach to cross-border challenges.

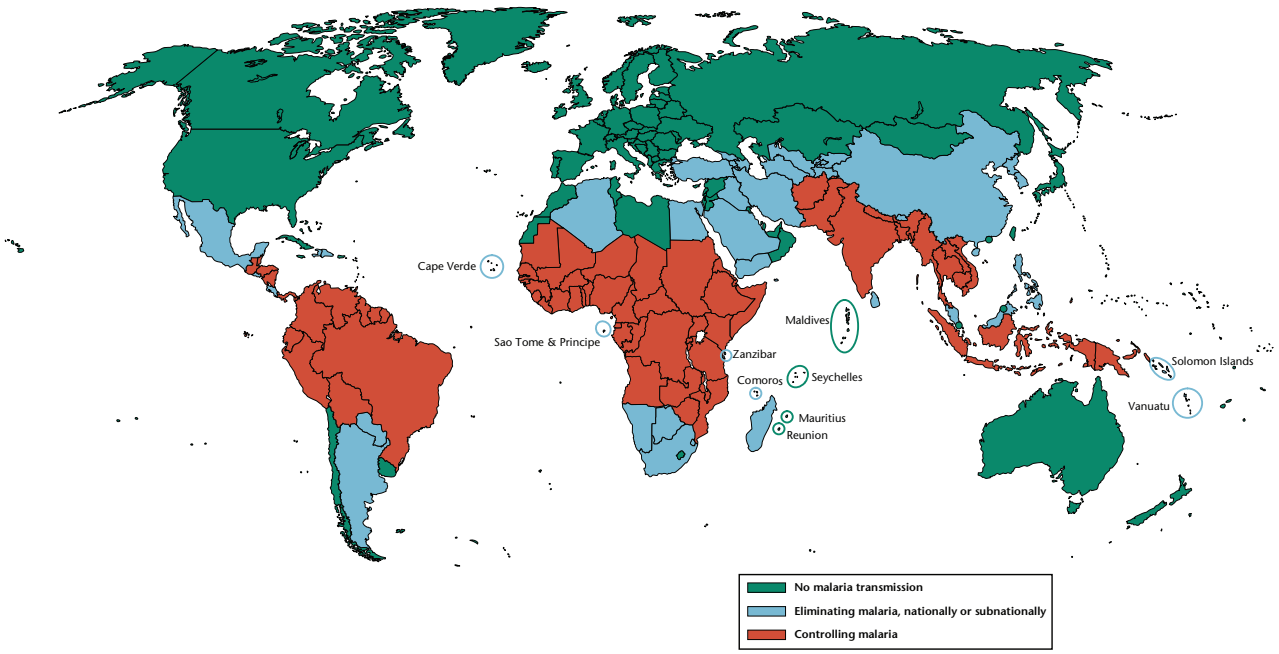


**FIGURE 1.1** | Malaria freedom, elimination, and control, by country, 2009

countries—for example, Algeria, Botswana, and Mexico—lie on the fringes of areas of malaria transmission. Over time, when such fringe countries have achieved elimination, neighboring countries—including in this example Niger, Zambia, and Guatemala, respectively—will find themselves on the boundaries of areas of transmission, and they will de facto be faced with the decision of whether or not to pursue the same goal, either for their border areas or for the whole country. Figure 1.1 shows that countries in large parts of Eurasia, Asia, and South America, as well as island countries from the Caribbean, Africa, and Oceania, have made the decision to go for elimination.

While it is countries that typically embark on malaria elimination and are eventually certified by WHO as malaria free, there are important subnational and supranational components to this effort. Countries can choose to pursue malaria elimination in limited areas pending a move toward a nationwide effort to eliminate. For example, a country composed of many islands, such as Vanuatu or the Solomon Islands, may undertake spatially progressive elimination by pursuing elimination island by island. Similarly, large countries, such as China, India, and Indonesia, may focus initially on malaria elimination in certain states and provinces before launching national elimination efforts.

### THE ELIMINATION DECISION

The decision to begin the elimination process is complex and should not be made lightly, as the consequences of failure can be discouraging and costly. A premature elimination target can lead to false expectations and may be followed by resurgence of malaria, damaged credibility because of the failure to achieve expected results, and consequent erosion of national and international support. At the same time, excessively conservative control targets can carry similar risks in that populations, governments, and donors may eventually tire of ongoing activity despite low disease risk. For some countries, political interest in and consensus on the feasibility of achieving and sustaining zero transmission will be strong enough initially so that the decision can be made with little analysis. This has been the case with some countries that have adopted elimination in recent years. With other countries, a more rigorous and evidence-based decision-making process will be needed. In line with previous and current WHO guidelines, the MEG recommends that countries unsure about an elimination program (subnational, national, or regional) should undertake a rigorous and structured study. The appropriateness and timing and the technical, operational, and financial feasibility of moving toward or participating in a program should be considered. Before a discussion of these issues takes place, some background is provided here on the potential economic (and other) benefits to a country of moving from a high degree of control to elimination.

## 1.2 Potential Benefits of Elimination

Successful, sustained elimination can yield substantial benefits for a country. These benefits range from the reduced burden of malaria and its sequelae, such as anemia, to the corresponding increase in educational attainment[11] and productivity in the population, to the potential stimulation of the tourist industry and greater foreign direct investment.

Eliminating malaria from a country requires current investment; the returns are realized later. These returns can come in one or both of two forms. First, elimination may simply be less costly than sustained control in the long run. Second, even if the long-term costs of elimination exceed those of sustained control, the ultimate benefits may still exceed the costs. A brief history of the economic consequences of attempts to eliminate other diseases may provide insight before the benefits and costs of malaria elimination are considered.

## ECONOMIC CONSEQUENCES OF ELIMINATING OTHER DISEASES

A review of the economic effects of disease elimination naturally begins with smallpox, which was globally eradicated in 1979. This is compared with the very different situation with measles. Table 1.1 addresses smallpox and measles, as well as the ongoing elimination/eradication programs for polio, Guinea worm, and river blindness.

Before the smallpox eradication campaign began, many countries had already unilaterally eliminated smallpox within their borders. Elimination by individual countries served as an indicator that eradication might be feasible. Eradication yielded specific dividends—removing the need to vaccinate, as well as the absence of risk of any future infections. This expectation of high benefits was met by the extremely high benefit-cost ratios, which were estimated later. It was possibly the greatest single public investment the world had ever made.[12] The key to the success of this investment was that smallpox eradication benefited the world, as well as every country. Yet, the effort almost did not succeed; its greatest challenge was international financing.[12]

The economics of malaria eradication differs from that of smallpox because in the latter case, every country had to vaccinate to a critical and even level everywhere (80%). Malaria has an ecological basis, and because of this the steps needed to eliminate malaria vary substantially from country to country. In this way, feasibility is inherently different between the two diseases, suggesting the desirability of the MEG's strategy to eliminate first in less-challenging countries on the endemic margins of malaria.

Measles has recently been eliminated in the Americas and in Asia; in other places, the number of cases has declined dramatically because of increased control. The benefit-cost ratio shown in Table 1.1 is small compared with smallpox eradication, partly because measles has a low mortality rate in resource-rich countries. It is also because, as yet, there is no dividend analogous to the cessation of vaccination that followed smallpox eradication. Because measles is highly infectious, sustaining elimination in the face of a substantial risk of reintroduction requires that countries maintain very high levels of immunization coverage. As we shall see, in countries technically well positioned for an elimination effort for malaria, there may be more economic similarity to smallpox eradication than to measles elimination, despite the differences outlined above.

## ELIMINATION AS A COST-REDUCING INVESTMENT

Before we conduct an analysis of malaria elimination relative to sustained control in a country, we need cost and epidemiological data, including estimates of

the inherent potential within a country to spread malaria (outbreak risk) and its risk of new infections from abroad (importation risk). If epidemiological and cost assessments are sufficiently favorable, elimination may prove to be a cost-reducing investment.

On the cost side, we first need to obtain the baseline costs of sustained control. Next, we need information about the most efficient combination of interventions that can eliminate malaria and about what that combination will cost. Ideally, we will have not just a point estimate but also an understanding of how costs vary with the level of control. The costs of approaching elimination are likely to be high in countries with a high importation risk or high outbreak risk. Elimination may not be economical in these countries, even if it is deemed technically feasible.

Finally, we need data on the costs of sustaining elimination after it has been achieved. As noted previously, for measles the marginal costs of achieving and sustaining elimination are the same. In both elimination and prevention of reintroduction, population immunity must be kept at the critical level through continued immunization. For malaria, it is possible that the measures needed to sustain elimination will be different from the measures that were used to achieve elimination. If the costs of sustaining elimination are lower than the costs of sustaining control, there will be an investment dimension to elimination.

The first step in an economic analysis of malaria elimination is to explore whether elimination could be a cost-reducing investment. Current historical information is highly limited for all three types of cost—sustaining control, pushing toward elimination, and sustaining elimination. Careful empirical case studies would provide much firmer guidance than is now possible about the circumstances that are likely to make elimination ultimately cost reducing. That said, cost analyses have been undertaken for a number of regions contemplating elimination, and these studies give an idea of the range of costs that might be expected. To take one example (which Chapter 4 further discusses, along with several others), our analyses suggest that Hainan Island, China, is now spending about $2.9 million per year to sustain a high level of control. The estimated cost of a push to elimination would be about twice as high annually for approximately 5 years. After transmission interruption, the estimated cost of holding the line would be about $1.6 million a year—substantially less than is now being spent. The 5-year investment period ultimately yields cost savings. For Swaziland, however, planning estimates point to the likelihood that sustaining elimination is likely to result in a permanent increase in costs. This increase can be justified by the benefits if their magnitude is sufficient.

**Table 1.1 | Economic studies of the elimination of selected diseases**

| Disease | Target | Status | Economics |
|---|---|---|---|
| **Smallpox** | The goal of eradication was declared by the World Health Assembly (WHA) in 1959. | The last endemic case was in 1977; smallpox was declared eradicated in 1979. | The benefits-costs ratio for global expenditure was 159:1; for international financing, 483:1.[13] |
| **Measles** | WHO Americas agreed to eliminate by 2000; WHO Europe by 2007; WHO Eastern Mediterranean by 2010. | It was eliminated in the United States in 2000 and in the Americas in 2002. Imports occur regularly. | Pelletier et al.[14] show that, for Canada, moving from a one-dose to a two-dose immunization program to eliminate measles yields a benefits-costs ratio between 2.6 and 4.3. |
| **Guinea worm (dracunculiasis)** | The goal of eradication was established by the Centers for Disease Control in 1980 and later reinforced by several WHA resolutions. | It was eliminated from 11 countries, including all of South Asia. It remained endemic in 9 sub-Saharan African countries at the end of 2006. | Kim et al. estimate a positive net present value,[15] implying benefits > costs; but see Miller et al.[16] |
| **Poliomyelitis** | The goal of eradication was declared by the WHA in 1988. | Wild poliovirus type 2 has not been detected since 1999. The other two wild viruses are endemic in 4 countries (Afghanistan, India, Nigeria, and Pakistan), down from 125. | Barrett and Hoel[12] showed that benefits > costs.[17] However, these analyses assume that eradication is certain to occur and that vaccination can cease post-eradication. |
| **River blindness (onchocerciasis)** | Two regional control programs, OCP and APOC, are in sub-Saharan Africa. WHO Americas pledged to eliminate onchocerciasis by 2007. | As of 2007, no new cases of blindness in the Americas have been due to onchocerciasis. Control efforts are successful in sub-Saharan Africa, but elimination has not been achieved. | Analysis shows benefits > costs for the OCP[18] and APOC.[19] |

## OTHER BENEFITS OF MALARIA ELIMINATION

Beyond the potential for cost reduction, there are other benefits of elimination efforts, notably, marked reductions in morbidity and mortality, an improved climate for tourism and foreign direct investment, and the satisfaction of a national accomplishment. These benefits may sometimes be of quantitative significance, but others are likely to prove difficult to measure. Even so, a judgment concerning their importance should be factored into the overall decision about whether to commence explicit elimination efforts.

In addition to the benefits within the country of achieving elimination,

there are international effects that may be important. Neighboring countries will no longer need to worry about importing cases from the eliminating country. The world as a whole will have taken a step toward the global public good of eradication, and many will have learned something from each country's experience. And, finally, the country will no longer be a source of potential resistance to antimalarial drugs, which will benefit all countries.

## EQUITY IMPACT

Every member of a country remaining at risk of malaria will benefit from malaria elimination. One consideration relevant to the decision of whether to eliminate is the equity consideration: will disadvantaged members of society share fully in the benefits of the program? Economists and others regularly conduct "benefit-incidence" analyses to ascertain which portions of a population benefit from a particular public sector program. Typically, but far from uniformly, programs favor the better-off. In the Philippines in 1998, for example, immunization coverage was about 75% overall, but in the poorest quintile, coverage was only about 50%. Given this starting situation, moving from 75% to universal coverage would differentially benefit the poor. It is plausibly similar with malaria elimination: because control efforts are likely to have first reached the better off and more engaged populations, elimination programs will, by reaching remaining segments of the population, almost surely prove to be equity enhancing.

In conclusion, our analyses point to the importance of considering the investment potential when elimination's initial costs are counterbalanced by a situation in which maintaining elimination is less costly than sustaining high levels of control. The possibility of such a situation is suggested by our analyses for Hainan Island; a country's actual importation and outbreak risks will determine the reality. Additionally, but harder to measure, elimination will improve a country's environment for tourism and foreign direct investment. The experience of malaria elimination in the United States and polio elimination in South America suggests that, if properly undertaken, these programs can contribute to overall health system strengthening. Finally, there is strong reason to believe that malaria elimination programs will enhance equity by principally serving disadvantaged subpopulations. These conclusions must be viewed with the caveat that the evidence available at this time is limited. It is important that malaria elimination efforts gather data as they progress so the economics of elmination can be reassessed on an ongoing basis.

## 1.3 The Feasibility Assessment

### TECHNICAL FEASIBILITY

According to WHO, elimination is technically feasible if it has been demonstrated in a similar eco-epidemiological setting in the recent past.[1] For the moment, this excludes, de facto, the whole of sub-Saharan Africa, where elimination has not been achieved recently. Pampana (1969) defined technical feasibility as "evidence that conditions in a country are such that a particular technique . . . will succeed in an acceptable period of time and that, once obtained, absence of transmission could be maintained."[20] The MEG further defines technical feasibility as the probability that malaria transmission can be reduced to zero in a given area using the currently available tools and that elimination can be maintained in that area. Achieving elimination thus depends on the effectiveness of the control tools used, which is influenced by the strength of transmission in a given area. Maintaining zero not only depends on the local strength of transmission but also on the probability that an infected person or mosquito does not reintroduce malaria into the area. The technical feasibility of maintaining elimination in a given area depends on the following:

- the malaria transmission potential of that area, or outbreak risk (receptivity)
- the likelihood that malaria will be reintroduced once elimination has been achieved, or importation risk (vulnerability)

Recent efforts to quantify both outbreak and importation risks are discussed in Chapter 7. Although there are no definite criteria for establishing the exact levels for both variables,[1] mathematical modeling should be an integral part of the methodology used to assess technical feasibility.

Modeling of outbreak risk is important for the elimination decision because the actual transmission levels at which countries should begin elimination efforts may vary significantly. Zanzibar, before 2000, was considered to be moderately to highly endemic and therefore not a country that, according to WHO guidelines, should aim for elimination. However, it achieved such levels of control that it recently decided to assess the feasibility of malaria elimination on the islands. Even though they had not reached the recommended WHO milestone of a slide positivity rate (SPR) of less than 5%,[1] the modeling of their outbreak risk demonstrated that elimination would be technically feasible in the next 6 to 10 years (David Smith, University of Florida, personal communication, February 2009).

Mathematical modeling of importation risk not only will quantify the risk of

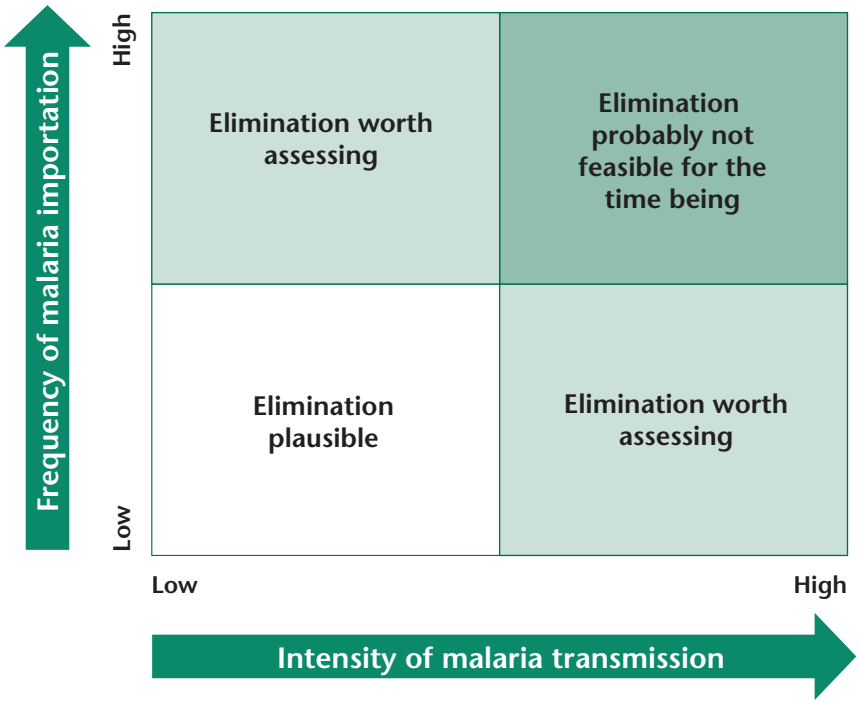


FIGURE 1.2 | Some factors determining technical feasibility

reintroduction but also might identify specific groups that need to be targeted with surveillance to avoid reintroduction of malaria. It will also provide the necessary arguments to convince governments, regional bodies, and donors of the importance of cross-border operations such as the Lubombo Spatial Development Initiative (LSDI) in Mozambique, South Africa, and Swaziland. Modeling outbreak and importation risks provides a more quantitative basis on which to determine technical feasibility, to complement WHO's qualitative definition of "proof in a similar eco-epidemiological setting."[1]

The decision to eliminate malaria is ultimately determined by its technical feasibility. If assessment of this feasibility concludes that technically it is unlikely that malaria can be eliminated, further evaluations of operational and financial feasibility become unnecessary. As illustrated in Figure 1.2, the concepts of outbreak and importation risk can help countries to grasp the technical feasibility even before rigorous evaluations are finalized.

When both factors are deemed to be high, as in Nigeria, the elimination decision should most probably be postponed. Instead, countries with high importation risk and high outbreak risk should scale up their malaria control for impact, both to reduce burden and to make it possible for themselves and

their neighbors to eventually move toward elimination. If the importation risk is low but outbreak risk high, as in certain island settings, feasibility will mainly depend on the country's ability to maintain high levels of control, reduce the vector capacity, provide prompt and effective treatment, and rapidly respond to detected cases. If a country's outbreak risk is considered to be low but importation risk is high because of population movements from endemic countries, elimination will only be possible if a near-perfect surveillance system detects all imported cases immediately. An example is in Bhutan, where 77% of all malaria cases originate from three districts located on its southern border with India.[21] Thailand provides a similar example of a country with high importation risk, where a vast majority of cases are imported from neighboring countries that do not have as strong malaria control measures. Both examples demonstrate that malaria is a regional issue. When both outbreak and importation risks are low, countries should seriously consider elimination.

### OPERATIONAL FEASIBILITY

Historically, operational feasibility was subdivided into administrative and practical feasibility. Administrative feasibility was defined as "the possibility to create a national organization that can carry out a malaria elimination program with a strong long-term governmental commitment, a conducive legal environment for malaria elimination control activities especially spraying and surveillance, and the availability of sufficient funds." Practical feasibility meant "countrywide access for personnel and materials, sufficient human resources for the malaria control program and the health facilities, and cooperation of the general public."[22] Given the importance of financial feasibility, the MEG proposes that it should be considered separately, and operational feasibility should focus on requirements related to the implementation of all activities needed to achieve and maintain elimination. The operational feasibility component thus tries to answer the questions around if and how the interventions needed to achieve and sustain elimination can be implemented given the capacity of the national malaria program and the health system. Unlike technical feasibility, which is defined by the malaria epidemiology in a given area that does not necessarily follow administrative borders, operational (and financial) feasibility can only be addressed using defined regional, national, or subnational units. While technical feasibility is paramount in the decision to go for elimination or not, operational feasibility is much more dependent on whether a government can or is willing to meet the necessary programmatic requirements and to create an enabling environment to facilitate the elimina-

tion process. If elimination is deemed technically feasible and the financial means and political will are available, almost anything can be done.

It is prudent to note that a variety of operational shortcomings were an important part of the failure of the Global Malaria Eradication Program, even when political commitment and financial means were available.[20] Key operational issues related to "getting to zero" and "holding the line" are therefore discussed in detail in the later chapters. When assessing the different aspects of operational feasibility, it is important to keep two main questions in mind:

1. What activities are essential, and for how long, to achieve and maintain elimination?
2. How are these activities different from "sustained control"?

Operational feasibility is extremely context dependent, but the following operational requirements can be considered universal components for any malaria elimination program:

- A health system that is capable of providing near-universal access to high-quality diagnosis and treatment—access and quality are important in order to guarantee sufficient coverage and specificity for passive case detection. This can be achieved through both the private and public sector and, as discussed in the following chapter, might be possible even when the health system is not yet fully developed. In addition, this will require sufficient capacity, both managerial and technical, at the central or district levels.
- The capacity to implement a near-perfect surveillance system; to design and run an effective information, education, and communication program; and to establish a monitoring and evaluation (M&E) system for measuring elimination-specific targets—the delivery of these key interventions is discussed in detail in the two following chapters. They are not unique to an elimination program but require either a higher level of perfection in their execution or a shift in focus or methods, which necessitates a careful evaluation of the operational implications.
- An enabling environment with political stability, genuine political buy-in and support, a legal framework adapted to the operational needs of elimination, good collaboration between the different sectors involved (e.g., immigration, education, and agriculture), community participation, and cross-border collaboration—all are important, but political stability can be considered an absolute.

> Political support has to reach beyond high-level, politically motivated declarations, and it requires direct involvement of political leaders to make elimination a matter of national priority and pride. In addition, it is important that malaria elimination be treated as a regional and global public good, with regional initiatives complementing national decision-making. In many ways, the ideal approach for most countries would be to join the pursuit of a multinational elimination target, which defines the scope of a program based on epidemiological factors rather than arbitrary national borders. As such, the MEG supports the idea of broad sub-regional or multi-country targets and collaborations as being the most effective approach to cross-border challenges.

## FINANCIAL FEASIBILITY

The efficient administration of any health program requires long-term stability. Providers need to learn their jobs within the system, and patients need to learn when and where to seek care. Stability, in turn, requires adequate levels and continuity of financing. Malaria elimination is no exception. Where then will the required financing come from? The annual amounts involved may reasonably be in the order of $0.25 to $25.00 per person in the population at risk (with the higher end ($25) being substantially more in difficult-to-reach locations [see Chapter 4 for more detail]). For middle-income and upper-income countries (9 of the 39 elimination countries in Table 1.2), domestic public financing can suffice. For the 11 low-income countries and for many of the 19 lower-middle-income countries, external assistance will be required and must be assured. (Low-income countries spend only $6 to $8 per person per year on health through the public sector.)

Beyond the concern for adequacy of financing, malaria elimination requires two additional elements of financial design. First, the country must sustain financing after the disease has ceased to exist in the population and has therefore lost political salience. Second, cross-border transmission will often call for international financing. The magnitude of the need for cross-border financial arrangements will increase with the country's importation risk. Chapter 4 proposes mechanisms to sustain financing after transmission in a country has ceased. These mechanisms include long-term loans or grants, earmarked taxes, and where feasible, creation of endowments. International financing can come from a relatively rich eliminating country to a poorer, malarious neighboring country. More typically, international financing will involve support by bilat-

## TABLE 1.2 | Demographic, economic, health, and aid characteristics of the 39 elimination countries[1]

| Country | Population (millions) | Life expectancy at birth (years) | GNI per capita (U.S. $)[2] | Health expenditure per capita (U.S. $)[2] | Private health expenditure (% of total health expenditure) | GFATM[3] R9 malaria eligibility (Y/N) | PMI[4] selected (Y/N) | World Bank IDA[5] eligible (Y/N) |
|---|---|---|---|---|---|---|---|---|
| **LOW-INCOME ECONOMIES** | | | | | | | | |
| Comoros | 0.6 | 65 | 650 | 14 | 47 | Y | N | Y |
| Haiti | 9.6 | 61 | 420 | 28 | 69 | Y | N | Y |
| Korea (North) | 23.7 | 66 | — | 14 | 14 | Y | N | N |
| Kyrgyz Republic | 5.2 | 66 | 450 | 29 | 60 | Y | N | Y |
| Madagascar | 19.7 | 59 | 290 | 9 | 38 | Y | Y | Y |
| Sao Tome and Principe | 0.2 | 61 | 800 | 49 | 15 | Y | Y[6] | Y |
| Solomon Islands | 0.5 | 67 | 630 | 28 | 8 | Y | N | Y |
| Tajikistan | 6.7 | 64 | 330 | 18 | 77 | Y | N | Y |
| Uzbekistan | 26.9 | 68 | 530 | 26 | 52 | Y | N | Y |
| Yemen | 22.4 | 61 | 650 | 39 | 58 | Y | N | Y |
| Zanzibar[7] | 1.0 | 43 | 340 | 17[8] | 43[8] | Y | Y | Y |
| **LOWER-MIDDLE-INCOME ECONOMIES** | | | | | | | | |
| Algeria | 33.9 | 71 | 2,720 | 108 | 25 | Y | N | N |
| Armenia | 3.0 | 69 | 1,470 | 88 | 67 | Y | N | Y |
| Azerbaijan | 8.6 | 64 | 1,260 | 62 | 75 | Y | N | Y |
| Bhutan | 0.7 | 64 | 1,270 | 52 | 29 | Y | N | Y |
| Cape Verde | 0.5 | 70 | 1,980 | 114 | 18 | Y | N | Y |
| China | 1,320.0 | 73 | 1,740 | 81 | 61 | Y | N | N |
| Dominican Republic | 9.8 | 70 | 2,310 | 197 | 67 | Y | N | N |
| Egypt | 75.5 | 68 | 1,270 | 78 | 62 | Y | N | N |
| El Salvador | 6.9 | 71 | 2,530 | 177 | 53 | Y | N | N |
| Georgia | 4.4 | 70 | 1,300 | 123 | 80 | Y | N | Y |
| Iran | 71.0 | 71 | 2,580 | 212 | 44 | Y | N | N |
| Iraq | 28.5 | 56 | — | — | 26 | Y | N | N |
| Namibia | 2.1 | 61 | 2,950 | 165 | 35 | Y | N | N |
| Paraguay | 6.1 | 75 | 1,230 | 92 | 64 | Y | N | N |
| Philippines | 87.9 | 68 | 1,270 | 37 | 63 | Y | N | N |

**TABLE 1.2** | *(continued)*

| Country | Population (millions) | Life expectancy at birth (years) | GNI per capita (U.S. $)[2] | Health expenditure per capita (U.S. $)[2] | Private health expenditure (% of total health expenditure) | GFATM[3] R9 malaria eligibility (Y/N) | PMI[4] selected (Y/N) | World Bank IDA[5] eligible (Y/N) |
|---|---|---|---|---|---|---|---|---|
| **Sri Lanka** | 19.9 | 72 | 1,170 | 51 | 54 | Y | N | Y |
| **Swaziland** | 1.1 | 42 | 2,210 | 146 | 36 | Y | N | N |
| **Turkmenistan** | 5.0 | 63 | 1,234 | 156 | 33 | Y | N | N |
| **Vanuatu** | 0.2 | 69 | 1,580 | 67 | 35 | Y | N | Y |
| **UPPER-MIDDLE-INCOME ECONOMIES** | | | | | | | | |
| **Argentina** | 39.5 | 75 | 4,460 | 484 | 56 | N | N | N |
| **Botswana** | 1.9 | 52 | 5,320 | 362 | 36 | N | N | N |
| **Costa Rica** | 4.5 | 78 | 4,660 | 327 | 24 | N | N | N |
| **Malaysia** | 26.5 | 72 | 5,070 | 222 | 55 | N | N | N |
| **Mexico** | 105.3 | 74 | 7,300 | 474 | 54 | N | N | N |
| **South Africa** | 47.6 | 51 | 4,810 | 437 | 58 | N | N | N |
| **Turkey** | 73.9 | 73 | 4,750 | 383 | 29 | N | N | N |
| **HIGH-INCOME ECONOMIES** | | | | | | | | |
| **Korea (South)** | 48.0 | 79 | 15,880 | 973 | 47 | N | N | N |
| **Saudi Arabia** | 24.2 | 70 | 12,540 | 448 | 24 | N | N | N |
| **Total countries** | 39 | | | | | | | |
| **Total population** | 2,173,020,000 | | | | | | | |

1. All data are from standard Web sources provided by the World Bank; World Health Organization; British Broadcasting Corporation; Central Intelligence Agency; the Global Fund to Fight AIDS, Tuberculosis and Malaria; and the Government of Tanzania. Data are from the most recent year available, mostly 2005-2008.
2. Atlas method (U.S. dollars): The Atlas Conversion Factor is used by the World Bank in order to facilitate cross-country comparisons of national income and health expenditure. The method uses the 3-year average of the local currency exchange rate to U.S. dollars, adjusting for inflation.
3. GFATM is the Global Fund to Fight AIDS, Tuberculosis and Malaria. R9 refers to applicant eligibility for Round 9 in 2009.
4. PMI is the President's Malaria Initiative of the U.S. Government.
5. World Bank IDA is the International Development Association.
6. Sao Tome and Principe is not among the PMI 15 focus countries but is receiving support from from the governments of Brazil and the USA for its elimination program.
7. Throughout this document we treat Zanzibar as if it were a country, because its malaria situation and intentions are different from those of mainland Tanzania.
8. These data include both Tanzania and Zanzibar.

eral or multilateral development assistance agencies for regional cross-border elimination projects.

The dynamics of malaria elimination point to the critical need for mechanisms to achieve sustainable international financing. In particular, the following considerations are important:

- After individuals are no longer exposed to the malaria parasite, they progressively lose what immunity they have acquired. The harm to a newly infected infant will be the same pre- and post-elimination. But for an adult who had acquired immunity through repeated exposure, and then lost it during elimination, the risk will be larger should malaria be reintroduced years after elimination. This biological feature of malaria increases the adverse consequences of reintroduction. Therefore, programs to eliminate malaria should ensure they maintain the highest levels of vigilance and the ability to respond.
- Elimination may have implications for drug resistance. According to the Global Malaria Action Plan, "sustained control increases the chances of resistance spreading; achieving elimination removes the risk of resistance."[8] Moving to elimination clearly has a potential role to play in containing resistance, and this has important implications for financial design. If drug resistance is particularly likely to occur in some regions (e.g., Southeast Asia), there is an important global public good associated with elimination. Containing resistance will not only place demands on sustained financing but also require development of appropriate international financial mechanisms.
- Malaria elimination is likely to shift the structures of costs and finances from those of a relatively independent control program to those of a program more fully integrated within a health system. In particular, it is natural to envisage shifts toward integrated vector control activities, multi-disease surveillance programs, and improved clinical management of imported malaria through generally strengthened clinical services. Sustaining the malaria component of these integrated activities may best be done by maintaining separate malaria elimination financing in the context of integrated operations.

In essence, transition to an elimination effort requires rethinking financing and, probably, adoption of new financial mechanisms. Financial feasibility requires institutional change as well as monetary resources. Regional or inter-

national bodies should provide the institutional structure not only to encourage and assist countries in achieving elimination but also to financially reward countries that pursue regional targets.

## 1.4 Conclusion

The decision to eliminate malaria is complex and should not be made lightly, as the consequences of an ill-informed or wrongly motivated decision can be serious. In the end, it is the role of each government, with local and international guidance as appropriate, to select and weigh the final set of factors that are relevant to its decision. The MEG strongly encourages countries to assess the technical, operational, and financial feasibility of elimination so that policy makers can make an informed choice on whether or not to pursue malaria elimination. Technical feasibility is a prerequisite for elimination, but certain aspects of operational feasibility, such as political stability, are equally important. Financial sustainability for activities aimed at a disease that will become increasingly rare will be a major challenge, and many malaria-endemic countries will most probably need long-term international financial support.

Donors and governments alike therefore need to be informed about the potential substantial benefits that successful and sustained elimination discussed earlier can yield. In that regard, it will be important to consider the investment potential of having elimination's initial costs counterbalanced by a situation in which maintenance of elimination is less costly than sustaining high levels of control.

It is important that malaria elimination be treated as a regional and global public good, with regional initiatives complementing national decision-making. In many ways, the ideal approach for most countries would be to join the pursuit of a multinational elimination target, and the MEG supports the idea of broad regional targets and collaborations as being the most effective approach to cross-border challenges. The MEG encourages countries and regions to be ambitious in their strategic thinking but believes that honest feasibility assessments followed by rigorous operational planning, in combination with novel approaches that guarantee sustainable financing, are key factors that will determine the success of any elimination effort.

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