The Fight against Malaria: A New Index for Quantifying and Assessing Policy Implementation Actions to Reduce Mortality in Sub-Saharan Africa

Bethencourt, Carlos and Marrero, Gustavo A. and Ngoudji, Charlie Y.

1 July 2021

The Fight against Malaria: A New Index for Quantifying and Assessing Policy Implementation Actions to Reduce Mortality in Sub-Saharan Africa

Carlos Bethencourt
University of La Laguna, CEDESOG
cbethenc@ull.edu.es

Gustavo A. Marrero (*)
University of La Laguna, CEDESOG and Equalitas
gmarrero@ull.edu.es

Charlie Y. Ngoudji
University of La Laguna, CEDESOG
cngoudji@ull.edu.es

July 2021

Abstract:

More than 90% of people suffering from Malaria live in Sub-Saharan Africa (SSA). We construct, for the first time, a Malaria Policy Index (MaPI) for 44 SSA countries to quantify and compare each country's antimalarial policy actions between 1990 and 2017. The MaPI compiles information on intervention strategies such as prevention, diagnosis and treatment (Pillar 1) and the use of antimalarial therapies and tests (Pillar 2). We find that: antimalarial policy implementation is a widespread phenomenon in the region from the mid-2000s on; initial differences in per capita GDP, quality of institutions and malaria burden are not associated with the current levels of policy implementation and; there exists a first stage of policy divergence (before mid-2000s), followed by a strong convergence period. The convergence period is associated with an unprecedented increase in international malaria fight funding, which was unevenly distributed across countries according to their necessities to eradicate the disease. Using a difference-in-difference events study design and a distributed lag model approach, we estimate the effect of antimalarial policy implementation increases on subsequent changes in malaria mortality within SSA countries. We find that policies included in Pillar 1 are key to reduce within-country malaria mortality: an increase of 10 p.p. in policies implemented in this pillar generates a cumulative malaria mortality decrease of about 6 p.p. after five years.

Keywords: Antimalarial policies, composite index, malaria death; Sub-Saharan Africa, external health aid; event study design.

JEL-Code: I15, O15, O22, O55

We would like to thank Nidia García, José-Víctor Ríos-Rull and participants at the Economic Research seminar at U. Autónoma de Barcelona and the XXVIII Meeting on Public Economics for valuable comments and suggestions. We specially thank to Raúl Santaeulalia-Llopis and Shaun da Costa for their helpful comments. This paper has received financial support from the Ministerio de Economía y Competitividad of Spain through project PID2019-107161GB-C33, and from Gobierno de Canarias through the ProID2017010088 (María del Carmen Betancourt y Molina program) R&D project, co-funded by the Operative Program FEDER 2014-2020. Any remaining errors are our own.

(*) Corresponding author: Gustavo A. Marrero, Departamento de Economía, Contabilidad y Finanzas. Universidad de La Laguna, Camino la Hornera, s/n, La Laguna, 38071, Spain.

1-. Introduction

Policy interventions are crucial to eradicate malaria (Lucas, 2010; Cutler et al., 2010; Blaekley, 2010). However, Sub-Saharan African (SSA) is staying behind (Sachs, 2002; Barofsky et al., 2015). In 2019, 229 million people were suffering from malaria, and 94% of them live in SSA. Limited resources and unfavorable natural conditions have made controlling the parasites causing malaria - the most important is the Plasmodium Falciparum mosquito - an extremely difficult task in the region. However, since 2000, the burden of malaria has declined considerably in SSA (World Malaria Report – WMR, 2011; Cohen et al., 2012). Between 2000 and 2019, the malaria incidence decreased from 363 to 225 per 1,000 population at risk, whereas the number of malaria deaths fell from 680,000 to 384,000 (WMR, 2020). Driven by international programs such as the Roll Back Malaria (RBM) Partnership Program or the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), this period is also characterized by a change in the international strategy of fighting against malaria.

The goal of this paper is to quantify policy actions against malaria, to identify main factors that explain policy implementation patterns along time and, to assess the effectiveness of such interventions on mortality rate reductions within SSA countries during the last 30 years.

There exists a plethora of papers studying the effects of different antimalarial programs on health, mortality, live births, educational attainment, etc. (Cutler et al., 2010; Lucas, 2010, 2013; Pathania, 2014, among many others), that mainly focus on the effectiveness of a particular eradication campaign or policy. However, this is not the way in which governments face the fight against malaria in practice. Rather than implementing isolated single policies, countries follow a strategic plan which encompasses a coordinated set of policies. The design and implementation of antimalarial policies packages becomes a widespread phenomenon in the region (Bhatt et al., 2015; Rosenthal et al., 2019). In this paper, we construct a synthetic Malaria Policy Index (MaPI) for a set of 44 SSA countries from 1990 to 2017, taking into account the implementation of all existing antimalarial measures. Next, using a difference-in-difference events study design and a distributed lag model approach, we estimate the effect of antimalarial policy implementation hikes on subsequent changes in malaria mortality within SSA countries between 1990 and 2017.

To construct the MaPI, we gather information from the World Malaria Reports (WMRs, 2005-2018) and collect data on 61 antimalarial policies. Inspired by Dabla-Norris et al. (2012), who constructed a synthetic indicator for the quality of public infrastructures, our MaPI is built in a two-stepwise approach. First, we classify policies according to the nature of the intervention in seven categories and two big pillars: Pillar 1, which includes four categories related to prevention and vectors' control, diagnosis, treatment and case management, and surveillance measures; Pillar 2, which includes three categories grouping policies related to antimalarial therapies, therapeutic efficacy tests and insecticide susceptibility bioassays.[1] Second, for each country-year, we consider alternative aggregation techniques to construct the MaPI, and show that the results are quite robust to these alternatives.

The MaPI quantifies and allows us to compare each country's global implementation plan in fighting against malaria between 1990 and 2017, and make distinctions between measures of different natures (categories and pillars). As far as we are aware, this is the first attempt to synthesize the whole information of antimalarial policies for a large set of SSA countries, using a homogenous dataset and for a long period of time. Moreover, the considered period includes more than ten years before and after the aforementioned change of the international strategy to fight against malaria. Thus, in addition to its usefulness for traditional regression analysis (time series or panel data estimations), this type of information would be extremely useful to implement policy evaluation experiments and to consider other approaches such as dif-in-dif dynamic models or event study designs.

More precisely, for policy evaluation, the standard approach of attributing observed changes in malaria burden to the implementation of one program in a particular year or period may lead to misleading results. First, countries do not normally implement an isolated policy. Generally, the implementation of antimalarial policies is part of a global strategy (Rosenthal et al., 2019; WHO, 2019b). Thus, observed impacts on malaria burden (or other variables) are probably due to the implementation of a mix of complementary policies. Second, adopting a particular policy is not the same as

[1] As particular examples of policies in Pillar 1, we have the implementation of Long-Lasting Insecticidal Nets (LLIN), or the use of Indoor Residual Spray (IRS), or Rapid Diagnostic Tests (RDT), and the treatment with Artemisinin-based Combination Therapy (ACT). As examples of policies in Pillar 2, we have the implementation of special antimalarial therapies for severe malaria, or the use of tests to improve efficacy of combined therapies, and to improve the efficacy of sprays.

implementing it (WMRs, 2005-2020). Once the policy is adopted, the country has the possibility of implementing it continuously over time or intermittently (i.e., due to resources availability). Considering this distinction is especially relevant when we evaluate the effectiveness of a particular policy within a particular period and for different countries at the same time. Third, the longer the period we consider evaluating the effectiveness of a policy, the higher the risk of having another (new or re-implemented) policy interacting with it. This policy may interact with the policy that we are evaluating and, consequently, the resulting effects on malaria would also depend on the interaction of several policies. Since the MaPI distinguishes between adopted and implemented policies, and it contains information of all policies that a particular country is implementing against malaria every year, it becomes a relevant tool to perform correct policy evaluation experiments.

Once constructed the MaPI for each country-year, we study their trends and classify SSA countries according to their policy performances in fighting against malaria. Following Pinkovskiy and Sala-i-Martín (2014), we show that all groups of countries (classified attending to different initial macroeconomic, institutional and health conditions) experienced relevant increases in the MaPI during the whole period, and their differences by the end of the sample are, on average, negligible. However, the correlation between the initial conditions and the intensity in the implementation of policies changes around the mid-2000s. In the first part of the period, countries with better initial conditions (i.e., with higher per capita GDP, better institutions and lower malaria deaths rates) presented higher levels of MaPI; but, after the mid-2000s, the situation is reversed, and countries with the worst initial conditions catch up those countries with better initial conditions.

The change in these correlations coincides with the change of the MaPI cross-country convergence process. Before the mid-2000s, we observe a divergent behavior of cross-country SSA MaPIs. In the divergent period, in general, the richer countries were implementing more policies than the poorer ones, and that maybe associated with differences between countries in prioritizing the fight against malaria. However, from the mid-2000s to 2017, we show a strong convergence process, with initially low-MaPI countries showing larger increases in the policy implementation activity. This convergence period was characterized, as commented above, by a change of the international strategy in fighting against malaria, that rendered in an unprecedented increase of overall malaria fight funding (mostly, from international sources), from US$

200 million in 2004 to US$ 2.2 billion in 2017 (WMRs, 2005-2018), and which was unevenly distributed according to each countries' necessities in the fight against malaria. Hence, this change in the international strategy seems to be the key and common factor behind the aforementioned changes in MaPI correlations and convergence process.

In the second part of the paper, we analyze the association between the antimalarial policy implementation and within-country changes of malaria deaths in the region. Our analysis explores common and country-specific effects of the implementation of antimalarial policies in the within-country reduction of mortality caused by malaria. Accordingly, we apply, for a country panel dataset, a difference-in-difference events study designs (Simon, 2016; Fuest et al., 2018) and a distributed lag models approach (Suárez-Serrato and Zidar, 2016) to estimate the effect of antimalarial policy increases on posterior changes in the malaria mortality rate within SSA countries.

In the event study specification, we identify a large increase of policy implementation as a raise above the 85th percentile of the entire distribution (Simon, 2016). Because of the different nature of the policies included in the MaPI, we distinguish between the effects generated by changes in Pillar 1 and Pillar 2. In these models, identification is achieved within countries and over the years, and causality requires pre-treatment effects to be irrelevant, compared with post-treatment impacts which must be significant. All our estimated models pass this requirement, especially for policy increases included in Pillar 1. We perform further estimation, identification and robustness checks in the paper.

We find that the implementation of policies included in Pillar 1 is the key to reduce the within-country malaria mortality rate in the region. Moreover, results are quantitatively relevant: an increase of 10 p.p. in this pillar generates a significant reduction of malaria mortality after two-three years and a cumulative decrease of about 6 p.p. after five years. We distinguish by age groups, and find that results are robust and significant in all cases, but the cumulative effect is higher, of about 8-9 p.p. after five years, for the group of children below five years old.

At the same time, we find that changes in the implementation of policies included in Pillar 2 (malaria therapies and tests) presented weak and noisy correlations with posterior changes in the malaria mortality rate. A plausible reason is that policies included in this pillar are more associated with the prevention and cure of malaria in the medium and long run. These different effects between Pillars 1 and 2 make the MaPI specification results noisy and less significant than those of Pillar 1. Therefore, while the MaPI is a convenient

index for tracking the overall implementation of antimalarial policies within and between SSA countries, we should distinguish between the different nature of their policies when focusing on a particular target, such as the reduction of malaria mortality.

Our paper is embedded in several strands of the literature. First, it is the body of the literature that investigates the efforts in fighting against malaria exerted by developing countries, particularly in SSA countries. One significant contribution in this area is Sachs (2002), which surveys the history of the malaria fight in this region till the launch of the RBM in 1998. He argues that one of the main reasons of the lack of strong efforts before the 90s was a general downturn in foreign aid mainly due to geopolitical reasons; moreover, for a successful eradication of the disease, despite major investment in R&D, it is needed: focusing on the most afflicted areas, campaigns funded adequately and consistently for at least two to three decades, and applying a plethora of measures that complement each other as part of a well-organized strategy. More recently, Rosenthal et al. (2019) highlight the relevance of external aid and the need to pay more attention to those countries that have persistent enormous burdens. They reviewed some of the most effective policies and stated that one of the main challenges is to integrate the best available tools into country systems and to target, phase, and combine their use to maximize their impacts. However, to date, except for papers that try to evaluate the implementation of some policy in a particular country, there has not been any study quantifying and comparing the current global efforts that different countries are exerting in fighting against malaria. The information contained in the MaPI may help to cover this gap.

Second, there is also extensive literature analyzing the impact of specific antimalarial policies on an individual's health. Studies in this field focus on the impact of malaria interventions on individual's health characteristics or other illnesses (see, among many others, Bhatt et al., 2015; Galactionova et al., 2015; Knols et al., 2016; Perera et al., 2020) and the multiple resurgences of the disease after periods of great declines in a particular location (Bruce-Chwatt, 1974; Cohen et al., 2012; Brock et al., 2017). However, as commented above, these papers only focus on isolated policy interventions and, in one particular period; and this may lead to misleading results, as countries, in general, apply coordinated policy plans as part of a broad strategy.

Third, another group of papers analyzes the impact of antimalarial policies on aggregate health indicators at the macroeconomic level. Some studies assess the effect and the

effectiveness of antimalarial intervention programs on, for instance, febrile illness and malaria cases (Witvorapong and Yakubu, 2019), child mortality (Fillinger et al., 2009; Yé et al., 2015; Klein et al., 2016; Gordon et al., 2017; RTS, 2015), adult mortality (Camponovo et al., 2017) or life expectancy and morbidity (Gunda and Chimbari, 2017; Weiss et al., 2020). Unlike the papers commented above, most of these works consider a wide group of countries, which allows making cross-comparisons. However, again, all of them focus on a single policy or a particular set of policies. The MaPI considers all policies implemented by countries in each period, and distinguishes the different nature of the intervention, hence its information may help improve the analysis conducted in this literature.

Finally, there exists long-standing literature that has studied the relationship between income, the quality of institutions and malaria burden. On the one hand, there is a group of papers that study the effect of malaria on economic performance. According to them, the effects of reducing malaria extend beyond direct health outcomes. These papers mostly discover that malaria leads to poor health outcomes, which in turn leads to low economic growth and worsen institutions (Carstensen and Gundlach, 2006;; Fielding and Torres, 2009; Bleakley, 2010; Okorosobo et al., 2011; Musumba et al., 2014; Gooch, 2017;; Flückiger and Ludwig, 2020; Kuecken et al., 2020; Aaron and Akpalu, 2021). On the other hand, another group of papers emphasizes the reverse causality, and they claim that the persistence of malaria in some countries and regions is linked to the initial level of development. According to them, low urbanization and development levels and low quality of institutions adversely affect the ability to prevent and treat the disease (Gallup and Sachs, 2001; Sachs, 2002; Datta and Reimer, 2013; Tusting et al., 2015). In this regard, the MaPI can be used as an instrument to link both perspectives: first, to study how macroeconomic variables as economic and institutional indicators affect the policy implementation, that is, the MaPI; second, to analyze how malaria burden (driven by changes in the MaPI) affects to macroeconomic variables, such as human capital or per capita GDP.

The rest of the paper is structured as follows. In Section 2, we show the procedure to construct the MaPI. In section 3, we describe its trend evolution between 1990 and 2017. We also analyze the causes of the convergence process observed between 2003 and 2017, and connect this process with external health aid and international intervention factors. In Section 4, we analyze the impact of antimalarial policy implementation changes on the

malaria mortality death rate. Finally, Section 5 ends with the main results and extensions. We provide extensive appendices showing the different antimalarial policies, the details in the construction of the MaPI and the detail of the evolution of the MaPI country by country (Online Appendix).

2-. The Malaria Policy Index

We propose a methodology to construct a Malaria Policy Index (MaPI). This index compiles and synthesizes available information on antimalarial interventions and it facilitates the tracking and assessment among countries and over time. To construct the index, we gather information from the World Malaria Reports (WMRs), period 2005 – 2018. This database is a homogenous source of antimalarial policies covering 44 SSA countries, and it represents the WHO Global Malaria Programme's flagship publications in the fight against malaria.[2] Each country profile contains well-structured information about existing antimalarial policies (prevention, diagnosis, treatment and surveillance), antimalarial therapies, therapeutic efficacy tests and insecticide susceptibility bioassays.

The WMRs distinguish between adoption and implementation status. In general, there is a delay between the adoption and the effective implementation of a policy and, in some cases, the implementation of an adopted policy can be interrupted in a particular year. Here we focus on implementation, which is the dimension that matters when evaluating the effective fight against malaria. However, whereas the WMRs provide information regarding adopted policies from 1930 to 2017, information for implemented policies is only available from 2004 to 2017.[3] In Section 3, we explain a simple strategy to recover data on implemented policies from adopted policies.

2-1. Antimalarial measures

The first step to construct the MaPI is to collect all potential antimalarial measures existing in SSA countries for a particular country-year (Table A1, Appendix A.1.).

[2] In general, each WMR contains information on the implementation of antimalarial policies for the year preceding the year of the publication report. For example, the WMR of 2005 contains information about the implementation in 2004. These reports collect data from 45 countries, but we have excluded South Sudan because it gained its autonomy in 2011 and we cannot produce antimalarial data of the country before this date. Moreover, we disregard 2018 (available in the WMR of 2019) from our sample because of insufficient available information for all countries.

[3] According to the WMRs, South Africa was the first country to adopt an antimalarial measure (the use of Indoor Residual Spraying, IRS, as the primary vector-control intervention) in 1930. It was followed by Zimbabwe that adopted the same measure in 1947; in 1950, Botswana adopted this measure and an additional one (the use of Dichlorodiphenyltrichloroethane – DDT for IRS).

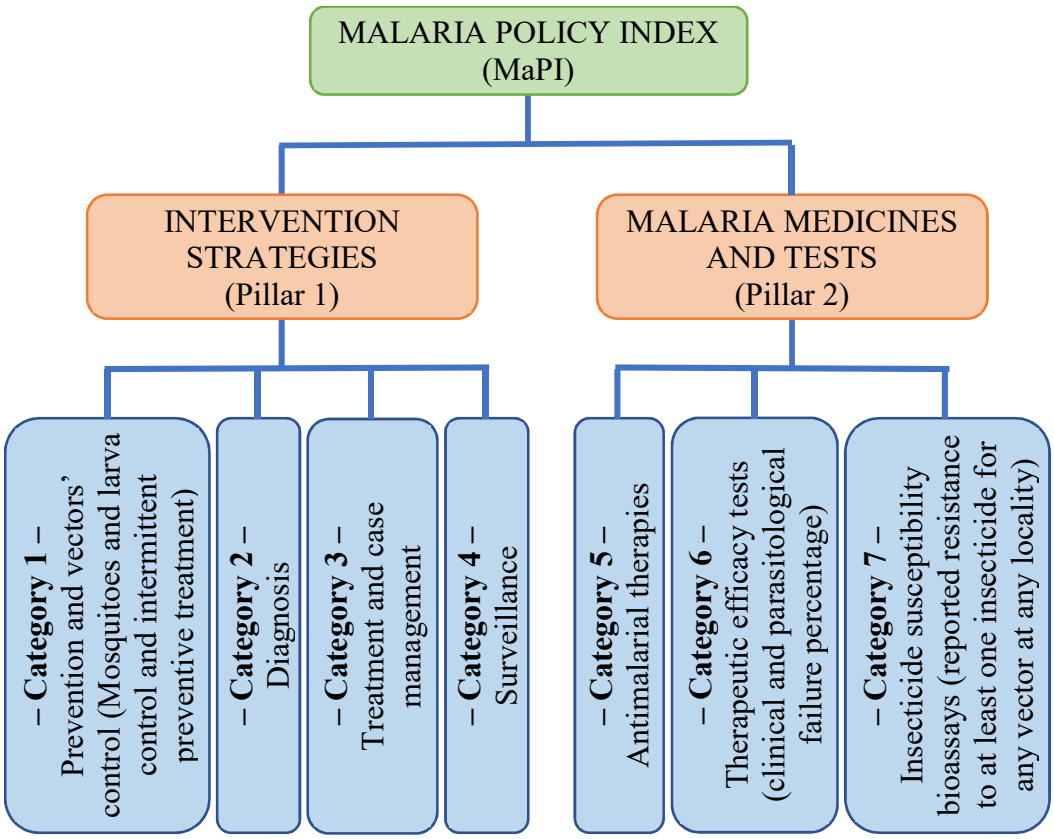
Policies definitions and classifications follow the guidelines established by the WMRs. In the next step, we group the different measures according to the nature of the intervention and their targets, and then we create different pillars and categories (Figure 1). More precisely, from the initial set of 61 measures, we define two large pillars and seven categories.

Pillar 1 (Intervention Strategies) includes 41 measures distributed among four categories. Category 1 (Prevention and vectors' control) comprises 16 measures targeted to the control of the mosquitoes and their larva, as well as the chemoprevention of the disease among children and pregnant women. Measures included in this category are: the insecticide treated nets –ITNs– (6 measures), the indoor residual spray –IRS– (6 measures), the larval control (1 measure) and the chemoprevention of malaria (3 measures). Category 2 (Diagnosis) is constituted by a set of 6 measures oriented to parasitological checking and confirmation (i.e., the massive use of Rapid Diagnostic Tests, RDT), measures beyond traditional clinical diagnosis. Category 3 (Treatment and case management) comprises 14 measures about malaria treatment and case management strategies. Specifically, 10 of them are oriented towards malaria treatment and the remaining 4 are targeting malaria case management. For example, after the detection of strong resistance to traditional treatments with Chloroquine and Sulfadoxine-pyrimethamine, new policies are oriented to the implementation of new treatments with Artemisinin-based Combination Therapy (ACT), parenteral quinine or artemisinin derivatives. Category 4 (Surveillance) comprises the remaining 5 measures related to surveillance strategies in terms of malaria care, such as the implementation of Active Case Detection (ACD) or mass screening campaigns.

Pillar 2 (Malaria Medicines and Tests) includes 20 measures distributed in three additional categories. Category 5 (Antimalarial therapies) is composed of 6 measures that are classified as antimalarial therapies (in special cases), such as the treatment used for unconfirmed and confirmed Plasmodium falciparum, for both Plasmodium vivax (another less frequent mosquito causing malaria) and severe malaria. This category also includes therapies used in treatment failure of Plasmodium falciparum and prevention of malaria during pregnancy. Category 6 (Therapeutic efficacy tests) comprises 10 measures devoted to improve the efficacy of combined therapies (i.e., those included in Category 3 based on combinations with artemisinin derivatives). Finally, Category 7 (Insecticide susceptibility bioassays) collects 4 different types of tests related to the potential

resistance of the mosquitoes to insecticide classes (i.e., Pyrethroids insecticide class) in different areas. Measures included in this category targets to improve the efficacy of vector control measures in Category 1.

Figure 1: The Malaria Policy Index Framework



Source: Constructed by the authors using information from the WMRs (2005-2018).

2-2. Policies scoring, aggregation and the MaPI construction

The MaPI is built through different levels of aggregation: categories, pillars and, finally, the index itself. However, a previous refinement before the multiple steps of aggregation is needed. In order to avoid double accountability, we must take into account that some measures are part of other broader measures. More precisely, we find that among the initial set of 61 measures, 19 of them are partially contained in other 12 broader ones (see Appendix A.2 and Table A.1 for details). Hence, we reduce the set of 61 antimalarial measures to a set of 42 broader measures or "policies".[4] In addition, depending on the

[4] An example of this situation is the policy "Free or highly subsidized Artemisinin-based Combination Therapy (ACT) in public sectors", which is included in the first category of Pillar 1. The WHO explicitly reports the existence of two alternative measures that are contained into this broader policy: "Free ACT for patients above 5 years in the public sector" and "Free ACT for children under 5 years old in the public sector".

relative importance given to each one and the way each level is aggregated, we can construct alternative versions of the MaPI. Indeed, we construct two different versions: raw (unweighted), and weighted.

In the raw version (MaPI-R), we consider all policies equally important inside across the category, that is, each category scores proportionally to the number of policies within the category. For example, category 1 in Pillar 1 has 8 policies. Therefore, the implementation of 2 policies in a particular country-year implies a score of 2/8. We apply this rule for all (seven) categories, countries and years. Next, we aggregate categories by pillars using a sample average: 1/4 for each category in Pillar 1, and 1/3 for each category in Pillar 2. Finally, each pillar weighs 1/2 in MaPI-R. The raw version of the index has a straightforward interpretation: the percentage of antimalarial policies that a particular country has implemented in a particular year. However, this version presents two shortcomings: all policies are assumed to be equally important; and aggregations are based on sample averages, which is an unrealistic assumption since categories do not have the same number of policies.

To overcome these weaknesses, we construct an alternative (weighted) index: the MaPI-W. To handle the first weakness, we classify each of the 42 policies as primary or secondary. This classification attends to the level of relevance the WHO gives to the implementation of each policy in the fight against malaria: primary policies are "strongly recommended" by WHO, while the rest of policies are assumed to be secondary ones (see Appendix A.2., Table A1). The implementation of a primary policy scores 1 whereas the implementation of a secondary policy scores 1/2.[5]

Table 1: Weights by category and by pillar

Pillars	Categories	MaPI-R weighting		MaPI-W weighting	
		Cat.	Pillars	Cat.	Pillars
Intervention Strategies (Pillar 1)	Prevention and vectors' control (Category 1)	0.250	0.5	0.341	0.595
	Diagnosis (Category 2)	0.250		0.159	
	Treatment and case management (Category 3)	0.250		0.318	
	Surveillance (Category 4)	0.250		0.182	
Malaria Medicines and Tests (Pillar 2)	Antimalarial therapies (Category 5)	0.333	0.5	0.400	0.405
	Therapeutic efficacy tests (Category 6)	0.333		0.333	
	Insecticide susceptibility bioassays (Category 7)	0.333		0.267	

[5] In cases where policies can be targeted by several measures (as the example commented in the previous footnote), if the broad policy is not implemented but, instead, any of the alternative measures is, this policy scores less than 1 or 1/2, depending on whether the broad policy is primary or secondary. In this latter situation, each policy scores proportionally to the number of measures contained on it. For instance, if a primary policy can be achieved by implementing three alternative measures and the country only undertakes two of them, then the score would be 2/3 (see part A.3. in Appendix A for details).

Source: Authors' calculation using information from WMRs (2005-2018).

To handle the second weakness, the MaPI-W weights each category and pillar unevenly, according to the number and relevance (primary versus secondary) of the policies included in each category and pillar (see Appendix A, part A.4., for details). Table 1 shows the distribution of weights in both MaPI-W and MaPI-R: whereas the four categories of Pillar 1 and the three categories of Pillar 2 in MaPI-R are weighted uniformly (1/4 and 1/3, respectively), the four categories of Pillar 1 in MaPI-W weight 0.34, 0.16, 0.32 and 0.18, respectively, and the three categories of Pillar 2 weight 0.40, 0.33 and 0.27, respectively. Similarly, Pillar 1 and Pillar 2 weight 0.60 and 0.40 in the MaPI, respectively.[6]

2-3. The average MaPI between 2004 – 2017

Figure 2.a shows the MaPI-R and the MaPI-W for each SSA country, taking their average values between 2004 and 2017. For illustrative purposes, Figure 2.b shows the MaPI-W average values in a Map. The 2004-2017 period is the one for which we have information for implemented policies. Since countries may change their implementation strategies from one year to another, the average for the 2004-2017 period is more representative of the global effort in the fight against malaria. Countries are presented in descending order according to their position in the MaPI-W. In all the 44 SSA countries, the average MaPI-W is larger than the average MaPI-R for the whole period.[7] Also, we find high similarities when comparing the country-ranking derived from MaPI-R and MaPI-W: their rank-correlation is 0.97.[8]

Indeed, though occupying different positions, the top-five countries are equal in both versions of the index. For example, Zambia takes the lead in the MaPI-W and comes third in the MaPI-R, while Ethiopia leads the MaPI-R and takes the second position in the MaPI-W; Sudan, Madagascar and Senegal complete the set of top-five countries in both

[6] Note that there are more ways of aggregating. Another alternative way of aggregating is considering that all policies have the same weight, that is, 1/42. In this case, weights for categories would be: 8/42, 4/42, 10/42, 5/42; 6/42, 5/42, 4/42 and pillars would be weighted as: 27/42 and 15/42 for Pillar 1 and Pillar 2 respectively. We have calculated the MaPI using these weights and we have checked that main results do not change (results are available upon request).

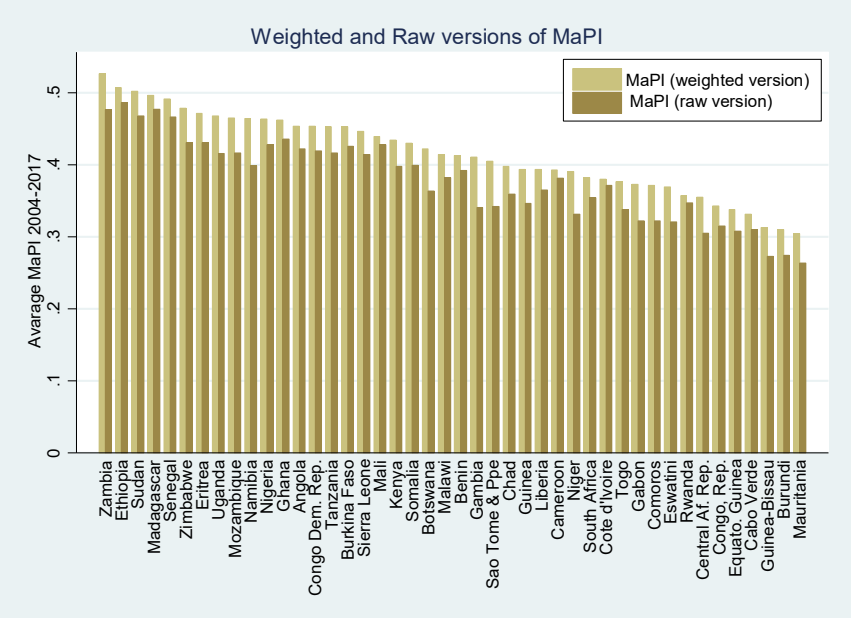
[7] This is because more implemented categories are the ones with higher weights in the index (i.e., Categories 1, 3 and 5, as shown in Table 1). See Table 2, where Categories 1, 3 and 5 show, in most of the cases, the highest scores.

[8] The rank correlation remains very high when comparing pillars and categories among the two versions of the index. This comparison is available upon request.

versions. We also find that the bottom-seven countries show similarities in the rankings of both versions of the index. For instance, Mauritania occupies the last position in the two versions, while Burundi and Guinea-Bissau come 43rd and 42nd (over 44) in MaPI-W, respectively, but swap places in MaPI-R. These three countries share the bottom-seven position with Cabo Verde, Equatorial Guinea, Congo Republic and the Central African Republic.

From now on, we focus on the MaPI-W (and refer to it as MaPI). Table 2 shows the average scores for Pillars 1 and 2, and the seven categories included in the index, between 2004 and 2017.[9] There exist positive correlations between the MaPI and the two pillars: 0.83 between MaPI and Pillar 1, and about 0.70 between MaPI and Pillar 2. However, the correlation between Pillar 1 and Pillar 2 is just 0.17, which is an evidence about the different nature of the policies implemented within each pillar: pillar 1 includes policies more related to prevention, diagnosis, treatment and surveillance of malaria, while policies in Pillar 2 are more related to the therapies used and tests carried on them, besides tests carried on insecticides used in the prevention of malaria.

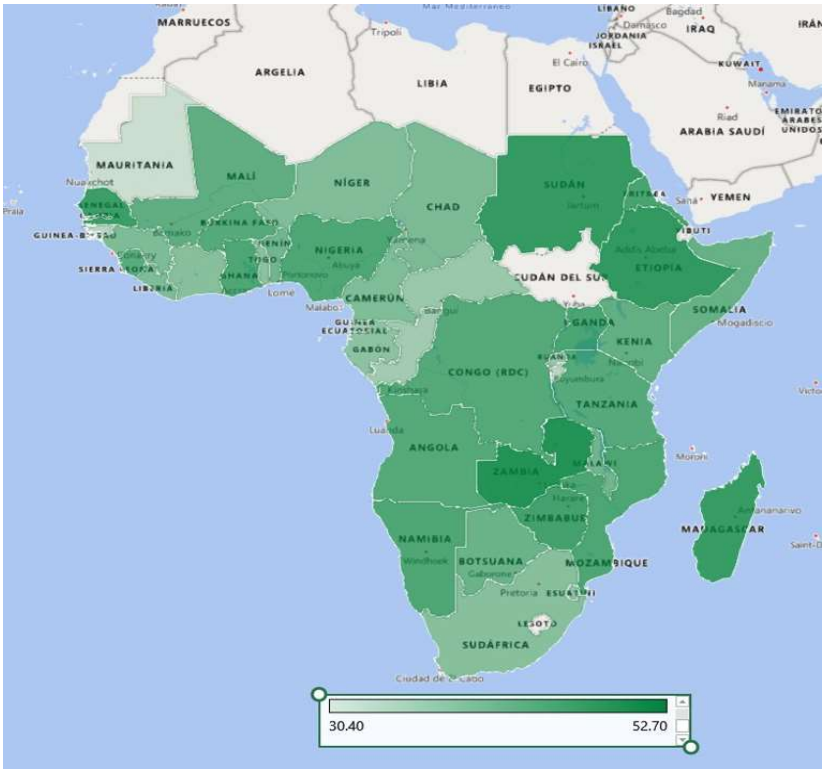
Figure 2.a: Antimalarial Policy Intervention Index, MaPI in SSA: 2004-2017 average (Ranking)



Source: Authors' calculation using information from WMRs (2005-2018).

[9] These results are almost similar for the raw and other versions of the index (results are available upon request).

Figure 2.b: Antimalarial Policy Intervention Index, MaPI in SSA: 2004-2017 average (Map; weighted version)



Source: Authors' calculation using information from WMRs (2005-2018).

There are also positive correlations between each pillar and their categories, but they are far from being perfect. This means that each category contributes valuable information to each pillar and the general index, which is a desirable property for a composite index. For instance, Pillar 1 is positively correlated to the four categories included in it; correlations are: 0.73, 0.73, 0.83 and 0.56, respectively. However, between categories, their pairwise correlations ranged between 0.15 and 0.57.[10] This clearly indicates that each category within Pillar 1 is capturing a different policy dimension. Pillar 2 is strongly correlated with Category 7 (0.86), and to a lesser extent with categories 5 and 6 (correlation of 0.34 and 0.49, respectively). Within this pillar, correlations between all pairwise categories are weak (ranging from -0.03 to 0.22).

[10] The highest correlation coefficient is between Category 2 (Diagnosis) and Category 3 (Treatment and case management) about 0.57, practically parasitological confirmation is required before any malaria treatment in the SSA region.

Table 2: Malaria Policy Index - MaPI (weighted version) in SSA

Countries*	MaPI	Pillar 1: Intervention Strategies					Pillar 2: Malaria Medicines and Tests			
		Pillar 1	Preven-tion	Diag-nostic	Treat-ment	Surveil-lance	Pillar 2	Antima-larial thera-pies	Thera-peutic tests	Insec-ticide tests
Zambia	0.527	0.519	0.702	0.624	0.521	0.080	0.538	0.798	0.200	0.571
Ethiopia	0.507	0.443	0.533	0.642	0.490	0.018	0.602	0.833	0.348	0.571
Sudan	0.502	0.413	0.517	0.449	0.519	0.000	0.634	0.906	0.357	0.571
Madagascar	0.497	0.462	0.530	0.539	0.462	0.269	0.548	0.833	0.188	0.571
Senegal	0.492	0.448	0.594	0.515	0.416	0.170	0.556	0.679	0.396	0.571
Zimbabwe	0.479	0.468	0.708	0.373	0.454	0.125	0.496	0.798	0.144	0.482
Eritrea	0.472	0.465	0.553	0.642	0.513	0.063	0.481	0.798	0.171	0.393
Uganda	0.468	0.458	0.610	0.558	0.485	0.036	0.483	0.782	0.111	0.500
Mozambique	0.466	0.454	0.661	0.530	0.454	0.000	0.483	0.674	0.197	0.554
Namibia	0.465	0.506	0.686	0.535	0.491	0.170	0.404	0.890	0.000	0.179
Nigeria	0.464	0.399	0.571	0.391	0.447	0.000	0.560	0.833	0.222	0.571
Ghana	0.462	0.375	0.629	0.308	0.351	0.000	0.590	0.833	0.314	0.571
Angola	0.454	0.442	0.533	0.615	0.443	0.116	0.471	0.752	0.168	0.429
Congo Dem. Rep.	0.454	0.397	0.579	0.429	0.323	0.156	0.536	0.782	0.314	0.446
Tanzania	0.453	0.427	0.536	0.346	0.443	0.263	0.492	0.833	0.090	0.482
Burkina Faso	0.453	0.378	0.551	0.406	0.375	0.036	0.563	0.833	0.245	0.554
Sierra Leone	0.447	0.390	0.455	0.584	0.447	0.000	0.531	0.833	0.192	0.500
Mali	0.439	0.367	0.463	0.501	0.320	0.154	0.545	0.833	0.192	0.554
Kenya	0.435	0.372	0.533	0.312	0.422	0.036	0.526	0.798	0.194	0.536
Somalia	0.430	0.367	0.483	0.500	0.349	0.063	0.524	0.917	0.257	0.268
Botswana	0.422	0.463	0.564	0.485	0.469	0.245	0.362	0.762	0.000	0.214
Malawi	0.414	0.320	0.480	0.172	0.406	0.000	0.552	0.833	0.286	0.464
Benin	0.413	0.344	0.429	0.350	0.395	0.089	0.515	0.752	0.186	0.571
Gambia	0.411	0.418	0.621	0.481	0.387	0.036	0.401	0.833	0.202	0.000
Sao Tome & Ppe	0.405	0.453	0.539	0.475	0.507	0.179	0.335	0.805	0.000	0.048
Chad	0.398	0.365	0.469	0.529	0.381	0.000	0.447	0.818	0.116	0.304
Guinea	0.394	0.363	0.507	0.326	0.425	0.018	0.439	0.833	0.118	0.250
Liberia	0.394	0.341	0.437	0.439	0.363	0.036	0.471	0.762	0.100	0.500
Cameroon	0.393	0.289	0.398	0.274	0.335	0.018	0.545	0.782	0.240	0.571
Niger	0.391	0.394	0.583	0.455	0.366	0.036	0.387	0.833	0.103	0.071
South Africa	0.382	0.378	0.348	0.535	0.415	0.232	0.388	0.798	0.049	0.196
Cote d'Ivoire	0.381	0.268	0.318	0.288	0.336	0.036	0.546	0.833	0.267	0.464
Togo	0.376	0.350	0.476	0.386	0.377	0.036	0.414	0.679	0.257	0.214
Gabon	0.373	0.322	0.400	0.331	0.408	0.018	0.448	0.798	0.329	0.071
Comoros	0.372	0.372	0.463	0.395	0.419	0.098	0.371	0.750	0.186	0.036
Eswatini	0.370	0.437	0.539	0.579	0.344	0.286	0.270	0.652	0.000	0.036
Rwanda	0.357	0.265	0.351	0.337	0.288	0.000	0.492	0.798	0.076	0.554
Central Af. Rep.	0.355	0.320	0.405	0.359	0.371	0.036	0.407	0.818	0.183	0.071
Congo, Rep.	0.343	0.233	0.417	0.163	0.205	0.000	0.505	0.833	0.400	0.143
Equato. Guinea	0.338	0.319	0.330	0.468	0.394	0.036	0.365	0.667	0.082	0.268
Cabo Verde	0.331	0.330	0.196	0.538	0.353	0.357	0.333	0.798	0.000	0.054
Guinea-Bissau	0.313	0.276	0.343	0.367	0.294	0.036	0.368	0.798	0.148	0.000
Burundi	0.310	0.282	0.360	0.269	0.335	0.054	0.352	0.667	0.029	0.286
Mauritania	0.304	0.353	0.362	0.408	0.467	0.089	0.232	0.524	0.026	0.054

Notes: * Countries are ordered from the highest to the lowest MaPI.
Figures in the table are the averages between 2004 - 2017.
Source: Authors' calculation using information from WMRs (2005 - 2018).

3-. Antimalarial policy implementation dynamics: trends and convergence

This section presents the evolution of the MaPI and its pillars between 1990 and 2017. The implementation of antimalarial policies was relegated to a few measures and countries before 1990. As commented above, information about policy implementation

is only available from 2004 on; data on implementation from 1990 to 2003 has been obtained from available data on adopted policies (see Appendix B, Part B1).[11]

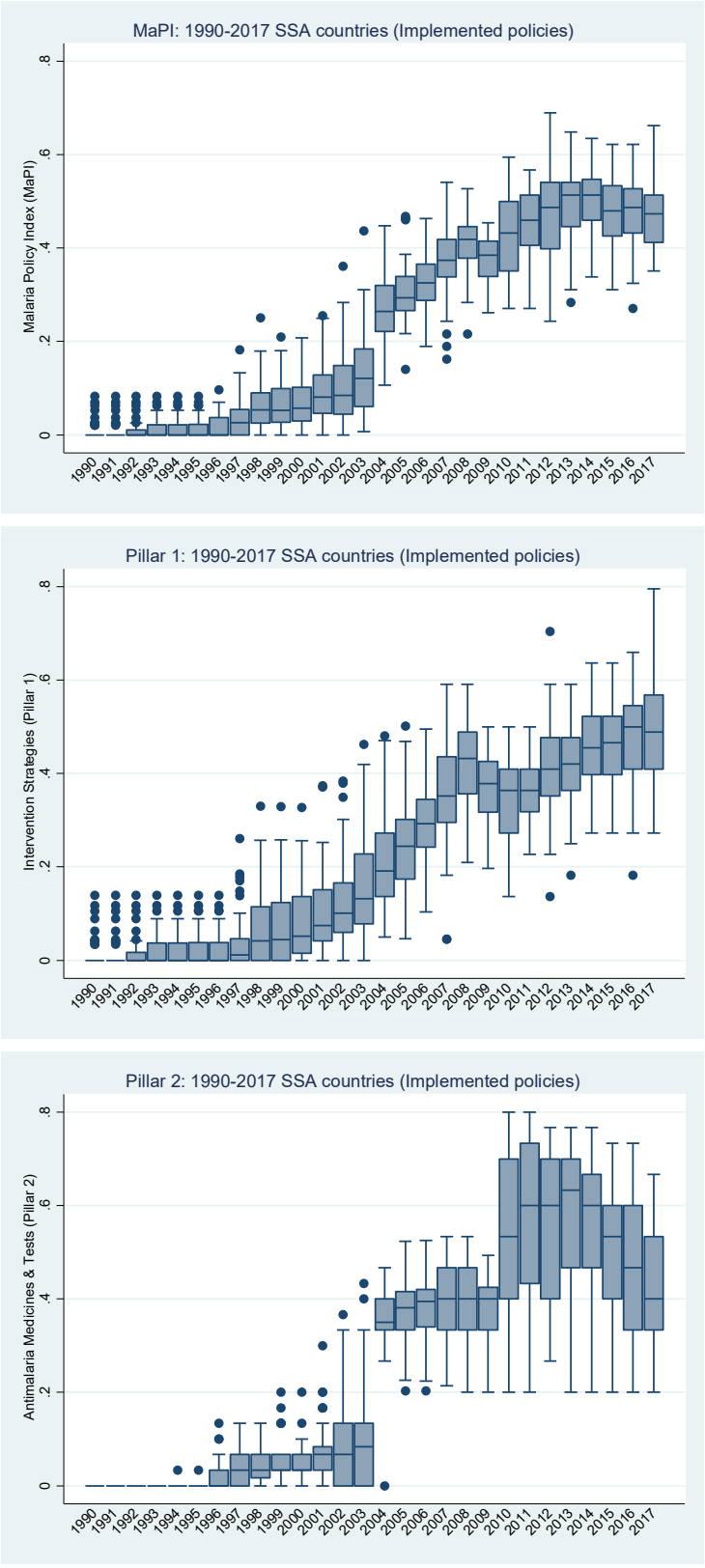
We first analyze the common trends of the MaPI across SSA countries between 1990 and 2017. Next, we investigate whether the MaPI dynamics and their current levels correlate with initial macroeconomic and health conditions. Finally, we study the convergence pattern between SSA countries and analyze the role played by international antimalarial campaigns and external health aid in such process.

3-1. Evolution of the MaPI: 1990 – 2017

The first graph in Figure 3 shows the evolution of the average MaPI between 1990 and 2017.[12] We can distinguish four different phases in this evolution. First, starting with few countries implementing malaria policies by 1990, the average MaPI level remained very close to zero until 1996 (Ethiopia presents the highest MaPI, about 8.3% in 1990). Second, between 1996 and 2003, the average MaPI shows a general but small upward trend, rising from 1.9% to 13.6% (an annual increase of 1.5 percentage points (p.p.)). In general, these two phases (between 1990 and 2003) are characterized by low rates of policy implementation in the SSA region. During these years, most national health agencies did not prioritize the fight against malaria (Nájera, González-Silva and Alonso; 2011). Moreover, the exclusion of the region from the WHO Malaria Elimination Programme initiated in 1955,[13] and the lack of international donor assistance to fight against the disease during this period (Narasimhan and Attaran, 2003) did not help to reverse this situation. Only the continuous and uncontrollable growth of malaria between 1984 and 2003 pushed some countries to increase preventive measures against the disease by the end of this period (Snow et al., 2017).

[11] We obtain the same conclusions for the series of implemented policies than for the adopted ones, before and after 2003. Hence, our analysis for implemented policies should not be affected by this extrapolation.
[12] Each box in the figure represents 50% of the cross-country distribution of the MaPI in a particular year; the limits of the box illustrate the 25th and 75th percentiles (the lower and the upper hinges, respectively), and the center is the median; the arms of the box indicate the extremes of the distribution (the minimum and the maximum values), and the dots the outliers.
[13] See http://www.cdc.gov/malaria/history/index.htm.

Figure 3: The implementation of antimalarial policies in SSA between 1990-2017



Source: Constructed by authors using WMRs (2005-2018).

In the third phase, between 2003 and 2014, the average MaPI presents a general upward trend, with most countries actively involved in the implementation of antimalarial policies. In this period, the annual increase was about 3.3 p.p., which implies that it almost doubled the increase experienced between 1996 and 2003.[14] For the entire sample, the average MaPI achieved its maximum value at 50.2% in 2014. This third phase coincides with a change in the international strategy to fight against malaria and the increase of overall malaria funding from international sources. In this period, we observed an unprecedented increase in external malaria fight funding in the region, from US$ 200 million in 2004 to US$ 1.56 billion in 2014 (WMRs, 2005; 2015). We will further discuss this situation in Section 3.3. In the fourth phase, between 2014 and 2017, the average MaPI stabilized (even showing a slight decrease trend), achieving a value of 47.0% in 2017. The decline in the external funding received in the previous years to fight against malaria and the re-allocation of funds by donors to prioritize high burden countries and other health goals could be the reason for this slight decrease (Shretta et al., 2017).[15]

Next, we analyze each pillar separately for a better understanding of the evolution of the MaPI (Appendix B2 shows the trend evolution for each category). The second graph in Figure 3 shows the average evolution of Pillar 1 between 1990 and 2017. Until 2014, the general trend of the average MaPI goes hand in hand with the trend of Pillar 1. A closer inspection of data reveals that, from 1996 till 2003, the increase of Pillar 1 is mainly caused by the implementation of policies included in category 1 (prevention and vectors' control). Preventing and controlling the spread of malaria vectors through intensive use of ITNs and IRS have been one of the main objectives of SSA countries and a major recommendation by the WHO (Bhatt et al. 2015; Knols et al. 2016).

The posterior acceleration between 2004 and 2008 is caused by the implementation of policies in categories 1, 2 (diagnosis) and 3 (treatment and case management). Pillar 1 is affected by the economic crisis of 2008, as reflected by the valley observed between 2009 and 2011. This decline was due to the brake in the implementation of policies included in the three aforementioned categories. Finally, Pillar 1 increased continuously from 2011 till 2017, caused by the implementation of the three categories previously mentioned,

[14] The average MaPI falls in 2009 probably because of the worldwide economic crisis of 2008.
[15] It should be noted that the different phases of evolution of the MaPI since 1990 have nothing to do with the process we follow to recover data on implementation policies before 2004. These phases are the same for adopted policies (results with data on adopted policies are available upon request).

together with the beginning of the implementation of policies included in category 4 (surveillance) by some countries.[16]

The third graph in Figure 3 shows the average evolution of Pillar 2. After the mid-2000s, the most important increases in MaPI are connected with Pillar 2 (see Section 4.3.). Countries started the implementation of policies included in this pillar after 1994. The 1996-2003 period coincides with the general implementation of policies in category 6 (antimalarial therapies) and an early implementation of policies included in category 5 (therapeutic tests) in some countries. The average score of Pillar 2 in this period is only 3.1%. The 2003-2008 period includes a first big hike and a posterior steady increase in the implementation of policies in category 5. The average score of Pillar 2 in this period is 38.4%. Next, the 2008-2014 period coincides with the starting and massive implementation of policies included in category 7 (insecticide bioassays), and the continuation in the implementation of policies in categories 5 and 6. In these years, the average score of Pillar 2 is 53.6%, we observe a second big jump.[17] Finally, between 2014 and 2017, the average score of Pillar 2 reduces to 46.5%. This fall is due to the sudden reduction in the implementation of policies belonging to category 6, which became less than 5% (on average) in 2017.

We have to highlight that despite of observing a common upward trend in the implementation of antimalaria policies in SSA countries, there exist important differences among countries regarding the speed, the level and the type of policy implementation. To illustrate this, we observe the evolution of the MaPI for four selected countries: Angola, Central Africa Republic, Ethiopia and Namibia. Figure 4 shows that the Angola's MaPI grows faster than the Cantral Africa Republic, and the MaPI for the first one is higher than the MaPI of the second for the whole period. Regarding the composition of the MaPI, we observe a significant difference between the MaPI in Ethiopia and Namibia, for example. Showing similar levels and trends for the MaPI, Namibia shows higher implementation levels of Pillar 1 along the entire period, whereas Ethiopia reverses this pattern and implement more policies included in Pillar 2 at the end of the period. The Online Appendix shows a country-by-country detailed analysis, which makes clear not

[16] The implementation of policies in category 4 has been weak from the beginning (i.e., this category shows the smallest score in the MaPI). Because of this, in March 2018, the WHO released a reference manual on malaria surveillance, monitoring and evaluation.

[17] Threats to the benefits from malaria control due to emerging resistance to insecticides among Anopheles mosquitoes forced endemic countries to carry out insecticide bioassays in order to select and use the most useful insecticide class.

only the common trends of policy implementation but also existing heterogeneity across countries.

Figure 4: The implementation of antimalarial policies between 1990-2017 for a selected set of SSA countries

Source: Constructed by the authors using WMRs (2005-2018).

3-2. MaPI dynamics and initial conditions

In this section we examine to what extent initial macroeconomic and health aspects are related to some advantages, or not, in the process of antimalarial policy implementation between 1990 and 2017. To analyze this issue, we adapt the regional analysis for the SSA poverty conducted by Pinkovskiy and Sala-i-Martín (2014). Regarding macroeconomic factors, we consider the per capita GDP, as a measure of development degree, and the World Governance Index (WGI) (Kaufmann and Kraay, 2002; 2010), as a measure of institutional quality. Regarding health factors, we use life expectancy, as an overall health indicator, and the malaria death rate, as a measure of malaria burden.[18]

[18] For the two malaria burden variables most widely used in the literature (incidence and mortality), we use the time series of mortality because these latter are of better quality than those of malaria incidence (because of the proportion of missing) in the SSA region.

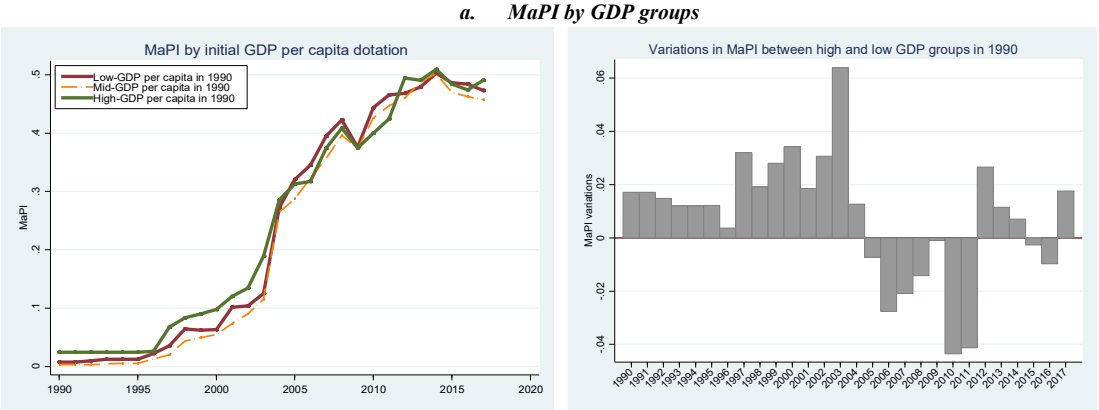
For each factor, we classify the set of countries according to their values in 1990, and break down the sample into three categories: *low*, for countries with values below the 25th percentile; *mid*, for countries with values between the 25th and 75th percentiles; *high,* for countries with values above the 75th percentile. Figures 5.a-d display the evolution of the MaPI for the different groups (left). We then evaluate the differences between the *high* and *low* groups (right).

In general, we find that all groups experienced relevant increases in the implementation of antimalarial policies during the whole period, and that the association between the countries' initial conditions and the degree of policies' implementation by the end of the sample (2014-2017) is, on average, negligible. However, we observe a change in the correlation between the initial conditions and the implementation of policies after the mid-2000s.

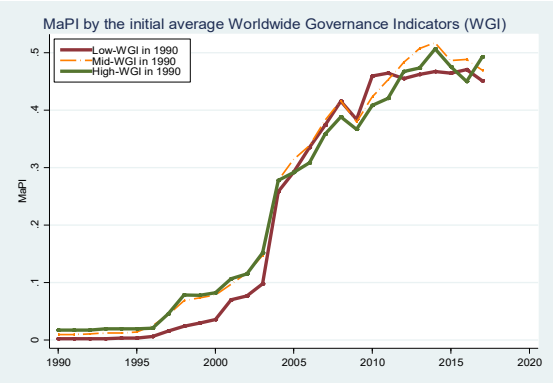
From the beginning of the period, countries with better initial conditions (i.e., with higher per capita GDP, better institutions, higher life expectancy and lower malaria death rate) present higher levels of MaPI. Nevertheless, the situation reverses after the mid-2000s with countries with worse initial conditions showing higher MaPIs at least during one decade. The change in the correlation after 2004 is more evident for health variables than for the macroeconomic aspects. For instance, using the period 2005-2011 as a reference, the (average yearly) gap between the low- and high groups of countries is 0.8 and 0.9 p.p. for life expectancy and malaria mortality, respectively, whereas these gaps are 0.5 and 0.6 p.p. for per capita GDP and WGI, respectively. As we will show in Section 3.3., the change in these correlations is associated with a change in the cross-country antimalarial policy implementation convergence process in the SSA region.

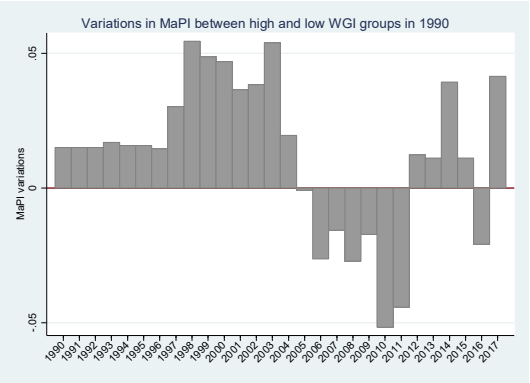
Figure 5: Evolution of the MaPI by groups (left) and gaps between the high and the low groups (right)

a. MaPI by GDP groups

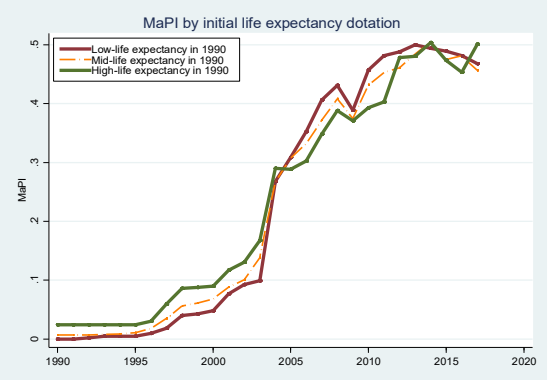


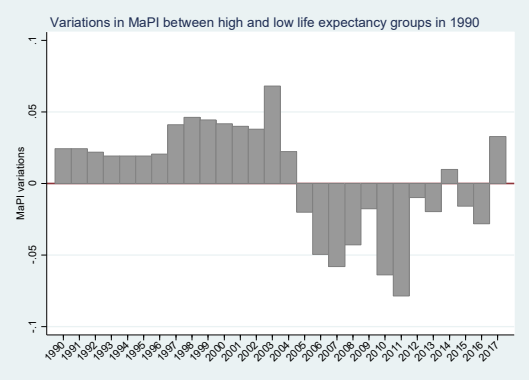
b. MaPI by WGI groups



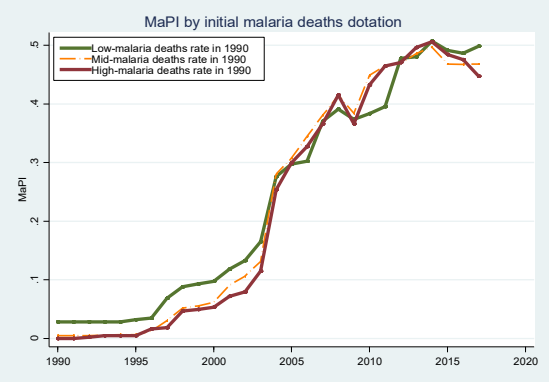


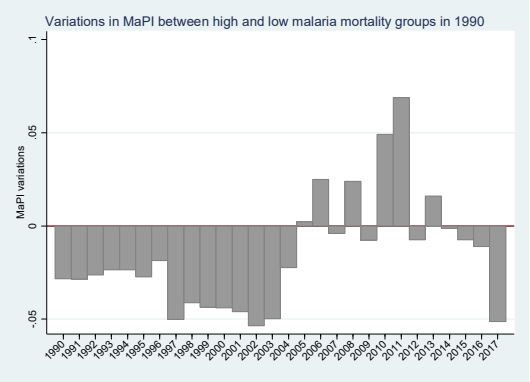
c. MaPI by life expectancy groups





d. MaPI by malaria death rate groups





Notes: The per capita GDP here is the expenditure-side real GDP at chained purchase parity powers (PPPs) taken from the Penn World Table 9.1. The Low-income group in 1990 include 11 countries (Burkina Faso, Burundi, Central African Republic, Ethiopia, Liberia, Malawi, Mali, Mozambique, Niger, Nigeria and Uganda) while the High-income group consists of 10 countries (Angola, Botswana, Comoros, Eswatini, Gabon, Ghana, Guinea, Namibia, South Africa and Zimbabwe). Eritrea and Somalia are excluded because of non-data availability.

With the aim of accounting for all these institutional quality aspects, we average all the 6 Worldwide Governance Indicators (WGIs) from the WGI project report (2020)[19] to obtain our WGI. In effect, the WGIs include six broad dimensions of governance over the period 1996-2019 and based on over 30 data sources: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. For the WGIs index, we approximate the values of 1990 by their values of 1996 because of the non-availability of WGI data before 1990. Results using WGI are very similar when using the polity2 variable from the Polity IV database (available under request). The Low-WGI group in 1990 is comprised of 11 countries (Angola, Burundi, Cameroon, Congo Democratic Republic, Guinea-Bissau, Liberia, Nigeria, Rwanda, Sierra Leone, Somalia and Sudan) and the High-WGI group also contains 11 countries (Benin, Botswana, Cabo Verde, Gabon, Ghana, Malawi, Mauritania, Namibia, Sao Tome and Principe, Senegal and South Africa). Initial values of WGI in1990 have been approximated by values of 1996.

We use life expectancy data from World Bank Health Nutrition and Population Statistics. Low- and High-life expectancy groups in 1990 are each comprised of 11 countries (Low group: Angola, Liberia, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Sierra Leone, Somalia and Uganda and High group: Botswana, Cabo Verde, Eswatini, Gabon, Kenya, Mauritania, Namibia, Sao Tome and Principe, Senegal, South Africa and Zimbabwe).

[19] Worldwide Governance Indicators (www.govindicators.org), The World Bank, Last updated September 28, 2020.

We use the Malaria deaths rate data from the Global Burden of Disease Study 2017 – GBD 2017 (Global Burden of Disease Collaborative Network, 2018) Results. High-malaria deaths rate group in 1990: Burkina Faso, Burundi, Congo, Dem. Rep., Cote d'Ivoire, Equatorial Guinea, Malawi, Mali, Mozambique, Niger, Sierra Leone and Uganda. Low-malaria deaths rate group: Botswana, Cabo Verde, Comoros, Eritrea, Eswatini, Mauritania, Namibia, Sao Tome and Principe, South Africa, Sudan and Zimbabwe.

Source: Constructed by the authors using WMRs (2005-2018), Penn World Table 9.1, WGI Project Report (2020), World Bank Health Nutrition and Population Statistics and GDB 2017.

3-3. Convergence in the implementation of antimalarial policies

We next investigate the convergence process of the MaPI across SSA countries between 1990 and 2017. We confront the initial situation of the MaPI (the x-axis) with its average yearly change (the y-axis) for all countries. A negative slope indicates that, on average, countries are reducing their gaps in terms of antimalarial policies' implementation, whereas a positive slope indicates a divergence pattern. Figures 6 show these scatter plots for the MaPI changes in two consecutive periods, from 1990 to 2003 and from 2003 to 2017, respectively. We divide the sample at 2003 for two reasons: first, from Section 3.1. 2003 coincides with a steady crease of the MaPI; from Section 3.2., we presented a change in how the MaPI correlates with countries' initials around this year.[20] This change in the convergence pattern is also observed for each pillar (see Figures B2, Appendix B, part B2).

The first graph in Figure 6 shows that only 10 out of 44 countries implemented antimalarial policies around 1990. Ethiopia stood out as the country with a major rate of policies' implementation with about 4 out of 42 policies implemented. From 1990 to 2003, there is no evidence of convergence in the MaPI. Countries that were at the top position in policy implementation in 1990 continue leading this ranking in 2003. In fact, 5 of the 10 countries which were already implementing antimalarial policies by 1990 belong to the top 10 countries with a higher implementation rate in 2003 (Zambia, South Africa, Ethiopia, Eritrea and Namibia). In this period of divergence, less than 50% of the countries in the sample were implementing some antimalarial policies, they were mostly associated with the first three categories of Pillar 1 and, to a lesser extent, to category 5 of Pillar 2.

Around the mid-2000s, this situation changes. All SSA countries start implementing antimalarial policies, which coincides with a change in the convergence process across

[20] These two periods are related to the four phases described in section 3.1. Indeed, we first observe that from 1990 to 1996, and from 1996 to 2003, there is no evidence of convergence and; second, we observe that from 2003 to 2014, and from 2014 to 2017, there is evidence of convergence in both cases.

countries (second graph in Figure 6): there is a well-defined negative relationship between the yearly change of the MaPI between 2003 and 2017 and its level in 2003. For instance, the bottom-five countries in 2003 increased their MaPI by 39.6 p.p. (from 2.5% in 2003 to 42.2% in 2017 on average) compared to an increase of 15.5 p.p. for the top-five countries in 2003 (from 31.8% in 2003 to 47.3% in 2017) in the same period.[21]

We can use this scatter plot analysis to classify SSA countries according to their policy performances in fighting against malaria during this period.[22] Since the correlation between the values in 2003 and their posterior annual changes is far from being perfect (the R^2 is 0.47), we can use the degree of dispersion around the regression line to argue that some countries were successful in terms of antimalarial policies' implementation, while some others did it badly and even have stayed behind. The first set corresponds to those countries located well above the regression line, four countries deserve to be highlighted: Madagascar, Zimbabwe, Namibia and Senegal. These countries started with relatively low levels of MaPI in 2003 (less than 25%), but they made big efforts between 2003 and 2017 to be located among the top 10 countries in 2017.[23]

The second set corresponds to countries located well below the regression line, such as Gabon, Guinea Equatorial, Togo, Guinea-Bissau, Central African Republic and Côte d'Ivoire. For example, in this group, we comment on the case of Gabon: despite being one of the most successful countries in policies' implementation in 2003 (with a MaPI above 30%), this country shows a very poor performance between 2003 and 2017 due to the abandonment of implementation of policies included in Category 6 of Pillar 2 and the reduction of the implementation of policies included in categories 1, 2 and 3 of Pillar 1. Lastly, most of the countries in our sample are located around the regression line (i.e., the convergence path), such as Zambia, Eritrea, Cameroun, Niger, Kenya, Ghana, Uganda, Angola or Mauritania.

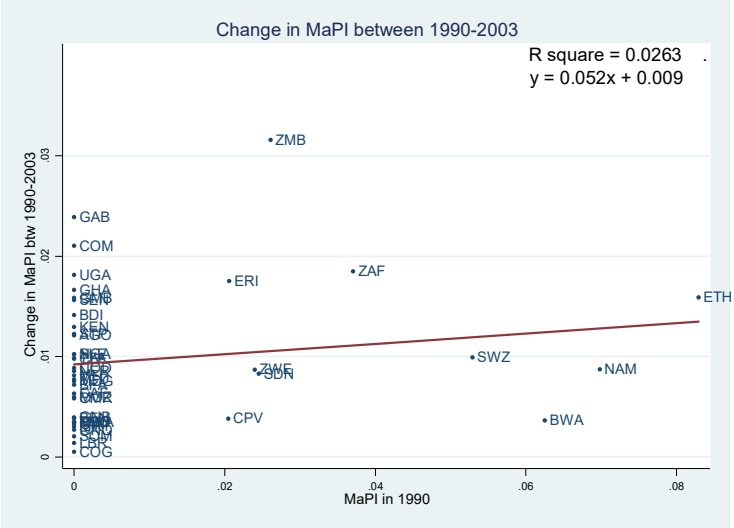
[21] The bottom-five countries in implementing malaria policies in 2003 are Congo Republic, Liberia, Somalia, Equatorial Guinea and Mauritania. Countries occupying the five-leading position in 2003 are Zambia, Gabon, Ethiopia, South Africa and Comoros.

[22] In Appendix B3 we show an alternative exercise to analyze this issue: the MaPI re-ranking of countries between 2003 and 2017.

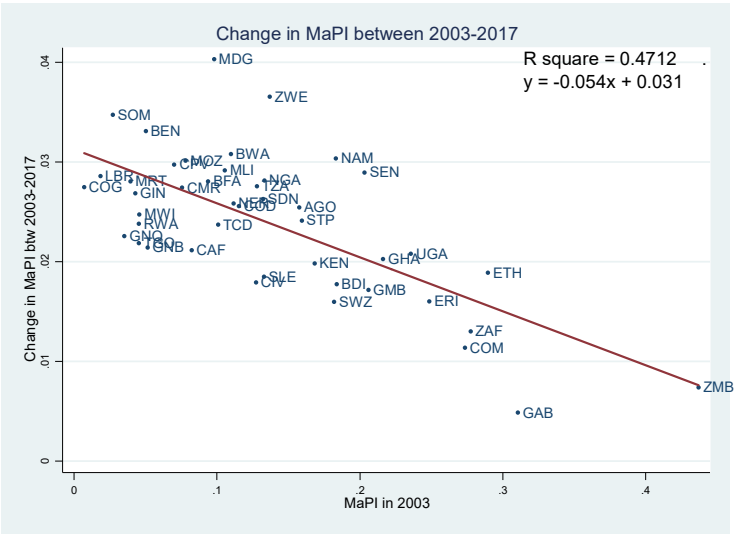
[23] Considering the convergence analysis using scores in 2003 and variations between 2003 and 2017 of Pillars 1 and 2, it appears that good performances in both pillars are needed to be above the regression line in Figure 5.b. The exception is Namibia, which holds its leading position in 2017 due to its performance in Pillar 1 between 2003 and 2017. In general, the contribution of each pillar to the performance in MaPI varies from one country to the other (see online Appendix C).

Figure 6: MaPI convergence process in SSA countries: 1990-2017

a. 1990-2003 period



b. 2003-2017 period



Source: Constructed by authors using WMRs (2005-2018).

3-4. The international strategy of fighting against malaria

We analyze the potential causes of the catch-up process in the implementation of antimalarial policies across countries observed after the mid-2000s. An evident explanation is the existence of a change in the convergence pattern of per capita GDP and institutional quality after the mid-2000s, which would drive a change in the policy implementation, stimulating a cross-country convergence of the MaPI. However, this hypothesis is not plausible, since we do not find evidence of convergence in these two macroeconomic variables in SSA between 1990 and 2003, nor between 2003 and 2017 (see Figure B4, Appendix B, Part B4).

Another possible explanation is that countries with an initial high malaria burden made a big effort in the past in fighting against the disease (showing an initial high MaPI), so they could slowed-down – even reduced – the subsequent implementation of antimalarial policies as far as they succeeded in containing its damage. However, data are not conclusive in supporting this hypothesis. For instance, countries such as Ethiopia, Zambia, Sudan or Zimbabwe, with initial high malaria mortality rates and high MaPIs, did not experienced a posterior fast reduction in mortality nor a reduction in the MaPI between 2003 and 2017; indeed, these countries are above the regression line in Figure 6.b. There is also a set of countries showing very low levels of malaria mortality rate along the entire period, such as Botswana, Namibia, Cabo Verde or Senegal (also above the regression line in Figure 6.b), that did not stop increasing the implementation of antimalarial policies and even reached the top positions in the 2017 ranking.

The most plausible explanation for the MaPI sudden increase and its convergence process between 2000 and 2017 is the change in the international strategy of fighting against malaria in the SSA region. International strategy included the implementation of regional programs, coordinated and funded by international organizations, which generated a rapid (and uneven) increase of external health care aid to fight against malaria country-by-country. As a result, antimalarial interventions were much more numerous in initially worsened countries, explaining the observed catch-up process in policy implementation (The Global Fund, 2011; de Jongh, 2013). We find at least three interrelated facts that reveal the existence of this coordinated strategy.

First, there was an increase in the compromise of national governments in fighting against malaria. In 2000, most African prime ministers agreed to commit tackling malaria and to set specific targets to fight against it: this was known as the "Abuja Targets" agreement[24] (Veloshnee, 2008; Haacker, 2010). The main idea behind this agreement was that countries compromise to fix specific targets to reduce malaria disease, and to implement WHO's key malaria control interventions: the use of ITNs; the early treatment of fevers in children; the intermittent preventive treatment (IPT) of pregnant women.

Second, as commented above, the launch of international programs promoted the assistance of policy interventions and facilitated the widespread use of effective and low-cost antimalarial policies in malaria-endemic countries. One of the most ambitious and

[24] The Abuja Declaration: Ten Years On, 2001. Available on: https://www.who.int/healthsystems/publications/abuja_declaration/en/

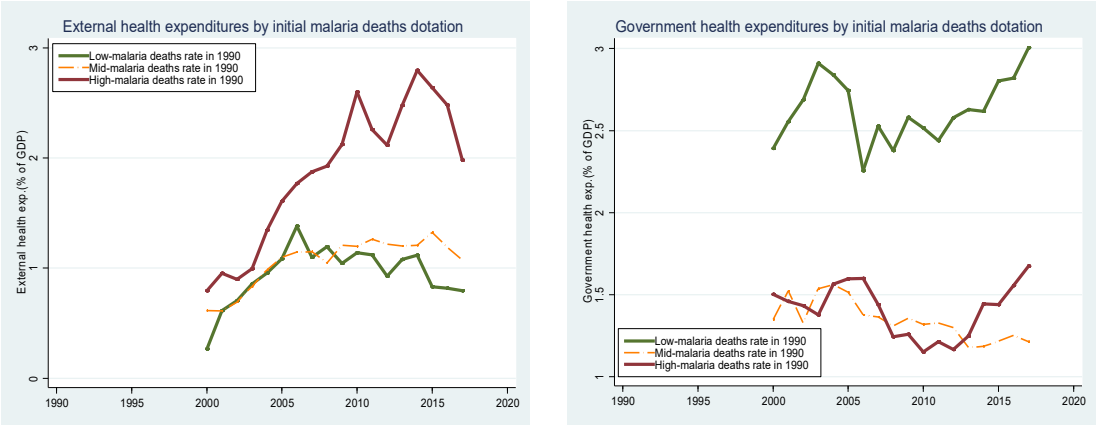
biggest programs was the Roll Back Malaria (RBM) Partnership Program. It was launched in 1998 by the WHO, UNICEF, UNDP and the World Bank to provide a coordinated global response specifically designed to fight against malaria (Sachs, 2002; Jakubowski et al., 2017; Kuecken et al., 2020).[25] Two of the most popular and extended measures promoted by the RBM program were the introduction of insecticide-treated bed nets (ITNs), mainly targeted to pregnant women and children under 5 years, and the implementation of artemisinin-based combination therapy between 2005 and 2009 (Snow et al., 2017). Another ambitious program is the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), established in 2002, has provided more than 50% of all international funds for malaria fighting and has invested more than USD 13.5 billion in malaria control programs till August 2020, the majority of this amount has gone to SSA.[26]

Third, as part of this global strategy, the widespread use of effective interventions was accompanied by an uneven increase of external health care aid depending on the country's specific necessities. To provide some quantitative evidence of this fact, Figure 7 (left graph) shows the evolution of the external health care expenditures as a percentage of GDP from 2000 to 2017, classifying countries according to their malaria death rates in 1990.[27] We observe that the external health aid benefited more to countries with initial higher malaria burden. For instance, between 2000 and 2014, the average annual growth rate of external aid received by initially more disadvantaged countries was 13.3%, in contrast with the 5.7% for the initially lowest malaria-burden group.

This patter is the opposite to that shown for health expenditure provided by national governments (right graph in Figure 7). Here, we observe a relatively stable increase of the national health care expenditure for all groups of countries between 2000 and 2017, but the governments of countries with initially high malaria burden spent less on health care than countries with lower malaria burden. This comparison reveals that it should be the external aid, and not the national health care expenditure, the main source driving the MaPI evolution and explaining its convergence process.

[25] RBM's overall strategy aims to reduce malaria morbidity and mortality by reaching universal coverage and strengthening health systems. See https://endmalaria.org/about-us/overview.
[26] The Global Fund. Malaria. https://www.theglobalfund.org/en/malaria/ accessed on May 2021.
[27] The starting point of the figures is 2000 because of the unavailability of external and government health expenditures data before this year.

Figure 7: Evolution of External and Government Health Expenditures in SSA countries according to malaria burden in 1990



Source: Constructed by the authors using WMRs (2005-2018) and the World Bank Health Nutrition and Population Statistics.

4-. The effect of antimalarial policies on malaria mortality

In this section we measure to which extent the implementation of antimalarial policies has succeeded in reducing the mortality due to malaria in SSA.[28] We proceed as follows: first, we show the malaria mortality patterns in the region; second, we present the empirical design and identification strategy and; finally, we show estimation results.

4-1. Malaria mortality in the SSA region

The burden of malaria has declined considerably in the 2000s in many highly endemic parts of the world, including SSA countries (Cohen et al., 2012, WMR, 2020). Figure 8 shows the evolution of both the average of total malaria mortality (in thousands of people) and the average malaria death rate, defined as the number of deaths caused by malaria over 100,000 population. We have considered our sample of 44 SSA countries during the 1990-2017 period. Moreover, together with these series, the figure also illustrates the evolution of the average MaPI, Pillar 1 and Pillar 2.

We observe that total mortality and mortality rate increase till the mid-2000s. After reaching a maximum around 2003, both series decreased steadily till 2017. Table 3 summarizes these trends: on average, total mortality and mortality rate increased about 48.6% and 2.6%, respectively, from 1990 to 2003; while they experienced a dramatic

[28] We use mortality instead of incidence of malaria because the incidence is sensitive to the number of policies implemented among diagnosis measures. Imagine a situation in which malaria incidence is being reduced because of the increase of the implemented policies (a MaPI increase). In this context, if the number of tests increases (and so the MaPI) this may imply an apparent increase in the incidence, just only because there are more tested population. This is not true for the mortality measure, that would result unchanged and robust to the increase in diagnosis.

decrease of about 34.1% and 53.5%, respectively, from 2003 till 2017. Therefore, these numbers reveal that the period of massive implementation of antimalarial policies in the SSA region (2003-2017) coincides with the period of big decreases in mortality due to malaria. Moreover, we also observe that insofar mortality rate is decreasing, Pillar 1 is increasing for the entire period (omitting the crisis of 2009); whereas by the end of the sample (2014-2017), Pillar 2 decreases and the MaPI stabilizes, at the same time that the mortality rate reduces more slowly.

This preliminary exploration of data put forth the existence of a negative correlation between malaria mortality and the implementation of antimalarial policies in the SSA region. However, as described above, there exists an important heterogeneity in the implementation of policies across countries, as well as in the nature of the policies. In our sample, the causality must be identified within-country and over time, hence we need to exploit the entire panel dataset. We next propose an empirical strategy to analyze and quantify to which extent the implementation of antimalarial policies is causing the reduction of malaria mortality in the SSA region.

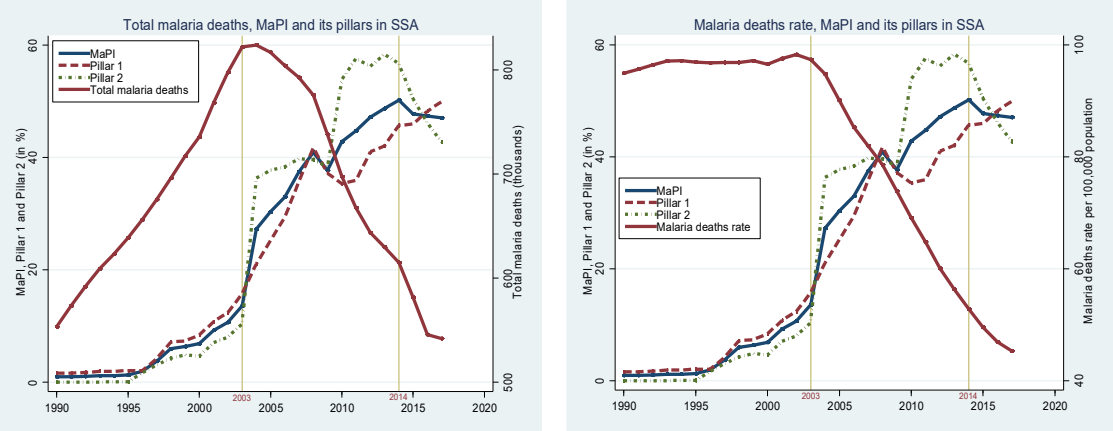
Table 3: Malaria mortality and MaPI in SSA

	Levels			Change		
	1990	2003	2017	1990-2003	2003-2017	1990-2017
Malaria mortality (total)						
	553135.7	822192.4	541911.1	48.64%	-34.09%	-2.03%
Malaria mortality (rate)						
Average	94.93	97.37	45.30	2.57%	-53.48%	-52.28%
Std	12.0502	12.0143	6.5491			
MaPI (%)						
Average	0.95	13.57	47.04	12.61 p.p.	33.48 p.p.	46.08 p.p.
Std	0.00312	0.01382	0.01159			
Pillar 1 of the MaPI (%)						
Average	1.61	15.74	49.96	14.13 p.p.	34.22 p.p.	48.35 p.p.
Std	0.00525	0.0158	0.01767			
Pillar 2 of the MaPI (%)						
Average	7.58	10.38	42.77	10.30 p.p.	32.39 p.p.	42.69 p.p.
Std	0.00075	0.01754	0.01876			

Notes: Malaria mortality (total) is measured as the number of deaths per 1,000. Malaria mortality rate is the number of deaths due to malaria over population multiplied by 100. MaPI, Pillar 1 and Pillar 2 are measured in %.
Changes in malaria mortality and mortality rate are calculated as growth rates (%), whereas changes in MaPI, Pillar 1 and Pillar 2 are calculated as increases in percentage points.
Since no policy of Pillar 2 was implemented before 1994, we use this date as a proxy of its 1990 value.

Sources: Constructed by the authors using WMRs (2005-2018) and GDB 2017.

Figure 8: Malaria mortality and antimalarial policies in SSA



Source: Constructed by the authors using WMRs (2005-2018) and the World Bank Health Nutrition and Population Statistics.

4-2. Empirical strategy

We use different empirical approaches to estimate the causal effect of antimalarial policy implementation on changes in malaria mortality in our sample of 44 SSA countries between 1990 and 2017. As in Jaumotte and Osorio-Buitron (2015), we adapt the individual- and firms-level data models developed by Simon (2016), Suárez-Serrato and Zidar (2016) and Fuest et al. (2018) to our country-level dataset. All estimated models have country-specific effects, capturing long-run unobservable differences among countries, as well as year-specific dummies, capturing temporal changes that are common to all countries (i.e., global shocks) and that may be driving both antimalarial policies and the malaria burden in the sample. These fixed effects hold constant fixed differences across SSA countries and over years.

Our baseline outcome variable is the within-country annual growth of malaria mortality, $\Delta ln(y_{i,t}) = ln(y_{i,t}) - ln(y_{i,t-1})$. By taking the first differences, country-specific stochastic trends observed in the data are removed, the first difference of resulting variables are stationary (for the whole panel and for each country).[29] Our regressors are related to changes in the policy implementation process, including lag and lead changes.

[29] In spite of including year-specific dummies, we still have significant country-specific trends. Since our database is at country level, we cannot include country-year dummies to remove this. For that reason, it is important to check for stationarity. We have used Fisher-type (Augmented Dicky Fuller and Phillips-Perron) unit-root tests (Choi 2001) and that of Im, Pesaran and Shin (2003), which allows for different autoregressive parameters for each country. In these tests, the null hypothesis is that all panels have a unit root. In all cases we do not reject this hypothesis for levels, but we reject it for the first difference (we remove country and year fixed effects to test these hypotheses). Results are available upon request.

Because of the different nature of policies included in Pillar 1 and Pillar 2, we estimate different models for the MaPI and each pillar.

In our first approach, we follow Simon (2016) and Fuest et al. (2018) and apply an event study design to capture how large increases in antimalarial policy implementation might affect posterior changes in malaria mortality:

$$\Delta ln(y_{i,t}) = \lambda_i + \delta_t + \sum_{j=-j_0}^{j_1} \gamma_j D_{i,t}^{j} + v_{i,t}; \quad (1)$$

$$i = 1, \dots, 44; \; t = 1990, \dots, 2017,$$

where λ_i is the country fixed-effect, and δ_t is the year fixed-effect. The set of regressors is represented by a set of dummies, $D_{i,t}^{j}$, indicating that an event is happening j periods away, from $-j_0$ to j_1. As in Fuest et al. (2018), we set the event window running from four years before the policy event happens to five years after: $-j_0 = -4$ and $j_1 = 5$.

The set of events is identified from annual changes in MaPI, Pillar 1 or Pillar 2. As in Simon (2016), we define events as large policy increases, considering any policy hike greater than or equal to the 85th percentile of the entire policy increase distribution (i.e., including all changes of the 44 SSA countries between 1990 and 2017). An advantage of using large increases is that we are considering potential non-linearities in the relationship (i.e., only policy increases that are large enough affect mortality), we can also limit the number of events per country and reduce the likelihood that other policy events happened within the same window.[30] The event study design is attractive because explanatory variables are free of measurement errors as they are binary dummies, and it can accommodate complex non-linearities in a flexible and parsimonious way.

In our second approach (Suárez-Serrato and Zidar, 2016 and Fuest et al., 2018), we estimate a within-country distributed lag model (DLM),

$$\Delta ln(y_{i,t}) = \lambda_i + \delta_t + \sum_{j=-j_0}^{j_1} \beta_j \Delta X_{i,t-j} + u_{i,t}; \quad (2)$$

$$i = 1, \dots, 44; \; t = 2000, \dots, 2017,$$

[30] As we will discuss in more detail below (see also Section 3), the MaPI and Pillar 1 and 2 present an overall upward trend, especially after 2000. Hence, we have many periods with increases (fewer periods of decreases). In this situation, if we define an event as a period of increases or decreases, as Simon (2016) and Fuest et al. (2018), we have many events in the same window, which would affect our identification strategy. For that reason, in our case, we focus on events defined as large increases. Results for events defined as increases or decreases are available upon request; in general, the signs of the coefficients are consistent with the main results, but estimations are noisy and tend to be non-significant.

where $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, with $X_{i,t}$ representing the implementing rate of antimalarial policies in country i and year t (according to MaPI, Pillar 1 or Pillar 2); the error term is denoted by $u_{i,t}$. As for the event study design, we set $j_0 = -4$ and $j_1 = 5$, although we also consider a basic DLM specification by setting $j_0 = 0$. While the event study specification uses dummy variables to capture antimalarial policy changes, the DLM accounts for different magnitudes of policy changes.

In (1) and (2), the coefficients of interest (the set of γ_j and β_j) measure the effects of policy changes on within-country annual growth in malaria mortality at different periods: contemporaneously, for $j = 0$; before the policy change, for $j = -4, \dots, -1$ and after the policy change, for $j = +1, \dots, +5$. The sequence of lagged coefficients allows us to test whether antimalarial policy hikes tend to reduce malaria mortality growth over the following five years; and the sequence of leaded coefficients helps us to test the non-existence of pre-trend effects, which is needed to identify causality, as we discuss below. Moreover, we can use the sequence of estimated γ_j and β_j coefficients to calculate the cumulative impact of changes in policies on within-country malaria mortality, given by $\sum_{j=-j_0}^{j_1} \gamma_j$ and $\sum_{j=-j_0}^{j_1} \beta_j$ for the event study and DLM estimates, respectively.

Thus, in both cases, the lag-lead specification can be seen as a generalization of a standard difference-in-difference model, allowing us to account for antimalarial policy hikes with different magnitudes, occurring in multiple years in all the countries of the sample. We can use them to test the main assumption of difference-in-difference models, that is, that there are no differential trends between treated (country-year policy hikes) and non-treated situations (non-country-year policy hikes) before (lead coefficients) and after (lag coefficients) the policy increase.[31]

Identification of causal effects requires both no-statistically significant malaria mortality responses preceding an antimalarial policy change and a significant response after the policy shift. That is, the pre-treatment effect must be irrelevant, which implies that we cannot reject the hypothesis that the estimated lead coefficients - γ_{-4}, γ_{-3}, γ_{-2} and γ_{-1} in (1) and β_{-4}, β_{-3}, β_{-2} and β_{-1} in (2) - are jointly statistically equal to zero, whereas the opposite should be true for γ_1, γ_2, γ_3, γ_4 and γ_5 in (1), and β_1, β_2, β_3, β_4 and β_5 in (2).

[31] In our specification, the control group would be a situation where there are not policy hikes. This is a reasonable assumption since there are only very few situations with large policy decreases in the sample.

We provide a battery of robustness checks to our results. First, we restrict the sample to the 2000-2017 interval, as it is the period that concentrates a higher number of policy increases; and we include endogenous dynamic terms (lagged 3 and 4 to reduce endogeneity concerns) as additional regressors.[32] We estimate (1) and (2) for different age groups: below 5 years old, between 5 and 14, 15 and 49, 50 and 69 and above 70. Second, we provide further checks to assess whether within-country identification can be altered under the existence of country-specific shocks that are systematically affecting malaria mortality and policy implementation. Since we cannot include "country-year" dummies to account for these country-specific shocks non-parametrically, we proceed as follows: first, we estimate (1) using per capita GDP, institutional quality and employment as dependent variables, and check whether pre-treatment coefficients are non-significant and; second, we identify country-specific time-varying factors and control by them (using lagged values).

We also control for the existence of big outliers (i.e., estimated residuals above 5 standard deviations are removed), which might artificially generate an autoregressive structure in the residuals and even an artificial correlation between malaria mortality and the implementation of antimalarial policies.[33] Indeed, in our empirical estimations, we omit the following countries from our original database because of the excess of noise in their malaria mortality growth rates: Sao Tome and Principe, Comoros and Cabo Verde. These are small countries with low malaria incidence (see on-line Appendix C for a description of these countries).

4-3. The Event study design results

4-3.1. The description of policy events

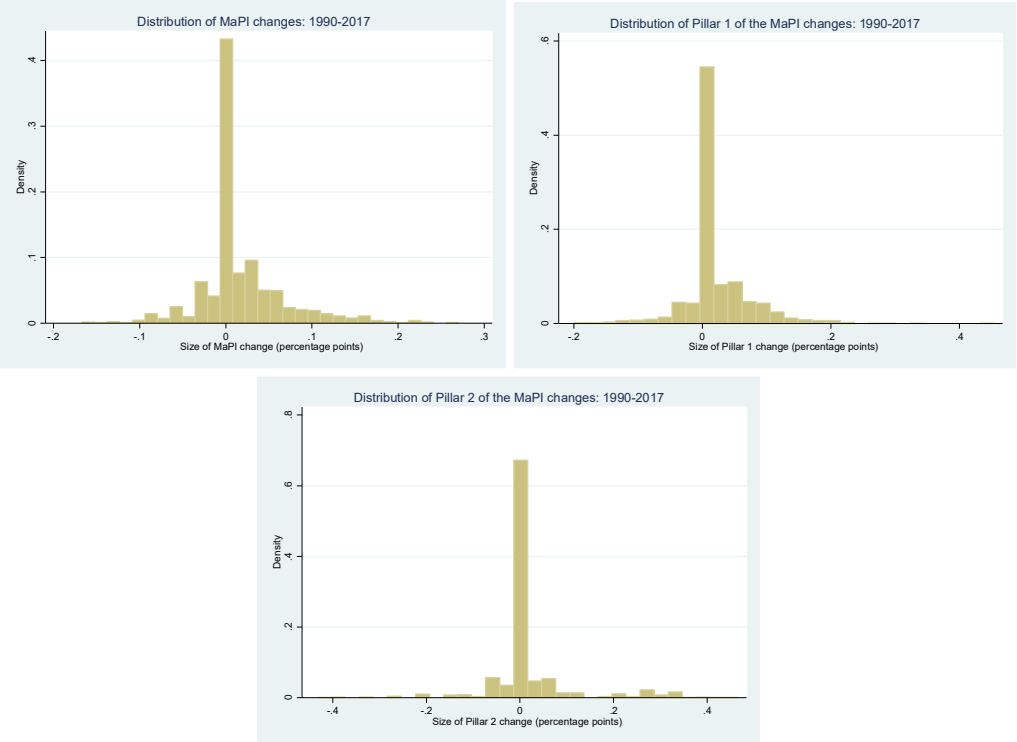
We first describe our sample of events for the MaPI, Pillar 1 and Pillar 2. Figure 9 shows the distribution of MaPI and pillars annual changes for the entire sample (44 SSA countries from 1990 to 2017). We observe that there exists a high concentration of values around zero since few countries were implementing antimalarial policies between 1990

[32] The inclusion of dynamic regressors, $\Delta X_{i,t-j}$, does not remove the autoregressive structure in the error term (i.e., the conditional-within country malaria mortality growth rate still shows a significant inertia), hence, as a robustness check, we include a lagged term of the endogenous variable in (1), $\Delta ln(y_{i,t-1})$. The inclusion of this dynamic term can be relevant to control for country-specific shocks, which, as discussed below, is needed to achieve identification in the model estimates.

[33] We remove between 3 and 4 big outliers corresponding to the data in Kenya, Eritrea and Rwanda.

and the mid-2000s. This is more evident for Pillar 2, whose policy implementations started after the mid-1990s in all countries.

Figure 9: Distribution of policy changes



Source: Authors' calculation using information from WMRs (2005-2018).

Regarding these distributions, we observe that: medians are close to 0 for both MaPI, Pillar 1 and Pillar 2; they are skewed to the right (i.e., there are more big increases than big decreases) and; the 85% percentile, which is the one we chose to define a large increase event, is 0.055, 0.065 and 0.067 p.p., respectively.[34] For the distribution of MaPI changes (see Table 4), the 50% are increases, 15% are large increases, and 25% are decreases; the average size of all increases is 4.9 p.p., while it is 11 p.p. for large increases and only -3 p.p. for decreases. Regarding Pillar 1 (Pillar 2), these percentages are: 46% (24%) increases, 15% (15%) large increases; 22% (15%) of decreases; and the average size for all increases are 5.4 p.p. (12.1 p.p.), about 11.3 p.p. (17.4 p.p.) for a large increase,

[34] Because of the high concentration of zeros, we need to use a high enough percentile to identify a truly large policy increase. Simon (2016) had the same situation. We follow his strategy and choose the 85th percentile. Note that if we use the distribution of changes between 2000 and 2017, a much lesser density around zero is observed. For example, the median is 0.014 for MaPI changes, and its 85th percentile is close to 0.08. Therefore, using the 75th percentile (Fuest et al., 2018) in this restricted sample is more or less equivalent to using the 85th percentile in the 1990-2017 sample.

and -3.2 p.p. (-8.3 p.p.) for all decreases. Percentage of increases (but especially for large increases) are concentrated after 2003.

Table 4: Changes in MaPI, Pillar 1 and Pillar 2

All countries	Total	<2003	>=2003
Percentage of any increase			
MAPI	50.0	17.3	30.0
Pillar 1	46.0	15.4	27.1
Pillar 2	23.8	7.0	15.8
Percentage of large increases (>85th percentile)			
MAPI	15.0	2.0	12.6
Pillar 1	15.0	2.0	12.6
Pillar 2	15.0	3.7	10.7
Percentage of any decrease			
MAPI	25.2	7.9	16.4
Pillar 1	22.1	8.0	12.6
Pillar 2	15.4	2.4	11.9

Sources: Constructed by the authors using WMRs (2005-2018)

Table 5 shows the percentage of coincidental (country-year) events in pairwise comparisons for MaPI, Pillar 1 and Pillar 2. The 85% of any increase coincides with MaPI and Pillar 1; the 45% with MaPI and Pillar 2; and 29% for Pillar 1 and Pillar 2. For any decrease, the percentages of coincidence are very similar: almost 70% for MaPI and Pillar 1; 46% for MaPI and Pillar 2; and 15% for Pillar 1 and Pillar 2. However, when we look at large increases we observe that the coincidence between MaPI and their pillars is pretty similar, about 60% in both cases, whereas the coincidence between Pillar 1 and 2 is about 19%. These numbers imply that, for the event design experiment, the MaPI results will be affected by both Pillar 1 and Pillar 2 events. Since the policies included in each pillar are of different nature, some results for the MaPI could be difficult to interpret. We will further discuss this issue below.

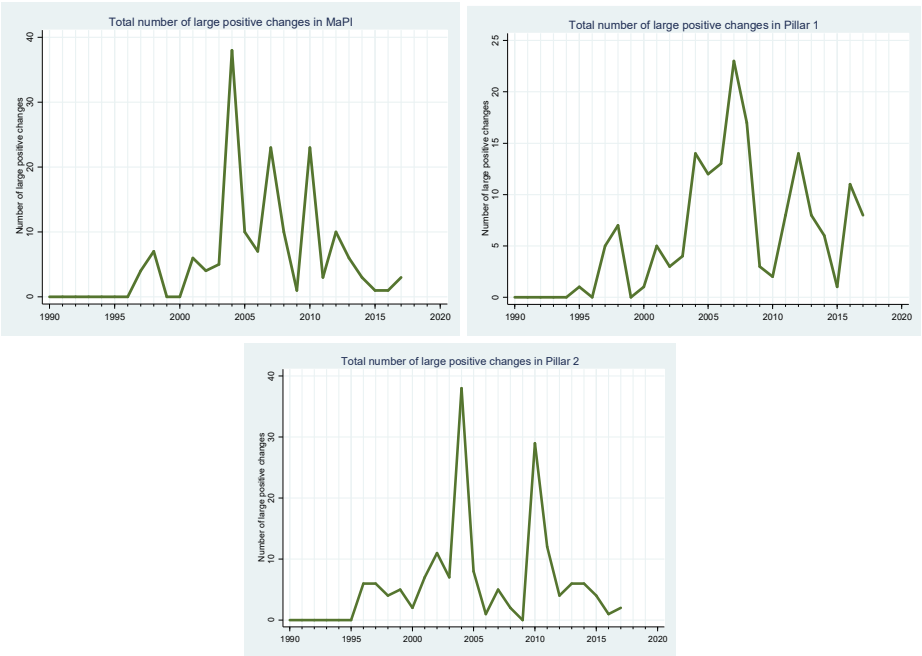
We have identified a total of 165 big changes in our sample. Looking at the time dimension, large increases are concentrated between 2004 and 2011 (see Figure 10), and we find several key years in this range: 2004 and 2010 for Pillar 2 and; 2007 and 2013 for Pillar 1. Since the years of concentration are different for Pillar 1 and Pillar 2, it will be easier to identify the existence (or not) of causality of each type of policy. For a cross-country comparison, Table C.1 (Appendix C) shows the distribution of big events among countries (for the MaPI, Pillar 1 and Pillar 2). No country shows zero events. For instance, the country with lower big changes (looking at the MaPI) is Guinea-Bissau, with two; and the countries with more events are Senegal, Tanzania and Zambia, with six.

Table 5. Large increases coincidence matrix

All countries	MAPI	Pillar 1	Pillar 2
% of Big events that coincide for each country-year			
MAPI	100		
Pillar 1	60.6	100	
Pillar 2	58.2	18.8	100
% of INCREASES that coincide for each country-year			
MAPI	100		
Pillar 1	84.5	100	
Pillar 2	44.8	29.2	100
% of DECREASES that coincide for each country-year			
MAPI	100		
Pillar 1	69.5	100	
Pillar 2	45.9	15.1	100

Sources: Constructed by the authors using WMRs (2005-2018)

Figure 10. Big events over years for MaPI, Pillar 1 and Pillar 2



Source: Constructed by the authors using WMRs (2005-2018).

4-3.2. Estimation results

Table C.2 (Appendix C) presents estimation results of equation (1) when the event is defined as a large increase (for MaPI, Pillar 1 and Pillar 2).[35] Each coefficient is expressed in relation to the coefficient for the year before the event happens (i.e., $\gamma_{-1} = 0$). Figure

[35] Results defining the events as "any increase" or as "any decrease" are available upon request. As commented in Section 4.2, estimated lagged coefficients (for MaPI and Pillar 1) show the expected signs (negative for "any increase" and positive for "any decrease"), but they are non-significant in most cases. For Pillar 2, results are noisy and inconclusive. Moreover, as commented above, many policy increases coincide in the same event window, which hinders a correct identification of the event's impact on within-country malaria mortality.

11 represents the point estimates of all other γ_j coefficients, together with their 90% confident intervals, for MaPI, Pillar 1 and Pillar 2.

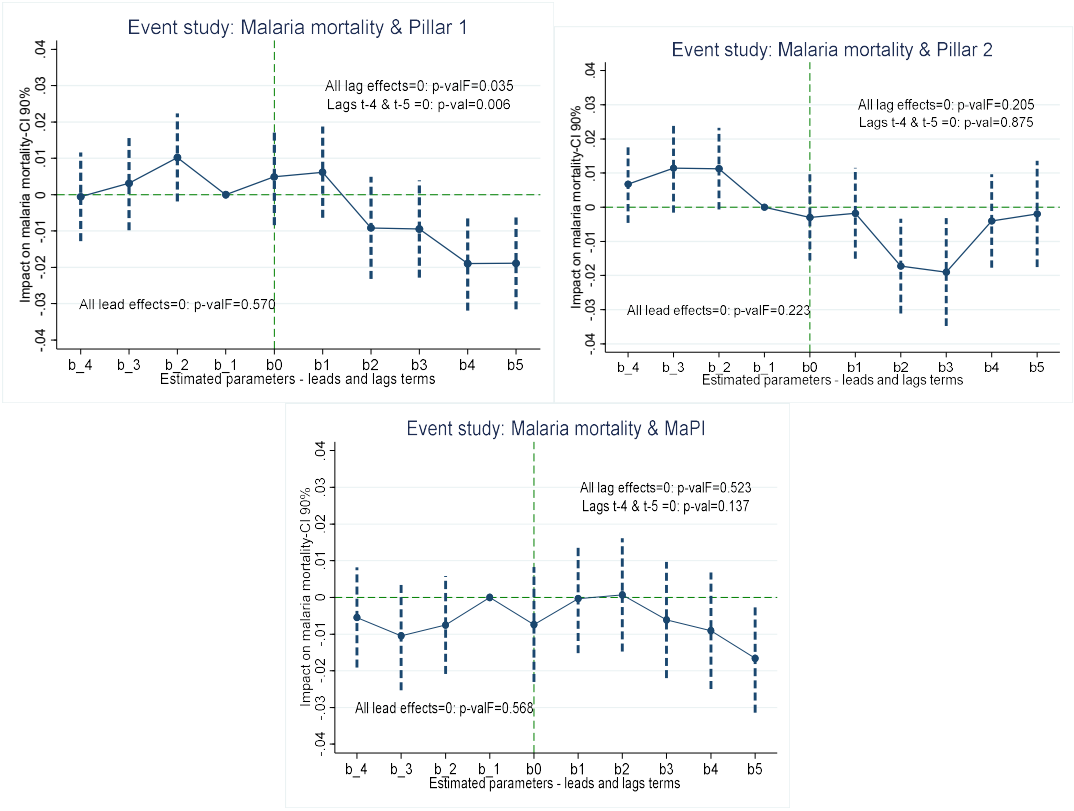
For illustrative purposes, we start showing the results for Pillar 1. First, we observe that point estimates do not show a pre-trend significance, which implies that we can interpret our results as the causal impact of Pillar 1 antimalarial policies on malaria death rates. For lag effects, we obtain negative and significant results after 3 years. Of special relevance is the estimation of the coefficient for the fifth period, as it gives an idea about the mid-term impacts of the antimalaria policy. Indeed, we reject that all lag impacts are equal to zero, and obtain relevant quantitative results: a big increase of Pillar 1 is associated with a point reduction of the malaria mortality growth rate between 2 and 2.4 p.p. after three years; moreover, the sum for the first five periods gives a cumulative impact of about 6 p.p.

When looking at Pillar 2, we obtain that the second and third lagged coefficients are significant only at 10%, and the fourth and fifth coefficients are highly non-significant. In general, results are noisy and, regarding the non-existence of a negative trend, we cannot reject that all lag coefficients are equal to zero. Moreover, depending on the model specification, we obtain some significant pre-treatment structure for Pillar 2, which cast doubt on the identification of causal effects for this pillar on malaria mortality.

The fact that Pillar 2 is part of the MaPI, and since there exists a relevant amount of coincidence between their big events, as discussed above, makes the results for the MaPI noisier and less significant than the ones obtained for Pillar 1. We find that a large increase of MaPI has a negative impact on posterior reductions in malaria mortality after 3 years, but it is only significant at year five. The magnitude of the γ_5 coefficient is close to 0.02, lower than that obtained for Pillar 1. In this baseline specification for the MaPI, the identification tests reveal that we cannot reject that all lead effects are equal to zero, but notice that we also cannot reject that all lags are equal to zero.

In order to test the robustness of results obtained with Pillar 1, we repeat the previous analysis by age groups. Figure 12 shows these estimations. Qualitatively, results are robust.

Figure 11. Event study: Baseline model estimates using Pillar 1, Pillar 2 and MaPI



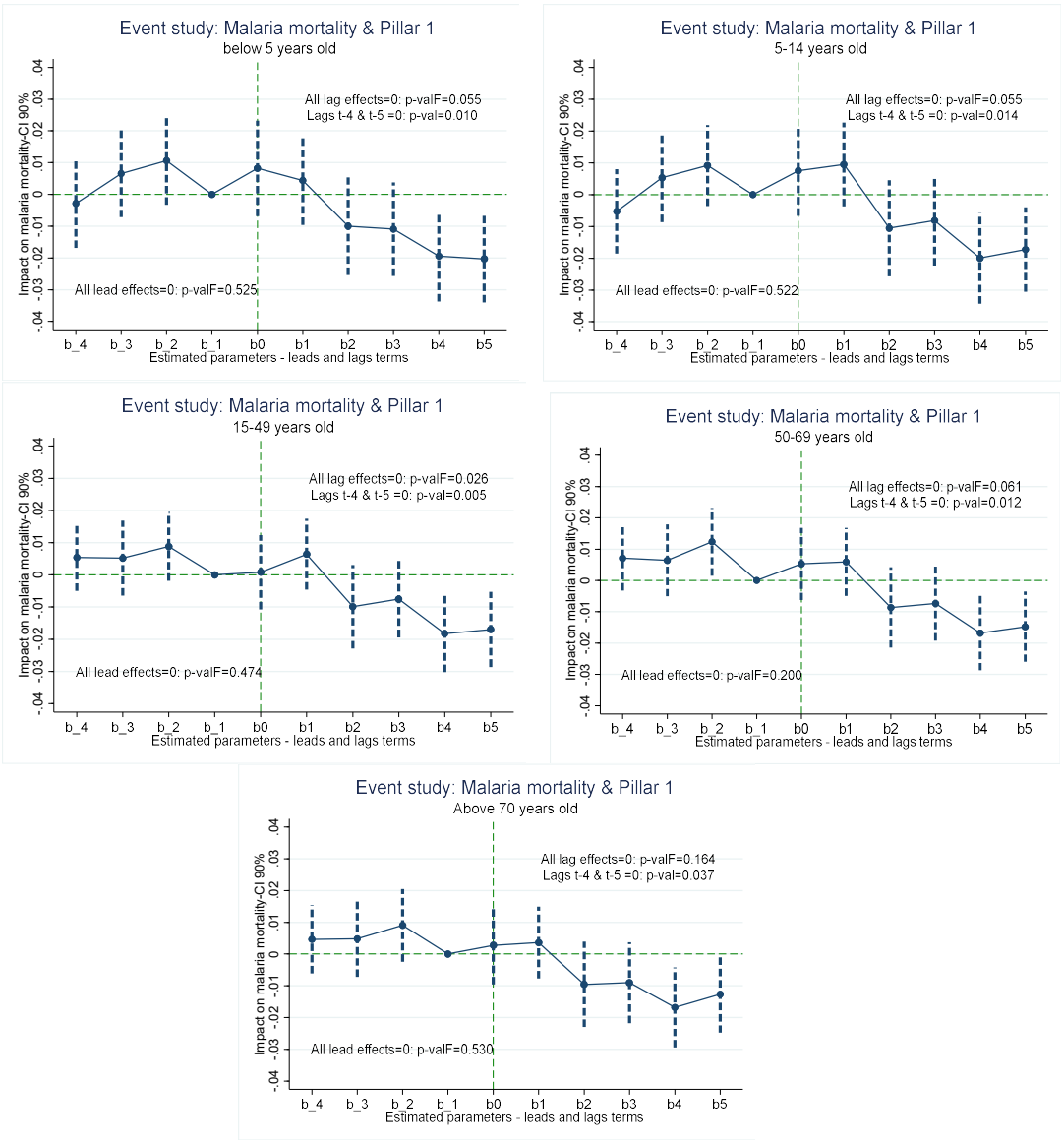
Note: These graphics represent estimated results of event study estimates $\gamma_{-4}, \gamma_{-3}, \ldots, \gamma_4, \gamma_5$. Estimation results are for equation (1) for the baseline specification: sample from 1990 to 2017; no additional regressors are included (only controlling by fixed country and year effects). Events are defined as MaPI (first line), Pillar 1 (second line) and Pillar 2 (third line) changes above the 85th percentile for the entire country-year distribution. Events occur at period t=0 (vertical line). We present 90% confidence intervals.

Source: Constructed by the authors using WMRs (2005-2018) and GDB 2017.

First, for all age groups, we find that large increases of Pillar 1 have negative and significant impacts on posterior reductions in malaria mortality after 3 years (results for Pillar 2 and MaPI are also robust and available upon request). Second, point estimates do not have a pre-trend significance which indicates the causal impact of Pillar 1 antimalarial policies on malaria death rates of all age groups. Finally, we reject the hypothesis that all lag impacts are equal to zero in all age groups, and obtain relevant quantitative results: a big increase of Pillar 1 is associated with a reduction of the malaria mortality growth rate between 1.3 and 2 p.p. per year after three years. Moreover, if we look at the γ_5 estimation, we can conclude that there exists a monotone relationship, with younger age groups experiencing higher reductions in mortality: the largest magnitude of coefficient γ_5 is for the group of 4 years old and less (more than 2 p.p. after 3 years) and the lowest is for the group of 70 years old and more (1.3 p.p.). It is worth noting that the cumulative impact is

about 8 p.p. for the group of children below 5 years old, which is probably the most important targeted group when fighting against malaria.

Figure 12. Event study: Baseline model estimates using Pillar 1 by age groups



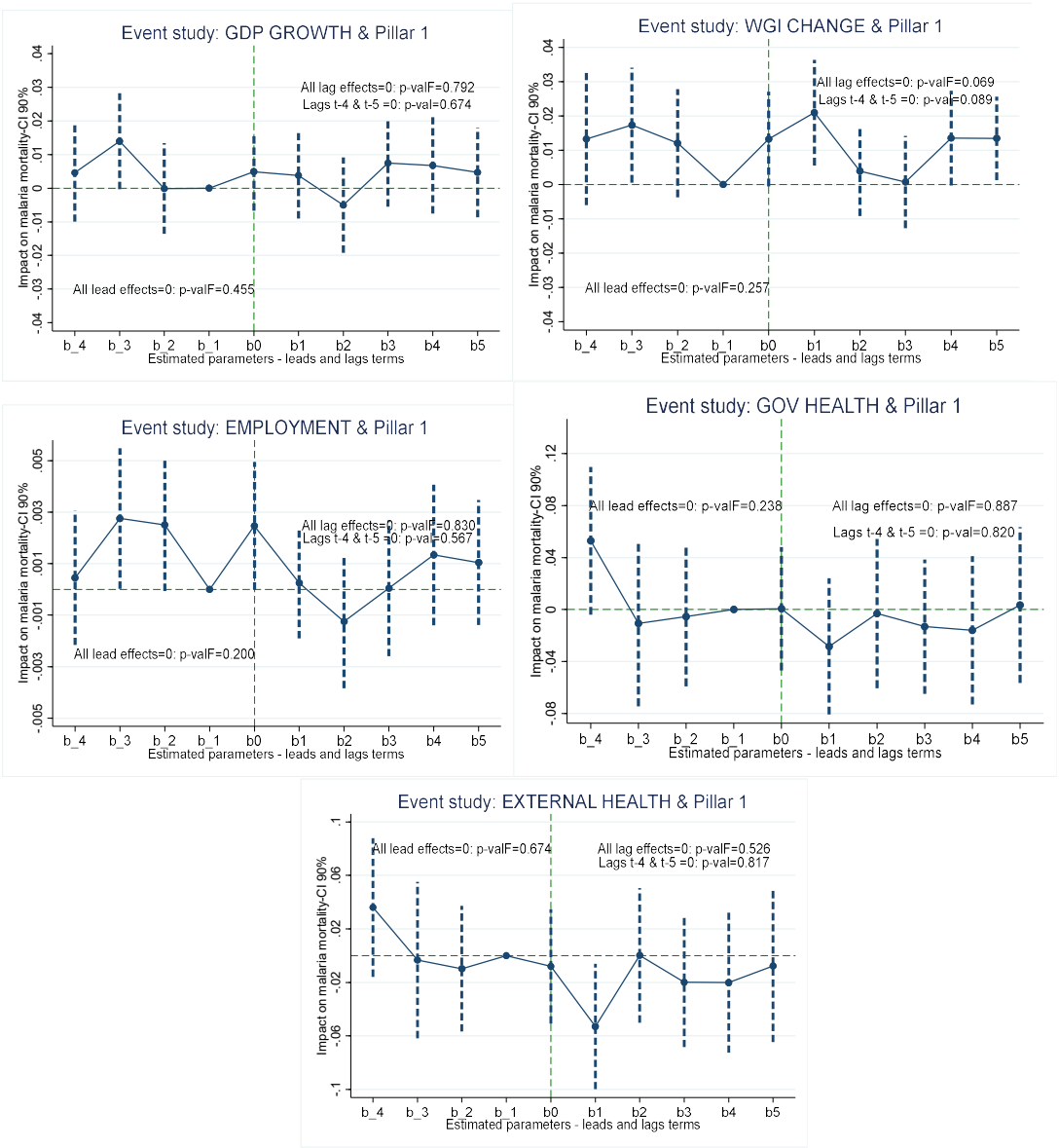
Note: These graphics represent estimated results of event study estimates $\gamma_{-4}, \gamma_{-3}, \ldots, \gamma_4, \gamma_5$. Estimation results are for equation (1) for the baseline specification: sample from 1990 to 2017; no additional regressors are included (only controlling by fixed country and year effects). Events are defined as Pillar 1 changes above the 85th percentile for the entire country-year distribution. Events occur at period t=0 (vertical line). We present 90% confidence intervals.

Source: Constructed by the authors using WMRs (2005-2018) and GDB 2017.

We further extend our analysis in two ways: we restrict the sample to the 2000-2017 period (left panel in Figure C.1, Appendix C), and we include endogenous dynamic terms

in the regression, as motivated in Section 4.2 (right panel in Figure C.1, Appendix C).[36] Results are qualitative and quantitatively similar. The most significant difference is that results for Pillar 1 are more significant and intense when the sample is restricted to the 2000-2017 period.

Figure 13. Event study results: country-specific business cycle effects



Note: These graphics represent estimated results of event study estimates $\gamma_{-4}, \gamma_{-3}, \ldots, \gamma_4, \gamma_5$. Dependent variables are the growth rates of the following variables: per capita GDP; the World Governance Index (WGI); the employment rate; government health expenditure; external health expenditure. Events are defined as Pillar 1 changes above the 85th percentile for the entire country-year distribution. Events occur at period t=0 (vertical line). We present 90% confidence intervals.

Source: Constructed by the authors using WMRs (2005-2018), Penn World Table 9.1, WGI Project Report (2020) and World Bank Health Nutrition and Population Statistics.

[36] We lag $\Delta ln(y_{i,t})$ 3 and 4 periods to reduce the endogeneity problems. Both coefficients are highly significant, which illustrates the existence of autoregressive structure in the residuals, as commented above.

A remaining identification concern is that policy changes might be influenced by aggregate macroeconomic or institutional factors, which could also affect the malaria burden. Following Fuest et al. (2018), we can test directly for violations of these identifying assumptions by using macroeconomic and institutional outcomes as left-hand-side variables in the event study equation (1). Significant pre-treatment trends for these macroeconomic factors would hint at country-specific shocks and would cast doubt on our identification assumption.

Figure 13 shows the results for per capita GDP, the World Governance Index (WGI), employment, governmental health expenditure (as share of GDP) and external health expenditure (as share of GDP), as dependent variables in equation (1), using large events constructed for Pillar 1. In all cases, we cannot find clear pre-trends in the specification for large events, which implies that our specifications are well identified.

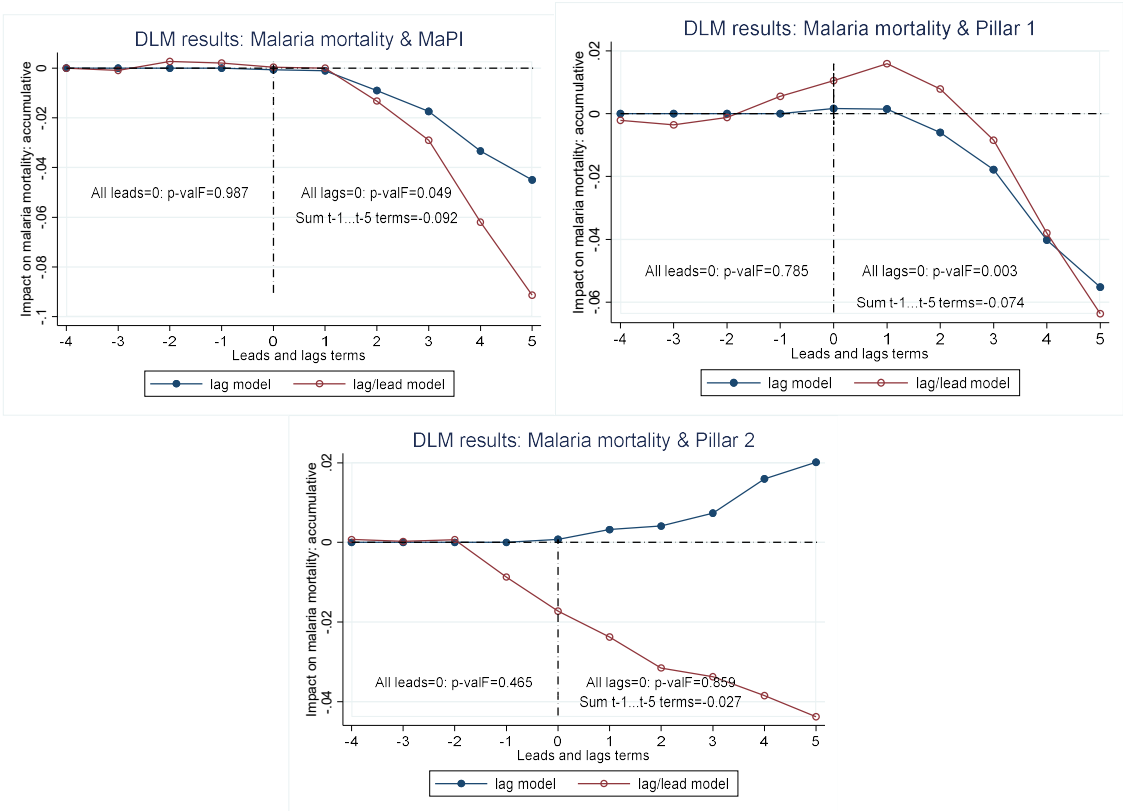
We also estimate specifications of the event model (1) extended with additional controls that capture the country-specific and time-varying business cycle effects (Figure C.2, Appendix C). We include the same variables as in Figure 12 (lagged growth rates, see note in Figure C.2) as additional controls: per capita GDP, the World Governance Index (WGI), employment, governmental health expenditure (as share of GDP) and external health expenditure (as share of GDP). Although we find some changes in the estimates (magnitude and significance), the main results are qualitatively the same: a big increase of policies in Pillar 1 shows a significant and meaningful impact on malaria mortality after 2 or 3 years, depending on the specification.

4-4. DLM estimation results

Table D.1 (Appendix D) shows estimated results of the DLM model (2) (for the lag and lag-lead specification) for the MaPI, Pillar 1 and Pillar 2. Coefficients are scaled so they represent a change (in p.p.) of malaria mortality due to a change in 10 p.p. of the policy index, which is about two times the standard deviation of MaPI changes in the entire sample. Thus, it represents a notorious policy increase, and comparable in magnitude with results for the event study model. In general, we obtain similar results (qualitatively and quantitatively) for the event study design and the DLM estimates: the higher the policy change, the smaller the malaria mortality rate. Moreover, we find a flat pre-trend when including the four leads in the model specification (the lead/lag model) in all cases.

For the MaPI and Pillar 1, we obtain significant and negative estimates for coefficients lagged 2 or 3 more periods, depending on the case. In addition, we reject the null hypothesis that all lagged terms are zero. However, for Pillar 2, lagged coefficients are negative but none of them are individually significant; only the contemporaneous and the first lead terms are close to being significant at 10%. Moreover, in both cases (for all lags and leads), we cannot reject that all terms are zero. Notice that MaPI and Pillar 1 results are more similar for the DLM specification than for the event study design due to, as explained above, the MaPI and Pillar 1 changes in coincidence are especially high when looking at "any increase", whereas the coincidence reduces significantly when we consider large changes (recall from Table 5).

Figure 14. DLM cumulative effects. Baseline model (MaPI, Pillar 1 and Pillar 2)



Note: These figures depict DLM estimates ($\hat{\beta}_j, j \in [-4, 5]$) of different specifications of equation (2). The dependent variable is the yearly change in the log malaria death rate. Depending on the specification, the main regressors are lags or leads of the yearly change in the MaPI (or each pillar of the MaPI) (see legend). The MaPI (or each of its pillars) change occurred for the treatment group in the event year $t = 0$, as indicated by the vertical line. All regression models include country and year fixed effects. Standard errors are clustered at the country level. Estimates are reported in Appendix D, Table D.1. Source: Authors' calculation based on malaria death rate data from UNICEF database and MaPI and its pillars scores calculated from the World Malaria Reports (2005-2018).

Source: Constructed by the authors using WMRs (2005-2018) and GDB 2017.

The DLM allows us to exploit the different sizes of antimalarial policy changes. Figure 14 shows the cumulative effects of the DLM when defining changes for Pillar 1, Pillar 2 and the MaPI. We include the plot for Pillar 2 for comparative purposes, since no coefficient is significant in this case (however, all estimations show negative signs).[37] We find that an increase of 10 p.p. of the MaPI has a significant cumulative impact (after 5 years) of about 4 p.p. (lag model) and 9 p.p. (lag/lead model) on the within-country malaria mortality growth rate. These cumulative numbers are close to 6 p.p. when looking at changes in Pillar 1 (as for the event study design model), for both the lag and the lead/lag model. Moreover, impacts of Pillar 1 are equally relevant in all age groups (results are available upon request), with the exception of the group of less than 5 years old, which has the highest cumulative effect of about 9 p.p.; these results are also similar to those found for the event study design model.

As above, a set of robustness checks are performed in Appendix D, among them: we restrict the sample to the 2000-2017 period and include an endogenous dynamic term in the set of regressors. In general, we find that the main results are robust to these alternative specifications.

5-. Concluding remarks

We have constructed a synthetic Malaria Policy Index (MaPI) for 44 SSA countries from 1990 to 2017. This index compiles information on intervention strategies such as prevention, diagnosis, treatment and surveillance (Pillar 1) and the use of antimalarial therapies and tests (Pillar 2). We find that: (i) antimalarial policy implementation is a widespread phenomenon in the region from the mid-2000s on; (ii) initial differences in per capita GDP, quality of institutions or malaria burden are not determinant factors accounting for the current levels of policy implementation; (iii) two antagonist periods shape the malaria fighting trends in SSA through the implementation of antimalarial policies; the first period from 1990 to 2003, marked by divergent patterns among SSA countries; the second period after 2003, characterized by a strong convergence in the fight against the disease in the region; iv) the convergence period is associated with an unprecedented increase in international malaria fight funding, which was unevenly distributed across countries according to their past malaria burden.

[37] Recall that results for the MaPI in this section are noisy because the MaPI contains Pillar 2 information.

We use difference-in-difference event study design models and distributed lag models (DLM) to estimate the effect of antimalarial policy increases on posterior changes in the malaria mortality rate within a set of SSA countries. We obtain robust and significant results (for both the event study design, and the DLM) for large increases in policies included in Pillar 1, which mostly concentrate prevention, diagnosis and treatment measures. Moreover, policies' effects on the mortality rate are of a meaningful magnitude even after 5 years of their implementations. Results are significant for all age group, but of special relevance for child below five years old.

The nature of policies included in Pillar 2 is more related to research and the development of antimalarial medicines and tests, which is expected to have (if any) long-run effects (probably beyond 5 years). This should be the reason why we observe non-significant results for any type of model estimated with policies included in Pillar 2. Thus, while the MaPI is a convenient index for tracking the overall implementation of antimalarial policies within and between SSA countries, we should distinguish between its Pillars when focusing on a particular target, such as the reduction of the malaria mortality rate.

An interesting extension of our research is proposing a more sophisticated version of the MaPI, which considers not only whether policies are implemented but the way they are implemented. Note that the MaPI captures whether a policy has been implemented or not (coding 0 or 1). However, it does not provide additional information on how well the policy has been implemented. In this regard, it would be interesting to improve the scoring system taking into account some measures of the intensity or the quality of implementation. This implies that we would have to look for consistent indicators that capture the way in which policies are implemented. For example, the WMRs collect information about the share of people sleeping under bed nets. We could use this indicator to re-score the policy of "bed nets": if the country has implemented this policy, the score of the MaPI category associated with this measure would be related with that share, instead of scoring one. In this case, the country would get a score of one only in the case that the whole population would be sleeping under a bed net. However, this is not an easy task: there are not indicators for all policies and for all years. More complete databases are needed to achieve this purpose.

The MaPI (and the entire information included on it) is a useful tool since it aggregates all countries' implemented policies to fight against malaria. However, it does not consider the possibility that there exists some complementarities between different policy

measures. A relevant extension is to explore the possibility of complementarities among different categories and policies. An interesting approach would be considering the MaPI as a production function of "antimalarial policy effort", and taking all policies (alternatively categories) as different inputs. We should then calculate the degree of complementarity among them. To do this, we might use exogenous sources (such us the WMRs or experts' recommendations) to calculate the degree of complementarity or substitution between alternative measures through, for instance, the impact that different potential combinations have in reducing the malaria mortality rate or looking at the financing patter of donors by identifying the most financed policies at each moment.

Another relevant aspect that can be addressed in further research is to characterize the interrelationship between malaria and other diseases, such as the HIV. Kwenti (2018), among others, documents that the distributions of these diseases overlap in the SSA region. The reason is that patients infected by HIV are more likely to be affected by malaria due to the low levels of defenses, and vice versa (Alemu et al., 2013). Consequently, all policies devoted to reduce and control HIV or malaria are also having a positive effect in controlling the other disease. Thus, in assessing the reduction of malaria mortality rate, we should consider not only the MaPI effect, but the interaction of MaPI with other policies devoted to control HIV, or other infection diseases.

The current Covid-19 crisis opens a new totally situation in the region, since coronavirus-related diseases were not a concern in SSA before the crisis. On the one hand, prioritizing the fight against Covid-19 could divert resources from the fight against Malaria, and the incidence and the mortality rates could rebound due to the sudden reduction in the implementation of antimalarial measures. On the other hand, this new situation may accelerate the discovery of new antimalarial measures that are effective in the long term (i.e., a highly effective vaccine) and thus, make more real the goal of eradicating malaria from the SSA region by 2050.

References

Aaron K. C. and Akpalu W. (2021). "The effect of adaptive capacity to malaria on subjective welfare in Ghana." *Environmental and Sustainability Indicators*, 9: 1-6.

Alemu A., Shiferaw Y., Addis Z., Mathewos B. and Birhan W. (2013). "Effect of malaria on HIV/AIDS transmission and progression." *Parasites and Vectors*, 6(18): 1-8.

Barofsky J., Anekwe T. D., Chase C. and Farzadfar F. (2015). "Malaria Eradication and Economic Outcomes in Sub-Saharan Africa: Evidence from Uganda." *Journal of Health Economics*, 44: 118-136.

Bhatt S., Weiss D. J., Cameron E., Bisanzio D., Mappin B., Dalrymple U., Battle K., Moyes C. L., Henry A., Eckhoff P. A., Wenger E. A., Briët O., Penny M. A., Smith T. A., Bennett A., Yukich J., Eisele T. P., Griffin J. T., Fergus C. A., Lynch M., Lindgren F., Cohen J. M., Murray C. L. J., Smith D. L., Hay S. I., Cibulskis R. E. and Gething P. W. (2015). "The effect of malaria control on Plasmodium falciparum in Africa between 2000 and 2015." *Nature*, 526(7572): 207-211.

Bleakley H. (2010). "Health, Human Capital, and Development." *Annual Reviews of Economics,* 2: 283-310.

Brock A. R., Gibbs C. A., Ross J. V. and Esterman A. (2017). "The Impact of Antimalarial Use on the Emergence and Transmission of Plasmodium falciparum Resistance: A Scoping Review of Mathematical Models." *Tropical Medicine Infectious Disease*; 2(4): 1-19.

Bruce-Chwatt L. J. (1974). "Resurgence of malaria and its control." *Journal of Tropical Medicine and Hygiene*, 77: s62–s66.

Camponovo F., Bever C. A., Galactionova K., Smith T. and Penny M. A. (2017). "Incidence and admission rates for severe malaria and their impact on mortality in Africa." *Malaria Journal*, 16(1):1-12.

Carstensen K. and Gundlach E. (2006). "The Primacy of Institutions Reconsidered: Direct Income Effects of Malaria Prevalence." *The World Bank Economic Review*, 20(3), 309-339.

Choi I. (2001). "Unit root tests for panel data." *Journal of International Money and Finance,* 20: 249-272.

Cohen J. M., Smith D. L., Cotter C., Ward A., Yamey G., Sabot O. J. and Moonen B. (2012). "Malaria resurgence: a systematic review and assessment of its causes." *Malaria Journal,* 11(122): 1-17.

Cutler, D., Fung W., Kremer M., Singhal M., and Vogl T. (2010). "Early Life Malaria Exposure and Adult Outcomes: Evidence from Malaria Eradication in India." *American Economic Journal: Applied Economics 2*, 2: 72-94.

Dabla-Norris E., Brumby J., Kyobe A., Mills Z. and Papageorgiou C. (2012). "Investing in Public Investment: An Index of Public Investment Efficiency." *Journal of Economic Growth*, 17(3): 235-266.

Datta S. C. and Reimer J. J. (2013). "Malaria and Economic Development." *Review of Development Economics*, 17(1): 1-15.

de Jongh T. E., Harnmeijer J. H., Atun R., Korenromp E. L., Zhao J., Puvimanasinghe J. and Baltussen R. (2014). "Health impact of external funding for HIV, tuberculosis and malaria: systematic review." *Health Policy Plan*, 29(5): 650-662.

Fielding D. and Torres S. (2009). "Health, Wealth, Fertility, Education and Inequality." *Review of Development Economics,* 13: 39-55.

Fillinger U, Ndenga B, Githeko A, Lindsay SW. (2009). "Integrated malaria vector control with microbial larvicides and insecticide-treated nets in western Kenya: a controlled trial." *Bulletin of the World Health Organization*, 87:655-665.

Flückiger M. Ludwig M. (2020). "Malaria suitability, urbanization and subnational development in sub-Saharan Africa." *Journal of Urban Economics*, 120(c): 1-17.

Fuest C., Peichl A. and Siegloch S. (2018). "Do Higher Corporate Taxes Reduce Wages? Micro Evidence from Germany." *American Economic Review*, 108(2): 393-418.

Galactionova K., Bertram M., Lauer J. and Tediosi F. (2015). "Costing RTS,S introduction in Burkina Faso, Ghana, Kenya, Senegal, Tanzania, and Uganda: A generalizable approach drawing on publicly available data." *Vaccine*, 33(48): 6710-6718.

Gallup J. L. and Sachs J. D. (2001). "The Economic Burden of Malaria." *The American Journal of Tropical Medicine and Hygiene* 64(1,2): 85-96

Global Burden of Disease Collaborative Network. (2018). *Global Burden of Disease Study 2017 (GBD 2017) Results*. Seattle, United States: Institute for Health Metrics and Evaluation (IHME).

Gooch E. (2017). "The impact of reduced incidence of malaria and other mosquito-borne diseases on global population." *Journal of Development Economics*, 124: 214-228.

Gordon M. C., Conley D. and Sachs J. D. (2017). "Malaria ecology, child mortality & fertility." *Economics & Human Biology*, 24: 1-17.

Gunda R. and Chimbari M. J. (2017). "Cost-effectiveness analysis of malaria interventions using disability adjusted life years: a systematic review." *Cost Effectiveness and Resource Allocation,* 15(10): 1-13.

Haacker M. (2010). "Macroeconomic Constraints to Health Financing: A Guide for the Perplexed." *World Health Report (2010) Background Paper, No 49*. 8 pages

Im K. S., Pesaran M. H., and Shin Y. (2003). "Testing for unit roots in heterogeneous panels." *Journal of Econometrics* 115: 53-74.

Jakubowski A., Stearns S. C., Kruk M. E., Angeles G., Thirumurthy H. (2017). "The US President's Malaria Initiative and under-5 child mortality in sub-Saharan Africa: A difference-in-differences analysis." *PLoS Med*icine, 14(6): 1-20.

Jaumotte F. and Osorio-Buitron C. (2015). "Power from the People." *Finance and Development*, 52(1): 1-3.

Kaufmann D. and Kraay A. (2002). "Growth Without Governance". World Bank Policy Research Working Paper No. 2928. 60 pages.

Kaufmann D., Kraay A. and Mastruzzi M. (2010). "Response to: What Do the Worldwide Governance Indicators Measure". *European Journal of Development Research*, 22: 55-58.

Klein S. L., Shann F., Moss W. J., Benn C. S., Aaby P. (2016). "RTS,S Malaria Vaccine and Increased Mortality in Girls." *mBio* 7(2): 1-2.

Knols B. G. J., Farenhorst M., Andriessen R., Snetselaar J., Suer R. A., Osinga A. J., Knols J. M. H., Deschietere J., Ng'habi K. R., Lyimo I. N., Kessy S. T., Mayagaya V. S., Sperling S., Cordel M., Sternberg E. D., Hartmann P., Mnyone L. L., Rose A. and Thomas M. B. (2016). "Eave tubes for malaria control in Africa: an introduction." *Malaria Journal*, 15(404): 1-7.

Kuecken M., Thuilliez J. and Valfort M. A. (2020). "Disease and Human Capital Accumulation: Evidence from the Roll Back Malaria Partnership in Africa." *The Economic Journal*, 104: 1-10.

Kwenti T. E. (2018). "Malaria and HIV coinfection in sub-Saharan Africa: prevalence, impact, and treatment strategies." *Research and Reports in Tropical Medicine*, 9: 123-136.

Lucas A. M. (2010). "Malaria Eradication and Educational Attainment: Evidence from Paraguay and Sri Lanka." *American Economic Journal: Applied Economics 2*, 22: 46-71.

Lucas A. M. (2013). "The Impact of Malaria Eradication on Fertility." *Economic Development and Cultural Change,* 61(3): 1-22.

Musumba M., Egbendewe-Mondzozo A. and McCarl B. A. (2014). "Analysis of the Cost of Malaria in Children and Use of Insecticide-treated Bednets in Africa." *African Development Review*, 26(1): 74-87.

Nájera J. A., González-Silva M. and Alonso P. L. (2011). "Some Lessons for the Future from the Global Malaria Eradication Programme (1955–1969)." *PLOS Medicine* 8(1): 1-7.

Narasimhan, V. and Attaran, A. (2003). "Roll Back Malaria? The scarcity of international aid for malaria control". *Malaria Journal*, 2(8): 1-8.

Pathania V. (2014). "The impact of malaria control on infant mortality in Kenya". *Economic Development and Cultural Change*, 62(3): 459-487.

Perera R., Caldera A. and Wickremasinghe A. R. (2020). "Reactive Case Detection (RACD) and foci investigation strategies in malaria control and elimination." *Malaria Journal*, 19(401): 1-11.

Pinkovskiy M. and Sala-i-Martin X. (2014). "Africa Is on Time." *Journal of Economic Growth,* 19(3): 311-338.

Rosenthal P. J., Chandy C. J., and Rabinovich N. R. (2019). "Malaria: How Are We doing and How Can We Do Better?" *Am. J. Trop. Med. Hyg.*, 100(2): 239-241.

RTS. (2015). "Efficacy and safety of RTS,S/AS01 malaria vaccine with or without a booster dose in infants and children in Africa: final results of a phase 3, individually randomised, controlled trial." *Lancet*, 386: 31-45.

Sachs J. D. (2002). “A new global effort to control malaria.” *Science*, 298(5591): 122-124.

Shretta R., Zelman B., Birger M. L., Haakenstad A., Singh L., Liu Y. and Dieleman J. (2017). “Tracking development assistance and government health expenditures for 35 malaria-eliminating countries: 1990–2017.” *Malaria Journal,* 16(251): 1-11.

Simon, D. (2016). “Does Early Life Exposure to Cigarette Smoke Permanently Harm Childhood Welfare? Evidence from Cigarette Tax Hikes.” *American Economic Journal: Applied Economics,* 8(4): 128-159.

Snow R. W., Sartorius B., Kyalo D., Maina J., Amratia P., Mundia C. W., Bejon P. and Noor A. M. (2017). “The prevalence of Plasmodium falciparum in sub-Saharan Africa since 1900”. *Nature*, 550: 515–518.

Suárez-Serrato J. C., and Zidar O. (2016). “Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms.” *American Economic Review,* 106(9): 2582–2624.

The Global Fund. (2011). *Making a difference: Global Fund results report 2011*.

Tusting L. S., Ippolito M. M., WilleyB. A., Kleinschmidt K., Dorsey G., Gosling R. D. and Lindsay S. W. (2015). “The evidence for improving housing to reduce malaria: a systematic review and meta-analysis.” *Malaria Journal*, 14(209): 1-12.

Veloshnee G., McIntyre D. and Loewenson R. (2008). “Progress towards the Abuja target for government spending on health care in East and Southern Africa.” *EQUINET Discussion Paper Series 57*. EQUINET: Harare

Weiss D. J., Bertozzi-Villa A., Rumisha S. F., Amratia P., Arambepola R., Battle K. E., Cameron E., Chestnutt E., Gibson H. S., Harris J., Keddie S., Millar J. J., Rozier J., Symons T. L., Vargas-Ruiz C., Hay S. I., Smith D. L., Alonso P. L., Noor A. M., Bhatt S., GethingSumm P. W. (2020). “Indirect effects of the COVID-19 pandemic on malaria intervention coverage, morbidity, and mortality in Africa: a geospatial modelling analysis.” *Lancet Infectious Diseases*, 21: 59-69.

WHO (2005 – 2020). *World Malaria Reports*, Geneva: World Health Organization.

WHO (2019b). *Guidelines for Malaria Vector Control*. Geneva: World Health Organization.

Witvorapong N. and Yakubu K. Y. (2019). “Effectiveness of antimalarial interventions in Nigeria: Evidence from facility-level longitudinal data.” *Health Services Research*, 54(3): 669-677.

Yé Y., Sankoh O., Kouyaté B. and Sauerborn R. (2017). *Environmental Factors and Malaria Transmission Risk: Modelling the Risk in a Holoendemic Area of Burkina Faso*. Eds. Taylor & Francis. 166 pages.

Appendix A. Antimalarial policies: details, scoring and aggregation

A.1. Antimalarial measures

World Malaria Reports (WMRs) provide information about the epidemiological profile, as well as the intervention measures of each malaria-endemic country. We use both the country individual profiles (when available) and the tables included in the annexes of the reports.

We identify 61 potential antimalarial measures (Table A1). These measures are grouped into seven categories: prevention and vectors' control (Category 1), diagnosis (Category 2), treatment and case management (Category 3), surveillance (Category 4), antimalarial therapies (Category 5), therapeutic efficacy tests (Category 6) carried on these therapies, and insecticide susceptibility bioassays (Category 7). The first four categories grouping 41 measures are included in the Intervention Strategies (Pillar 1) and the remaining three categories composed of 20 measures are grouped in the Malaria Medicines and Tests (Pillar 2).

In Pillar 1, Category 1 includes prevention and vectors' control strategies (16 measures). Within this group, there are 6 measures aiming at distributing Insecticide Treated Nets or Long-Lasting Insecticide Nets (ITNs/LLINs). The distribution of ITNs/LLINs, which is free or not depending of the country, occurs through specific targeted campaigns (children under five years and pregnant women in most cases) and routine programs including antenatal care and immunization therapies. Another set of 6 measures within this category concerns vector-control interventions through Indoor Residual Spraying (IRS). In most cases, insecticide-resistance management has been undertaken and dichloro-diphenyl trichloroethane (DDT) (the oldest and most popular measure) has been used alone or in combination with the other four commonly used insecticide classes – pyrethroids, organochlorines, carbamates and organophosphates. In this category, there is also a single larval control measure, which is designed to counteract the development of the *Anopheles* mosquito, the principal vector of malaria. Finally, the 3 remaining measures are related to chemoprevention, which refers to the administration of a medication for the purpose of preventing disease or infection. Among them, the measure related to intermittent preventive treatments for pregnant women and children under five years old is actually one of the most recommended preventive policies according to the WHO.

Category 2 involves the diagnosis of patients with symptoms (6 measures). Countries have progressively implemented two methods of diagnosis examination: parasitological confirmation and rapid diagnostic tests, as well as, the requirement for diagnosis before any treatment with primaquine. The major WHO recommendation is to provide these diagnostic methods free and make them available to all the population.

Category 3 includes 10 malaria treatment measures and 4 case management measures. Malaria treatment measures include several methods, and the Artemisinin-based Combination Therapy (ACT) is the most recommended. Others pre-referral treatments with primaquine or parenteral quinine or artemisinin derivatives or artesunate suppositories are also considered. Oral artemisinin monotherapies need to be banned or prohibited from registration or removed from the malaria program because their continued use is considered to be a major contributing factor to the development of resistance to artemisinin derivatives. Adopting each treatment measure depends on the type of plasmodium in case and on each national malaria program. Remember that two different types of plasmodium are present in the region: *Plasmodium falciparum* (P.falciparum) and *Plasmodium vivax* (P.vivax). Case management measures include measures aiming at carrying oversight regulation of malaria. Another measure in this group consists of the system monitoring of adverse reaction to antimalarials, and two additional measures provide information about whether malaria cases routinely be admitted for treatment.

Category 4 in the Pillar 1 contains 5 malaria surveillance measures. These set of measures consist of 2 detection measures: active case detection (ACD) at the community level and, for case investigation measures, as well as, 3 other measures concerning: reactive case detection and foci investigation, mandatory reporting from private sectors and, mass screening. Reactive case detection (RACD) and foci investigation help prevent the recurrence of malaria. They have considered as a core intervention by WHO and as one of the three pillars of the Global Technical Strategy for Malaria 2016–2030[38] (Perera et al. 2020).

The last three categories belong to Pillar 2. Category 5 (6 measures) englobes the antimalarial therapies used in the treatment of malaria depending on their causes. Thus,

[38] The Global Technical Strategy for Malaria 2016–2030 was adopted by the World Health Assembly in May 2015. It provides a comprehensive framework to guide countries in their efforts to accelerate progress towards malaria elimination. The strategy sets the target of reducing global malaria incidence and mortality rates by at least 90% by 2030.

we have measures on therapies used in first line treatment and also treatment failure of P.falciparum. The three other measures concern the therapies used in the treatment of severe malaria and P.vivax, and the prevention of malaria during pregnancy.

Category 6 contains a set of therapeutic efficacy tests (10 measures). These efficacy tests are carried on the individual therapies using chloroquine (CQ), sulfadoxine-pyrimethamine (SP), quinine (QN), amodiaquine (AQ) and Mefloquine (MQ) as well as the therapies combination using chloroquine and sulfadoxine-pyrimethamine (CQ+SP), amodiaquine and sulfadoxine-pyrimethamine (AQ+SP), artesunate and amodiaquine or mefloquine (AS+AQ), artesunate and sulfadoxine-pyrimethamine (AS+SP) artemether – lumefantrine (AL), and dihydroartemisinin-piperaquine (DHA–PPQ).

Finally, Category 7 (4 measures) involves insecticide resistance bioassays checking, beyond the resistance status by insecticide class, and their use for malaria vector control. The four most used insecticide classes are pyrethroids, organochlorines, carbamates and organophosphates.

A.2. Primary and secondary measures

The WHO gives more relevance to some policies than others. We use this information and classify the 61 measures as primary and secondary ones. A primary policy is defined as the one that is strongly recommended by the WHO, while the rest of policies are considered as secondary. Following this rule, we identify 50 primary policies and 11 secondary policies.

Moreover, examining carefully these 61 measures in order to avoid double accountability, we found that 19 of them are alternative measures to other 12 broader measures. Thus, in the construction of the index, these alternative measures are taken into account if and only if the broader measure has not been adopted. Among the 19 alternative measures, we have found that 18 are alternatives to another 11 broader primary policies, while just one is alternative to a secondary policy. This identification reduces the number of Antimalarial effective measures to 42. The details of this classification are described in the following paragraphs.

Regarding Category 1 there are three sets of alternative measures. The first set corresponds to 4 measures that are included into 2 other broader measures within the first target of this category – insecticide-treated nets (ITNs) measures –. The measure "Insecticide-treated nets (ITNs) distribution subsidized" is part of the primary measure

“ITNs / long-lasting insecticidal nets (LLINs) distributed free of charge”. The 3 measures “ITNs/LLINs distributed through antenatal care programs”, “ITNs/LLINs distributed through Expanded Program on Immunization (EPI) routine and campaign”, and “ITNs/LLINs distributed through mass campaigns to children under 5 years and pregnant women”, are part of a broader primary policy: “ITNs/LLINs distributed to all age groups”.

Indoor residual spraying (IRS) measures are the second set of alternative policies in Category 1. Here, the two measures: “IRS used for prevention and control of epidemics” and “IRS conducted with other options in the same area, e.g. ITN”, are part of a broader primary measure, which is “IRS as primary vector-control intervention (IRS recommended by malaria control program)”. The measure “DDT used alternatively with other insecticides in the same area” is part of the broader primary measure “DDT used for IRS (public health) only”.

The third, last case in Category 1, is related to the measure “Intermittent preventive treatment (IPT) implemented countrywide” included in the last set of Malaria Chemoprevention measures. This one is part of a broader primary measure “IPT used to prevent malaria during pregnancy”.

In Category 2, we find 2 measures which are part of another bigger primary measure. The two measures “Diagnosis of malaria of inpatients based on parasitological confirmation” and “Parasitological confirmation for patients of 5 years and above only” are both part of a larger primary measure “Parasitological confirmation for all age groups (Patients of all ages should receive diagnostic tests)”.

In Category 3, we find 4 measures in which 3 are part of two other primary measures and one is part of another secondary measure. Within the first target of this category – Treatment – the measure “Artemisinin-based Combination Therapy (ACT) delivered at community level through community agents (beyond the health facilities)” is an alternative to a primary measure “ACT for treatment of P. falciparum”. The two measures “ACT free of charge for patients above 5 years in the public sector” and “ACT free of charge for children under 5 years old in the public sector” are twin parts of the larger primary policy “ACT free or highly subsidized in public sectors”. And finally, a single measure “System for monitoring of adverse reaction to antimalarials exists” is an alternative to a broader secondary policy “Home management of malaria / Therapeutic

efficacy monitoring undertaken (Oversight regulation of case management in the private sectors)".

In Category 6, we find 5 measures that are part of 3 other broader primary policies. The two measures "Therapeutic efficacy test using Chloroquine (CQ) therapy" and "Therapeutic efficacy test using Chloroquine+Sulfadoxine-pyrimethamine (CQ+SP) therapy" are both part of the primary measure "Therapeutic efficacy test using Artesunate and Chloroquine (AS+CQ) therapy". Measures "Therapeutic efficacy test using Sulfadoxine-Pyrimethamine (SP) therapy" and "Therapeutic efficacy test using Amodiaquine+Sulfadoxine-pyrimethamine (AQ+SP) therapy" are alternatives to the primary broader measure "Therapeutic efficacy test using Artesunate and Sulfadoxine-Pyrimethamine (AS+SP) therapy". Finally, "Therapeutic efficacy test using Quinine, Amodiaquine, Mefloquine (QN, AQ, MQ) therapy" is part of a primary measure "Therapeutic efficacy test using Artesunate and Amodiaquine or Mefloquine (AS+AQ; MQ) therapy".

Summing up, we have reduced the set of measures to 42 policies, among which 32 are primary and 10 are secondary.

A.3. MaPI-W: scoring and weighting procedure

In the raw version of the MaPI (MaPI-R), all 42 policies are considered equally important regardless the relevance given by the WHO. All policies in the same category re weighted alike. Also, in the raw version of the index, we give the same weight to all categories in each pillar and further to each pillar in the index. Equal scores to policies and equal weight to different levels of categories are not reasonable assumptions in the construction of an index. To overcome these potential shortcomings, we propose scoring the policies differently, depending on their nature and characteristics, as well as, weighting categories and pillars according to the number of policies they contain (MaPI-W).

a. Scoring primary and secondary measures:

If a primary or secondary policy is implemented, they score 1 or 1/2, respectively. However, in cases where policies can be targeted by several measures (as in the cases described in A.2.), if the broad policy is not implemented but, instead, any of the alternative measures is approved, this policy scores less than 1 or 1/2, depending on whether the broad policy is primary or secondary. In this situation, each measure scores proportionally to the number of measures contained on it. For instance, if a primary policy

can be achieved by three alternative measures and the country undertakes only two of them, then the score would be 2/3.[39] Table A1 summarizes all these cases:

- Each of the five primary policies: "ITNs / LLINs distributed free of charge", "DDT used for IRS (public health) only", "IPT used to prevent malaria during pregnancy" "ACT for treatment of P. falciparum" and "Therapeutic efficacy test using AS+AQ/MQ therapy" can be achieved through the implementation of a unique alternative measure. If the measure is implemented instead of its broad policy, they country would score 1.
- The secondary measure "Home management of malaria / Therapeutic efficacy monitoring undertaken (Oversight regulation of case management in the private sectors)" can be achieved by one unique alternative so the country which implements this alternative scores 1/2.
- Three alternative measures can be approved to achieve the primary policy "ITNs/LLINs distributed to all age groups". Each of them, if implemented, scores 1/3.
- Finally, any of the five primary policies "IRS as primary vector-control intervention (IRS recommended by malaria control program)", "Parasitological confirmation for all age groups (Patients of all ages should receive diagnostic tests)", "ACT free or highly subsidized in public sectors", "Therapeutic efficacy test using AS+CQ therapy" and "Therapeutic efficacy test using AS+SP therapy" can be achieved through two different alternatives. Thus, each of these alternatives would score 1/2 if implemented by a country.

b. Weighting categories and pillars

The MaPI-R version of the index gives the same relevance to each category and pillar. Thus, each category weights 1/4 in Pillar 1, 1/3 in Pillar 2, and each pillar weights 1/2 in the MaPI. This aggregation might be an inconvenient decision, since: pillars contain different numbers of categories, categories contain different number of policies and, not all policies have the same relevance (some of them are primary and others are secondary).

The MaPI-W weights each category and pillar unevenly, according to the number and relevance of the policies included in each of them (primary or secondary policies). Table 1 in the main text shows these weights and in the following paragraphs, we explain how

[39] If there is only one alternative measure associated to a broader one, the score of the alternative measure will be equal to 1 or 1/2, depending if the broad measure is primary or secondary, respectively.

we construct them. As explained in Appendix A.2, among the set of 42 policies in our sample, 32 are classified as primary and 10 as secondary policies. Pillar 1 counts a total of 27 policies (17 primary and 10 secondary) whereas Pillar 2 counts 15 primary policies.

Pillar 1 contains four categories whose maximum possible score is 22.[40] Category 1 included 7 primary policies and a single secondary policy. Hence, the maximum possible score of this category is 7.5. Category 2 includes 3 primary policies and a single secondary policy; hence its maximum possible score is 3.5. Category 3 encompasses 4 primary and 6 secondary policies. Thus, the maximum possible score of this category is 7. Category 4 includes 3 primary and 2 secondary policies, accounting for a maximum possible score of 4. We then, calculate the weight of each category as the ratio between the maximum possible score of the category and the maximum possible score of the pillar.[41] Hence, the weights by categories in Pillar 1 are 0.34, 0.16, 0.32 and 0.18 for the first, second, third and fourth category, respectively.

Pillar 2 has three categories including only primary policies with a maximum possible score of 15. Thus, categories 5, 6 and 7 hold respectively 6, 5 and 4 primary policies. Hence, their weights are 0.40, 0.33 and 0.27 respectively.

Similarly, as weighting the categories, Pillar 1 and Pillar 2 are also weighted unevenly in MaPI-W. Weights are related to the relevance of each policy implemented (primary and secondary), as well as, the number of policies per pillar. The weight by pillar is then given by the ratio between the maximum possible score of the pillar and the overall maximum possible score that can be achieved with all antimalarial policies. Pillar 1 has 17 primary and 10 secondary policies and Pillar 2 is composed of 15 primary policies. This implies that the maximum possible score of all the antimalarial policies is then 37. Hence, the weight of Pillar 1 is 0.60 while the weight of Pillar 2 is 0.40.

[40] The maximum possible score of each primary policy is 1 and the maximum possible score of each secondary policy is 1/2. Pillar 1 contains 17 primary policies and 10 secondary policies, so its maximum possible score is $(17 * 1) + (10 * 0.5) = 22$. We follow the same approach to calculate the maximum possible score of Pillar 2, as well as, the maximum possible score of each category of these pillars and the overall malaria policies used for our MaPI-W.

[41] For instance, the maximum possible score of Pillar 1 is 22 and the maximum possible score of its first category is 7.5, so the weight of this category is $(7.5/22) = 0.34$. We follow the same approach to obtain the weights of pillars in MaPI-W.

Table A1: List of policies and weights given according to a priori information

Pillars	Categories	Targets	Policies (measures)	Type of variables	Score in MaPI-V1 and MaPI-V2	Initial 61 mea-sures	Final 42 policies
Intervention Strategies	Prevention and vectors' control	Insecticide-treated nets (ITN)	1.1.1. Insecticide-treated nets (ITNs) / long-lasting insecticidal nets (LLINs) distributed free of charge	primary	1	1	1
			1.1.2. ITN distribution subsidized	alternative to 1.1.1	1	2	
			1.1.3. ITNs/LLINs distributed to all age groups	primary	1	3	2
			1.1.4. ITNs/LLINs distributed through antenatal care programs	alternative to 1.1.2	1/3	4	
			1.1.5. ITNs/LLINs distributed through Expanded Program on Immunization (EPI) routine and campaign	alternative to 1.1.2	1/3	5	
			1.1.6. ITNs/LLINs distributed through mass campaigns to children under 5 years and pregnant women	alternative to 1.1.2	1/3	6	
		Indoor residual spraying (IRS)	1.1.7. IRS as primary vector-control intervention (IRS recommended by malaria control programme)	primary	1	7	3
			1.1.8. IRS used for prevention and control of epidemics	alternative to 1.1.7	1/2	8	
			1.1.9. IRS conducted with other options in the same area, e.g. ITN	alternative to 1.1.7	1/2	9	
			1.1.10. Insecticide-resistance management undertaken (implemented)	secondary	1/2	10	4
			1.1.11. Dichloro-diphenyl-trichloroethane (DDT) used for IRS (public health) only	primary	1	11	5
			1.1.12. DDT used alternatively with other insecticides in the same area	alternative to 1.1.11	1	12	
		Larval control	1.1.13. Use of larval control	primary	1	13	6
		Chemopre-vention	1.1.14. Intermittent preventive treatment (IPT) used to prevent malaria during pregnancy	primary	1	14	7
			1.1.15. Intermittent preventive treatment (IPT) implemented countrywide	alternative to 1.1.14	1	15	
			1.1.16. Seasonal malaria chemoprevention (SMC or IPTc) is used	primary	1	16	8
	Diagnosis	Diagnosis	1.2.1. Parasitological confirmation for all age groups (Patients of all ages should receive diagnostic tests)	primary	1	17	9
			1.2.2. Diagnosis of malaria of inpatients based on parasitological confirmation	alternative to 1.2.1	1/2	18	
			1.2.3. Parasitological confirmation for patients of 5 years and above only	alternative to 1.2.1	1/2	19	
			1.2.4. Malaria diagnosis free of charge in the public sector	primary	1	20	10

			1.2.5. Rapid diagnostic tests (RDTs) used at community level (RDTs in areas without microscopy)	primary	1	21	11
			1.2.6. Glucose-6-phosphate dehydrogenase (G6PD) test requirement before treatment with primaquine	secondary	1/2	22	12
	Treatment and case management	Treatment	1.3.1. Artemisinin-based Combination Therapy (ACT) for treatment of P. falciparum	primary	1	23	13
			1.3.2. ACT delivered at community level through community agents (beyond the health facilities)	Alternative to 1.3.1	1	24	
			1.3.3. ACT free or highly subsidized in public sectors	primary	1	25	14
			1.3.4. ACT free of charge for patients above 5 years in the public sector	alternative to 1.3.3	1/2	26	
			1.3.5. ACT free of charge for children under 5 years old in the public sector	alternative to 1.3.3	1/2	27	
			1.3.6. Oral artemisinin monotherapies banned (prohibited from registration or removed from the system)	primary	1	28	15
			1.3.7. Pre-referral treatment with parenteral quinine or artemisinin derivatives or artesunate suppositories provided	primary	1	29	16
			1.3.8. Directly observed treatment with primaquine undertaken	secondary	1/2	30	17
			1.3.9. Single dose of primaquine (0.25 mg base/kg) used as gametocidal medicine for Plasmodium falciparum	secondary	1/2	31	18
			1.3.10. Primaquine used for radical treatment of P. vivax	secondary	1/2	32	19
		Case management	1.3.11. Home management of malaria / Therapeutic efficacy monitoring undertaken (Oversight regulation of case management in the private sectors)	secondary	1/2	33	20
			1.3.12. System for monitoring of adverse reaction to antimalarials exists	alternative to 1.3.11	1/2	34	
			1.3.13. Uncomplicated P. falciparum cases routinely admitted	secondary	1/2	35	21
			1.3.14. Uncomplicated P. vivax cases routinely admitted	secondary	1/2	36	22
	Surveillance	Surveillance	1.4.1. Active case detection (ACD) at community level of febrile cases (pro-active)	primary	1	37	23
			1.4.2. Active case detection (ACD) for case investigation (reactive)	secondary	1/2	38	24
			1.4.3. Mass screening undertaken	secondary	1/2	39	25
			1.4.4. Reactive case detection and foci investigation undertaken	primary	1	40	26
			1.4.5. Mandatory case reporting from private sector	primary	1	41	27
	Antimalarial therapies	Antimalarial therapies	2.1.1. Implementation of unconfirmed First-line treatment of Plasmodium falciparum	primary	1	42	28
			2.1.2. Implementation of confirmed First-line treatment of Plasmodium falciparum	primary	1	43	29

Malaria Medicines and Tests			2.1.3. Treatment failure of Plasmodium falciparum	primary	1	44	30
			2.1.4. Treatment of severe malaria	primary	1	45	31
			2.1.5. Prevention of malaria during pregnancy	primary	1	46	32
			2.1.6. Treatment of Plasmodium vivax	primary	1	47	33
	Therapeutic efficacy tests	Therapeutic efficacy tests	2.2.1. Therapeutic efficacy test using Artesunate and Chloroquine (AS+CQ) therapy	primary	1	48	34
			2.2.2. Therapeutic efficacy test using Chloroquine (CQ) therapy	alternative to 2.2.1	1/2	49	
			2.2.3. Therapeutic efficacy test using Chloroquine+Sulfadoxine-pyrimethamine (CQ+SP) therapy	alternative to 2.2.1	1/2	50	
			2.2.4. Therapeutic efficacy test using Artesunate and Sulfadoxine-Pyrimethamine (AS+SP) therapy	primary	1	51	35
			2.2.5. Therapeutic efficacy test using Sulfadoxine-Pyrimethamine (SP) therapy	alternative to 2.2.4	1/2	52	
			2.2.6. Therapeutic efficacy test using Amodiaquine+Sulfadoxine-pyrimethamine (AQ+SP) therapy	alternative to 2.2.4	1/2	53	
			2.2.7. Therapeutic efficacy test using Artesunate and Amodiaquine or Mefloquine (AS+AQ; MQ) therapy	primary	1	54	36
			2.2.8. Therapeutic efficacy test using Quinine, Amodiaquine, Mefloquine (QN, AQ, MQ) therapy	alternative to 2.2.7	1	55	
			2.2.9. Therapeutic efficacy test using Artemether-Lumefantrine (AL) therapy	primary	1	56	37
			2.2.10. Therapeutic efficacy test using Dihydroartemisinin-Piperaquine (DHA–PPQ) therapy	primary	1	57	38
	Insecticide susceptibility bioassays	Insecticide susceptibility bioassays	2.3.1. Test on Carbamates insecticide class	primary	1	58	39
			2.3.2. Test on Organochlorines insecticide class	primary	1	59	40
			2.3.3. Test on Organophosphates insecticide class	primary	1	60	41
			2.3.4. Test on Pyrethroids insecticide class	primary	1	61	42

LEGENDS: Primary policies | Alternative policies | Secondary policies

Notes:
- The score of each policy is as follow: Primary policy = 1; Secondary policy=1/2; $\sum alternative\ measures = 1\ or\ 1/2$ if the broader policy is respectively primary or secondary.
- Alternative measures are taken into account only if the country didn't implement the broader policy of which this latter is part.

Source: Construct by the authors using information from WMRs

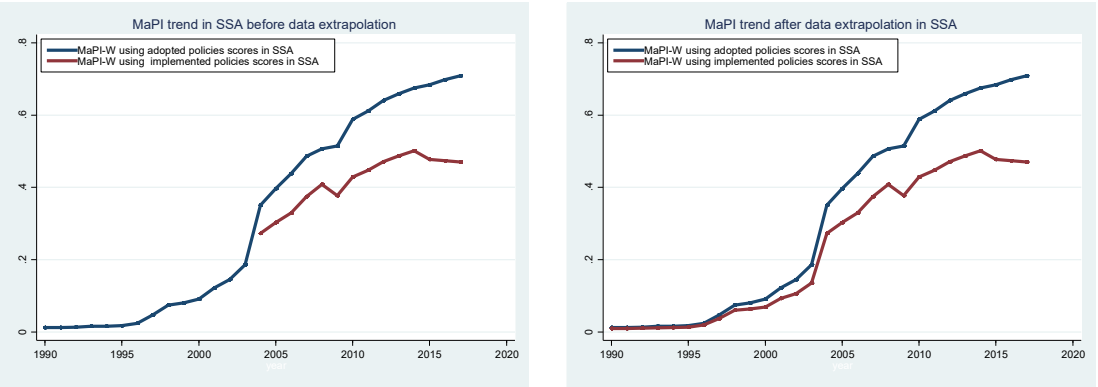
Appendix B.

B1. The interpolation of antimalarial policy implementation before 2004

We only have information of policy implementation from 2004 to 2017. However, the WMRs have documented the adoption of antimalarial policies from 1930 to 2017. Since the level of implemented policies by 2004 is very low, and the relationship between implemented and adopted policies becomes closer when approaching to this year (see Figure B1), we can easily construct backward the MaPI for implemented policies using the information of the MaPI for adopted policies.

Let's define the Coefficient of Implementation Policy of category i in year t (CIP_{it}) as the ratio between the implementation (y_{it}) and the adoption (x_{it}): $CIP_{it} = y_{it}/x_{it}$. Having x_{it} and CIP_{it} for all categories, we can easily recover y_{it} and construct the MaPI for implemented policies. However, we do not have the exact value of CIP_{it} for the years before 2004. Thus, starting with 2003, we use a forward and rolling sample average (of 5 years) of y_{it} and x_{it} to have a proxy for the CIP_{it} in 2003 for each category: $CIP_{i2003} = \frac{\sum_{j=2004}^{2008} y_{ij}}{\sum_{j=200}^{2008} x_{ij}}$. Next, we use this CIP_{i2003} and the observed x_{i2003} to obtain y_{i2003} for all i and recover the level of the MaPI for implemented policies in 2003. We then repeat this procedure backwards and obtain the entire time series of implemented policies from 1990 to 2003. Figure B1 compares the evolution of the cross-country average of the adopted-MaPI and the implemented–MaPI between 1990 and 2017. The left graphic uses data directly extracted from the WMRs, while the right graphic considers also extrapolated data for the implemented-MaPI from 1990 to 2003.

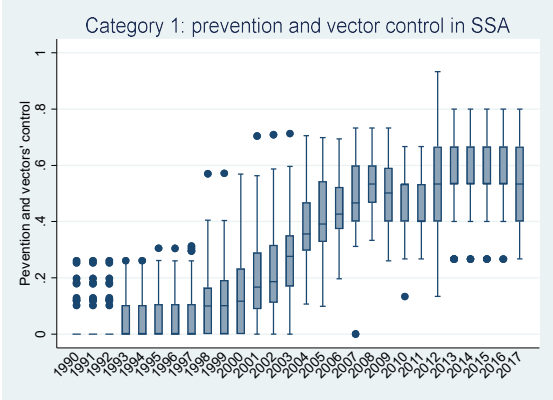
Figure B1: The MaPI between 1990 and 2017 in SSA countries

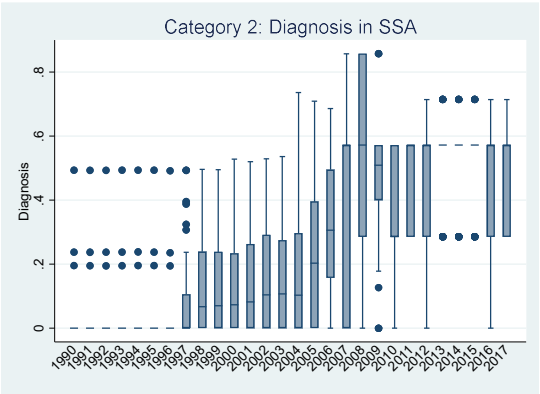


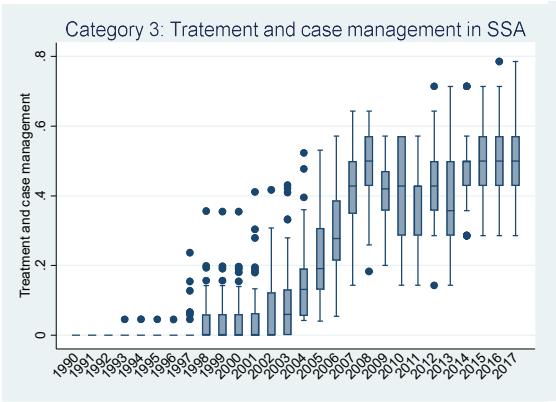
MaPI trend before data extrapolation **MaPI trend after data extrapolation**

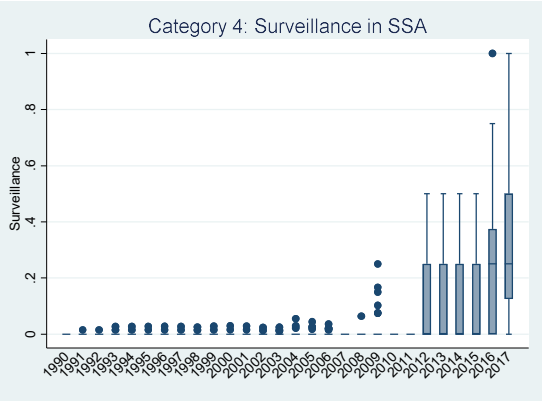
Source: Constructed by the authors using MaPI scores aggregated through information from the WMRs (2005-2018).

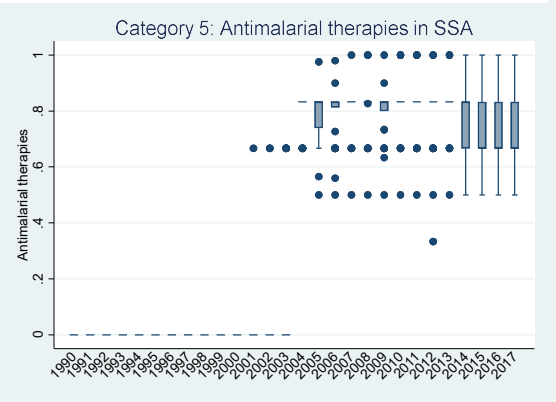
B2. MaPI trends by categories

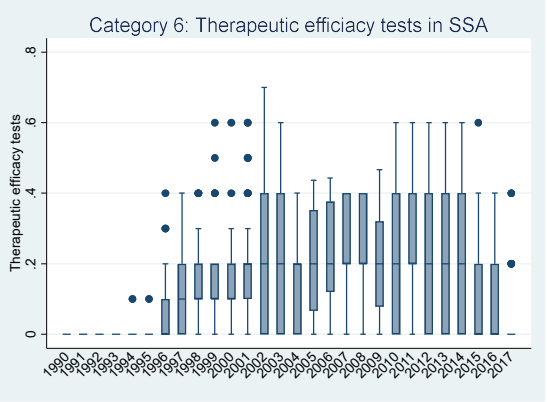


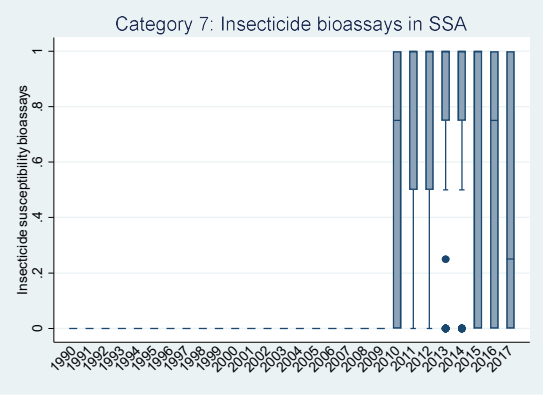








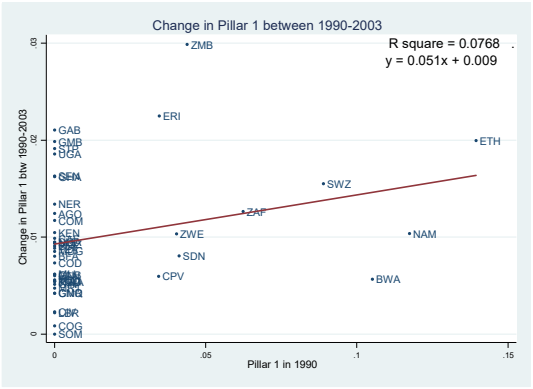




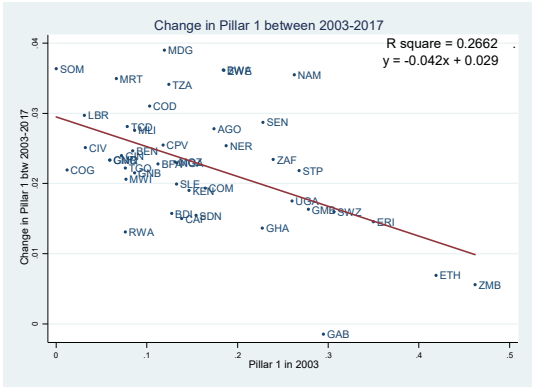
B3. Convergence of Pillar 1 and Pillar 2 polices

Figure B2: Variations in the implementation of pillars' antimalarial policies

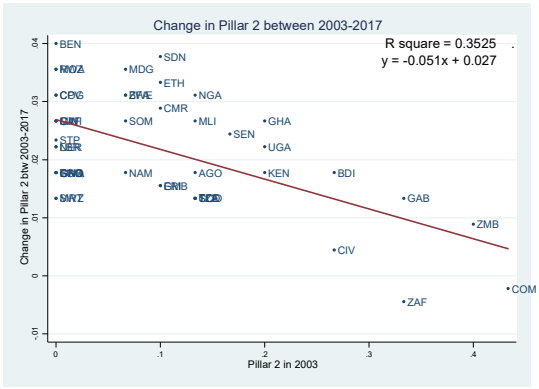
a. Change in Pillar 1 between 1990-2003



b. Change in Pillar 1 between 2003-2017



*c. * Change in Pillar 2 between 2003-2017**



Notes: * There is no correlation between the evolution of Pillar 2 and its initial position in 1990.
Source: Constructed by the authors using WMRs (2005-2018).

B4. The re-ranking of the MaPI between 2003 and 2017

We construct a transition matrix (Table B3). More precisely, we create four quartiles according to the MaPI values in 2003 (rows) and four quartiles corresponding to the 2017 MaPI (columns). We then fill the resulting 16 cells with all countries according to their positions in both years.[42]

We observe that 17 countries remain in the same quartiles (in the main diagonal), 15 ameliorate their positions (upper right triangle) and the remaining 12 countries tumbled from their starting position (lower left triangle). Among the 17 countries in the main diagonal, 4 of them (Ethiopia, Senegal, Uganda and Zambia) keep their top positions in both years, while 6 others (Congo Republic, Equatorial Guinea, Guinea-Bissau, Malawi, Rwanda and Togo) persist in the lowest position both in 2003 and 2017. Among the 15

[42] A country in the main diagonal means that it remains in the same quartile. If it is in the upper right triangle, the country has improved its position (moving to a higher quartile), while being in the lower left triangle means that the country has deteriorated its position (moving to a lower quartile).

countries which have gained ranking positions, Botswana and Madagascar jump from the 2nd to the 4th quartile, Benin, Somalia, Burkina Faso, Cabo Verde, Mali and Mozambique quitted the 1st and 2nd quartiles and joined the 3rd quartile, and Angola, Namibia, Nigeria and Zimbabwe move from the 3rd to the 4th quartile. Finally, among the 12 countries which experienced a re-ranking from the highest quartiles to lower quartiles, 5 of them have returned to the worst (1st) quartile: Gabon moved from the top (4th) quartile in 2003; Côte d'Ivoire, Eswatini and Sierra Leone from the 3rd; and the Central African Republic regressed from the 2nd quartile. Among the remaining 7 countries, 6 worsened, moving from the 4th quartile in 2003 to the 3rd (Ghana) and to the 2nd (Burundi, Comoros, Eritrea, Gambia and South Africa) quartiles in 2017; and the last one (Kenya) moved back from the 3rd to the 2nd quartile during the period.

Table B3: Transition mobility matrix of countries according to their MaPI

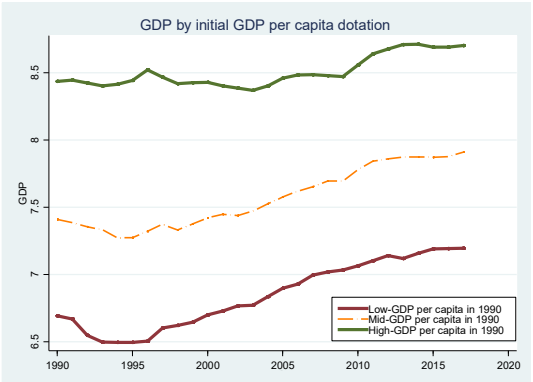
MaPI 2003 \ MaPI 2017	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
1st Quartile	Congo, Rep.; Equatorial Guinea; Guinea-Bissau; Malawi; Rwanda; Togo	Guinea; Liberia; Mauritania	Benin; Somalia	
2nd Quartile	Central African Rep.	Cameroon; Chad Congo, Dem. Rep; Niger.	Burkina Faso; Cabo Verde Mali; Mozambique	Botswana; Madagascar
3rd Quartile	Côte d'Ivoire Eswatini Sierra Leone	Kenya	Sao Tome and Principe Sudan; Tanzania	Angola; Namibia Nigeria; Zimbabwe
4th Quartile	Gabon	Burundi; Comoros; Eritrea; Gambia South Africa	Ghana	Ethiopia; Senegal Uganda; Zambia

Source: Constructed by the authors using MaPI scores aggregated through information from WMRs (2005-2018)

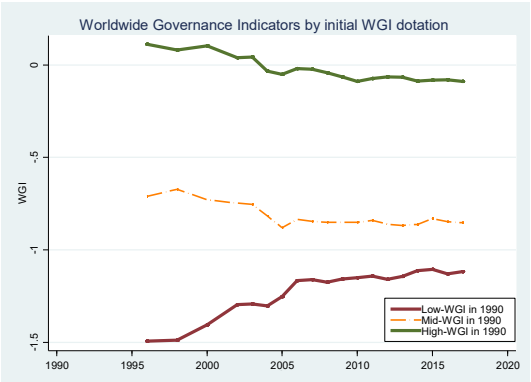
B5. Per capita GDP and Governance convergence in SSA

Figure B4: Per capita GDP and Governance convergence in SSA

a. Evolution of GDP per capita



b. Evolution of WGI



Source: Constructed by the authors using Penn World Table 9.1 and WGI Project Report (2020).

APPENDIX C. Event study results

Table C.1: Percentage of big changes (MaPI, Pillar 1 and Pillar 2) associated to each country

Countries	MaPI	Pillar 1	Pillar 2
Angola	3.03	3.61	3.01
Burundi	1.82	2.41	2.41
Benin	3.03	2.41	1.81
Burkina Faso	2.42	1.20	1.81
Botswana	1.82	3.61	1.20
Central Af. Rep.	3.03	1.81	2.41
Cote d'Ivoire	3.03	1.81	1.81
Cameroon	1.82	2.41	2.41
Congo Dem. Rep.	2.42	1.20	3.01
Congo, Rep.	1.82	1.81	1.81
Eritrea	2.42	4.22	3.61
Ethiopia	3.03	2.41	2.41
Gabon	3.03	1.81	3.61
Ghana	2.42	1.20	2.41
Guinea	2.42	1.81	1.81
Gambia	2.42	2.41	1.81
Guinea-Bissau	1.21	1.20	0.60
Equato. Guinea	2.42	1.81	3.01
Kenya	2.42	2.41	2.41
Liberia	1.82	1.81	3.61
Madagascar	3.03	3.01	1.20
Mali	2.42	2.41	1.81
Mozambique	2.42	3.61	3.61
Mauritania	1.82	2.41	1.81
Malawi	2.42	1.81	2.41
Namibia	3.03	3.01	2.41
Niger	2.42	3.01	1.81
Nigeria	3.03	2.41	3.01
Rwanda	1.82	3.01	2.41
Sudan	2.42	2.41	3.01
Senegal	3.64	3.61	2.41
Sierra Leone	1.82	2.41	2.41
Somalia	2.42	2.41	3.01
Eswatini	1.21	2.41	2.41
Chad	1.82	1.81	2.41
Togo	1.82	2.41	1.81
Tanzania	3.64	3.01	3.01
Uganda	2.42	1.81	3.01
South Africa	3.03	3.01	3.61
Zambia	3.64	3.01	3.01
Zimbabwe	1.82	3.61	2.41
Total	100	100	100

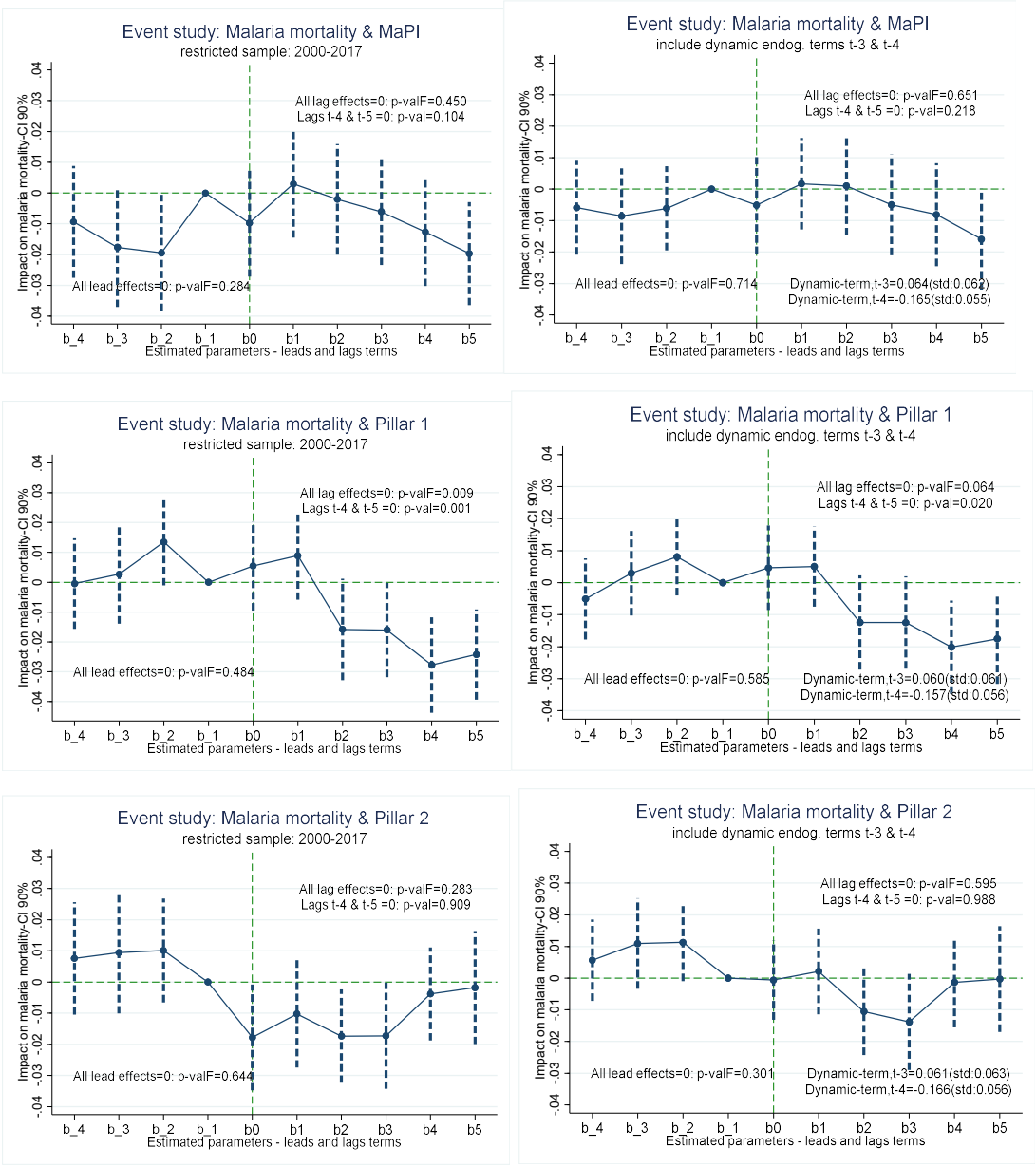
Sources: Construct by the authors using WMRs (2005-2018)

Table C.2: Event study estimates: baseline model

	MaPI	Pillar1	Pillar2
γ_{-4}	-0.00546	-0.000583	0.00676
	(0.00830)	(0.00739)	(0.00687)
γ_{-3}	-0.0105	0.00311	0.0114
	(0.00902)	(0.00784)	(0.00793)
γ_{-2}	-0.00754	0.0102	0.0113
	(0.00811)	(0.00736)	(0.00726)
γ_{-1}	--	--	--
	--	--	--
γ_{0}	-0.00741	0.00488	-0.00297
	(0.00951)	(0.00804)	(0.00766)
γ_{+1}	-0.000314	0.00619	-0.00181
	(0.00905)	(0.00763)	(0.00809)
γ_{+2}	0.000681	-0.00913	-0.0172**
	(0.00938)	(0.00853)	(0.00842)
γ_{+3}	-0.00614	-0.00945	-0.0190**
	(0.00962)	(0.00813)	(0.00957)
γ_{+4}	-0.00906	-0.0190**	-0.00402
	(0.00965)	(0.00787)	(0.00832)
γ_{+5}	-0.0166*	-0.0189**	-0.00197
	(0.00900)	(0.00767)	(0.00942)
R^2	0.259	0.266	0.264
N	1089	1089	1089

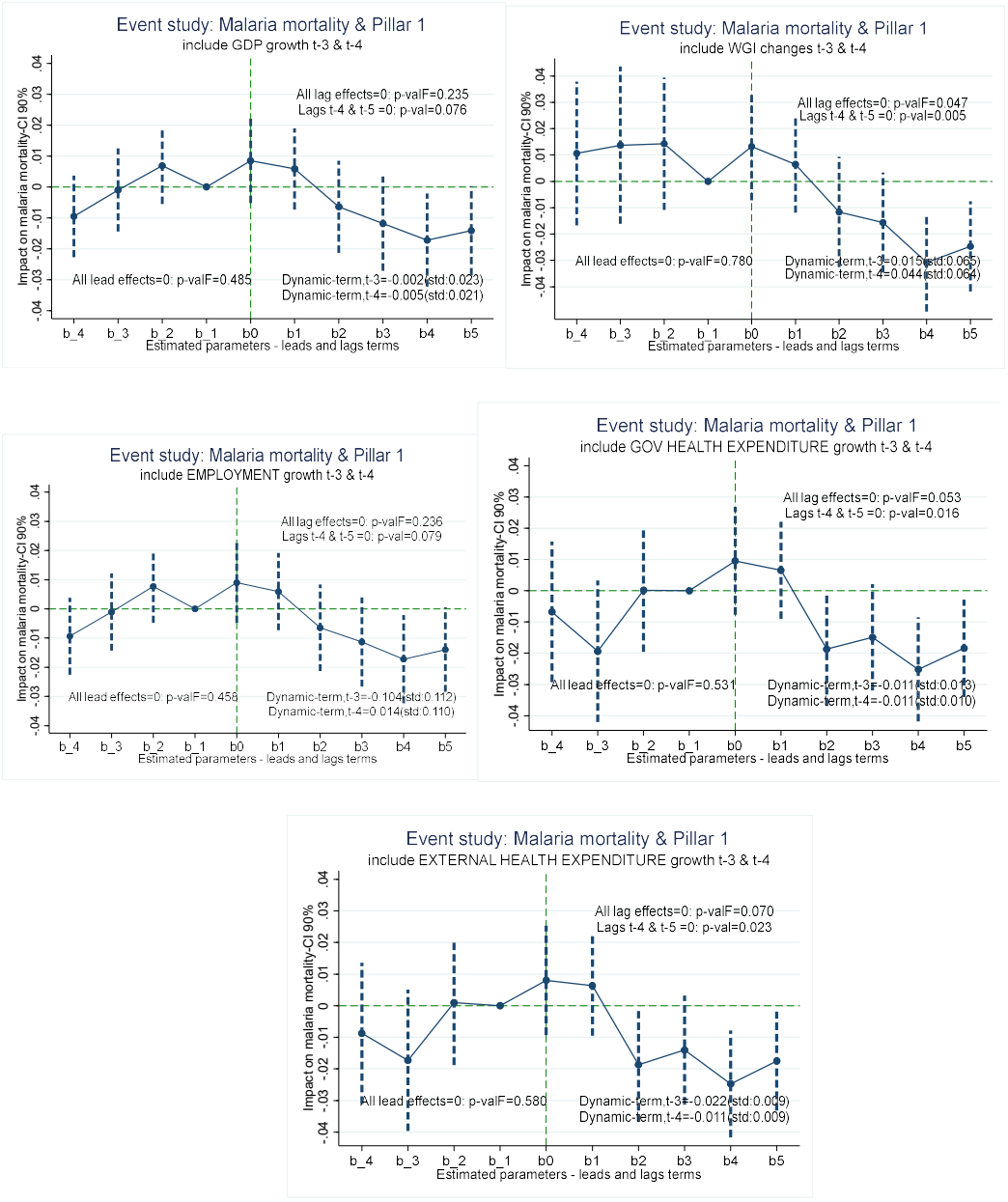
Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01. The table shows the event study estimates plotted in Figure 20a, b and c. Please refer to figure notes for further information. Source: Authors' calculation based on malaria death rate data from UNICEF database and MaPI and its pillars scores aggregated using information form the World Malaria Reports (2005-2018).

Figure C.1. Event study: extensions using MaPI, Pillar 1 and Pillar 2



Note: These graphics represent estimated results of event study estimates $\gamma_{-4}, \gamma_{-3}, \ldots, \gamma_4, \gamma_5$. Estimation results are for equation (1). Events are defined as MaPI (first line), Pillar 1 (second line) and Pillar 2 (third line) changes above the 85th percentile for the entire country-year distribution. Events occur at period t=0 (vertical line). We show 90% confidence intervals.

Figure C.2. Event study results: account for potential country time-varying confounders



Note: These graphics represent estimated results of event study estimates $\gamma_{-4}, \gamma_{-3}, \ldots, \gamma_4, \gamma_5$. Estimation results are for equation (1) extended with potential time-varying confounders. As additional regressors, we include 3 and 4 lagged growth terms to reduce endogeneity concerns. Potential confounders are: per capita GDP; the World Governance Index (WGI); the employment rate; government health expenditure; external health expenditure. Events are defined as Pillar 1 changes above the 85th percentile for the entire country-year distribution. Events occur at period t=0 (vertical line). We show 90% confidence intervals.

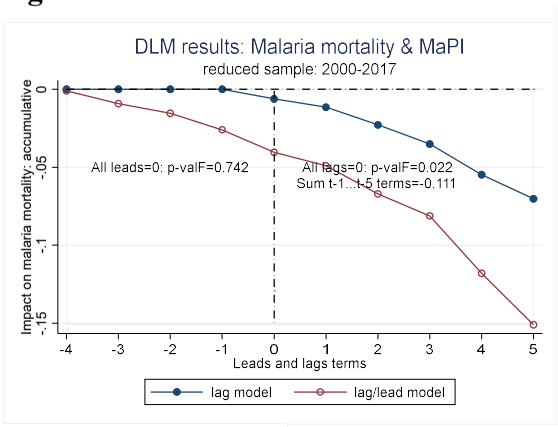
APPENDIX D. Distributed Lag Model results

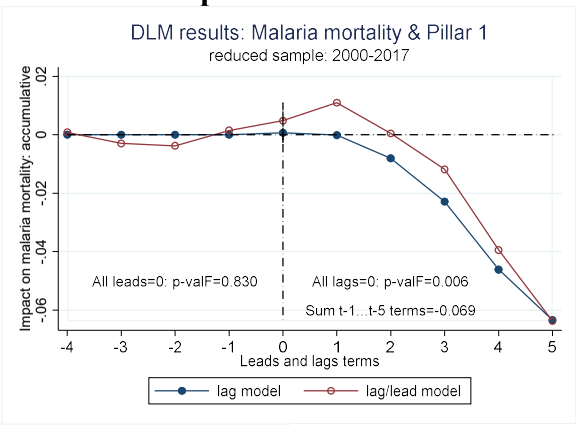
Table D.1: Distributed lag model estimates: baseline model

	MaPI	MaPI	Pillar 1	Pillar 1	Pillar 2	Pillar 2
	Lag	**Lead/lag**	**Lag**	**Lead/lag**	**Lag**	**Lead/lag**
β_{-4}		0.0000421		-0.00210		0.000724
		(0.00677)		(0.00597)		(0.00391)
β_{-3}		-0.000944		-0.00146		-0.000489
		(0.00732)		(0.00673)		(0.00429)
β_{-2}		0.00361		0.00237		0.000468
		(0.00757)		(0.00625)		(0.00532)
β_{-1}		-0.000609		0.00674		-0.00940
		(0.00786)		(0.00586)		(0.00607)
β_{0}	-0.000623	-0.00170	0.00164	0.00499	0.000758	-0.00857
	(0.00685)	(0.00844)	(0.00593)	(0.00674)	(0.00366)	(0.00608)
β_{+1}	-0.000454	-0.000391	-0.000158	0.00538	0.00245	-0.00649
	(0.00708)	(0.00864)	(0.00576)	(0.00665)	(0.00459)	(0.00685)
β_{+2}	-0.00791	-0.0132	-0.00746	-0.00807	0.000892	-0.00779
	(0.00845)	(0.0105)	(0.00713)	(0.00849)	(0.00489)	(0.00660)
β_{+3}	-0.00843	-0.0158	-0.0118	-0.0163*	0.00324	-0.00223
	(0.00890)	(0.0118)	(0.00721)	(0.00948)	(0.00515)	(0.00732)
β_{+4}	-0.0159	-0.0330**	-0.0224***	-0.0295***	0.00862	-0.00473
	(0.00979)	(0.0130)	(0.00720)	(0.00921)	(0.00624)	(0.00894)
β_{+5}	-0.0116	-0.0294**	-0.0150**	-0.0257***	0.00418	-0.00530
	(0.00825)	(0.0116)	(0.00632)	(0.00893)	(0.00578)	(0.00752)
R^2	0.263	0.353	0.273	0.362	0.263	0.342
N	894	731	894	731	893	731

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure D.1. DLM estimates. Extensions: 2000-2017 sample





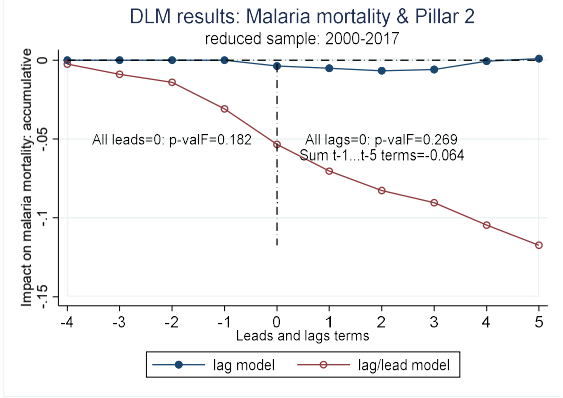
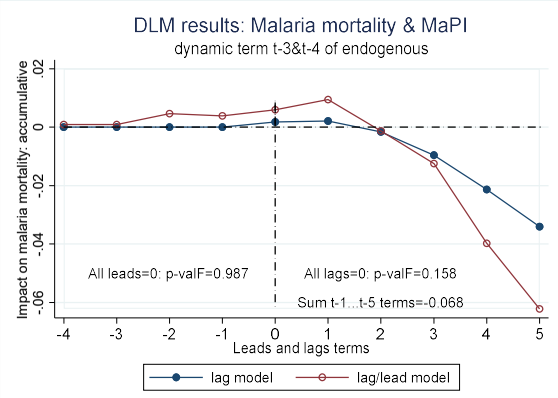
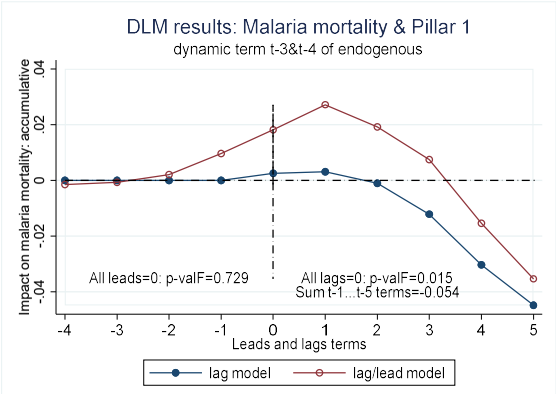
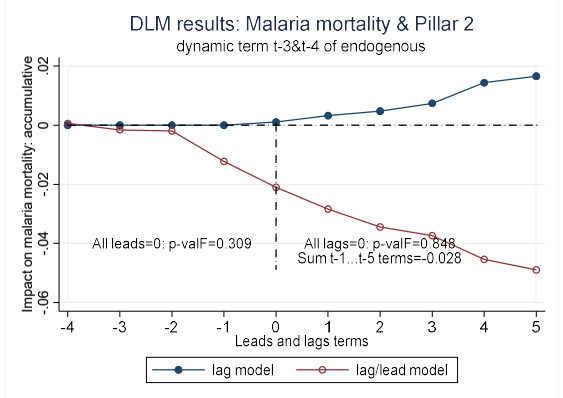


Figure D.2. DLM estimates. Extensions: include dynamic terms







Online Appendix

The Fight against Malaria: A New Index for Quantifying and Assessing Policy Implementation Actions to Reduce Mortality in Sub-Saharan Africa

Carlos Bethencourt
University of La Laguna, CEDESOG
cbethenc@ull.edu.es

Gustavo A. Marrero
University of La Laguna, CEDESOG and Equalitas
gmarrero@ull.edu.es

Charlie Y. Ngoudji
University of La Laguna, CEDESOG
cngoudji@ull.edu.es

We would like to thank Nidia García and participants at the Economic Research seminar at U. Autónoma de Barcelona and the XXVIII Meeting on Public Economics for valuable comments and suggestions. We specially thank to Raúl Santaeulalia-Llopis and Shaun da Costa for their helpful comments. This paper has received financial support from the Ministerio de Economía y Competitividad of Spain through project PID2019-107161GB-C33, and from Gobierno de Canarias through the ProID2017010088 (María del Carmen Betancourt y Molina program) R&D project, co-funded by the Operative Program FEDER 2014-2020. Any remaining errors are our own.

(*) Corresponding author: Gustavo A. Marrero, Departamento de Economía, Contabilidad y Finanzas. Universidad de La Laguna, Camino la Hornera, s/n, La Laguna, 38071, Spain. Email: gmarrero@ull.edu.es.

In this On-line Appendix we draw countries' profiles of antimalarial policies implementation and mortality due to malaria. To do that, we use scores of the Malaria Policy Index (MaPI), its pillars, the categories used to aggregate pillars and the malaria mortality rate for each country. Scores' calculations are based on data extracted from the World Malaria Reports (WMRs) from 2005 to 2018 and malaria mortality rates are obtained from Global Burden of Disease Study 2017. Our sample consists of 44 SSA countries for which data are available.[43]

Glossary of terms:

The malaria death rate (Id) is the number of deaths due to malaria (Deaths) divided by the total population (Pop) and multiplied by 100,000.

The MaPI (Malaria Policy Index) is a synthetic index measuring the country's efforts in fighting against malaria constructed using information on the effective implementation of antimalarial policies from the World Malaria Reports (WMRs). The values of the index vary from 0 to 1, 0 being a non-implementation of any antimalarial policy and 1 being a full implementation of all the available antimalarial policies.

The Pillar 1 of the MaPI is the part of the MaPI considering policies on intervention strategies, such as prevention (category 1), diagnosis (category 2), treatment (category 3) and surveillance (category 4) of malaria. Pillar 1 also varies from 0 to 1.

The Pillar 2 of the MaPI is the part of the index using grouping policies on malaria medicines and tests, such as antimalarial therapies used in the treatment of malaria (category 5), the therapeutic efficacy tests (category 6) and insecticide bioassays (category 7). Pillar 2 varies from 0 to 1.

Category 1 of the MaPI (Pillar 1) groups policies on prevention and vectors' control such as policies related with insecticide-treated nets (ITNs) / long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS), larval control, seasonal malaria chemoprevention (SMC), etc.

Category 2 of the MaPI (Pillar 1) holds information on malaria diagnosis beyond clinical, such as policies related with rapid diagnosis, parasitological confirmation, etc.

Category 3 of the MaPI (Pillar 1) collects policies on treatment and case management, such as policies related with the use of Artemisinin-based Combination Therapy (ACT) in the treatment of Plasmodium falciparum, the home management of malaria, etc.

Category 4 of the MaPI (Pillar 1) grasps information on malaria surveillance, such as policies related with active and reactive case detection, mass screening, etc.

Category 5 of the MaPI (Pillar 2) collets treatment measures related with special antimalarial therapies, such as policies beyond the first line treatment of Plasmodium falciparum, the treatment of severe malaria or cases of Plasmodium vivax.

Category 6 of the MaPI (Pillar 2) encompasses measures on therapeutic efficacy tests carried on different combination of antimalarial therapies.

[43] Our sample includes: Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo Democratic Republic, Congo, Côte d'Ivoire, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

Category 7 of the MaPI (Pillar 2) contains policies on insecticide susceptibility bioassays carried on different classes of insecticides used to control for malaria vectors.

Each category consists of the first level of aggregation of the MaPI using particular sets of policies and its values also vary from 0 to 1 as for the MaPI and each pillar.

ITNs: insecticide-treated nets. **LLNs**: long-lasting insecticidal nets; **IRS**: Indoor residual spraying or the process of spraying the inside of dwellings with an insecticide to kill mosquitoes that spread malaria; **WHO:** World Health Organization.

Angola

Angola is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the south of Angola, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, the incidence of malaria in Angola decreased from 222.4 to 155 per 1,000 population, whereas the malaria death rate did it from 64.4 to 29.9 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Angola occupies the 10th position (together with Somalia, Mali, Tanzania and Benin) in our sample of 44 SSA countries, with a score of 0.51 (Fig.2), following Uganda and Nigeria and preceding Sudan, Mozambique and Ghana. In Pillar 1 (Malaria Intervention Strategies), the country ranks 8th over 44 (with Mauritania and South Africa), with a score of 0.59, whereas it occupies the 22nd place over 44 in Pillar 2 (Antimalarial Medicines and Tests), with a score of 0.4, as in Malawi, Central African Republic, Comoros and Guinea.

Since 2000, the country engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector's control policies, such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women. From this year on, the country has gradually increased its policies implementation in this pillar, with some punctual jumps in diagnosis measures in 2001, and treatment and case management interventions in 2004. However, after a short decline from 2009 to 2011, the first big push in Pillar 1 occurs in 2012, motivated by the raise in all categories in this pillar including a one-year implementation of surveillance measures. The second big increase occurs in 2016, period in which the country reinitiated the implementation of surveillance policies.

Regarding Pillar 2 (Fig.4), the interventions started in 2002 with the application of therapeutic efficacy tests. The first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big increase occurs in 2010, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (preventive and vectors' control policies of Pillar 1). The third push occurs in 2013 due to the restarting of execution of therapeutic tests after its interruption in 2010. By 2016, the country has stopped carrying out insecticide bioassays tests.

Summing up, as it is shown in the Table, in 2017 Angola has implemented: first, regarding Pillar 1, the 67% of prevention policies, 71% of diagnosis, 43% of treatment and 63% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 40% of therapeutic tests. Regarding mortality rate, there has been a continuous decrease between 2004 and 2013, and a posterior rebound until 2017.

Angola: Malaria policies and mortality in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	9.5	15.0	8.4	7.7	8.4
Malaria death ratio (per 100,000 population)	64.4	84.5	38.3	29.3	29.9
MaPI (Index 0-1)	0.01	0.35	0.49	0.55	0.51
Pillar 1: Intervention	0.01	0.37	0.41	0.43	0.59
Cat 1: Prevention	0.04	0.50	0.53	0.53	0.67
Cat 2: Diagnosis	0.00	0.53	0.29	0.71	0.71
Cat 3: Treatment	0.00	0.36	0.57	0.43	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.63
Pillar 2: Medicines & tests	0.00	0.33	0.60	0.73	0.40
Cat 5: Medicines	0.00	0.81	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.00	0.03	0.00	0.60	0.40
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.00

Fig.1: Malaria mortality in Angola

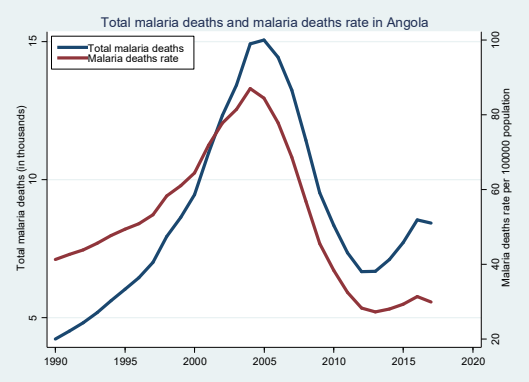


Fig.2: The Malaria Policy Index (MaPI) in Angola

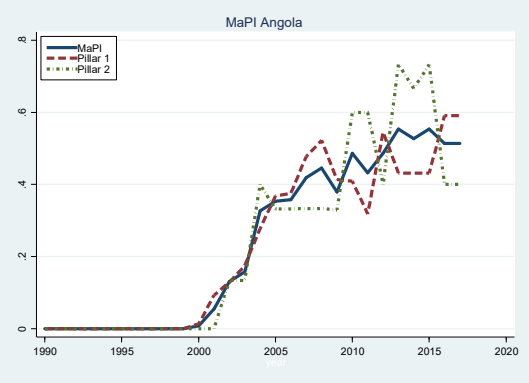


Fig.3: Malaria intervention strategies (Pillar 1) in Angola

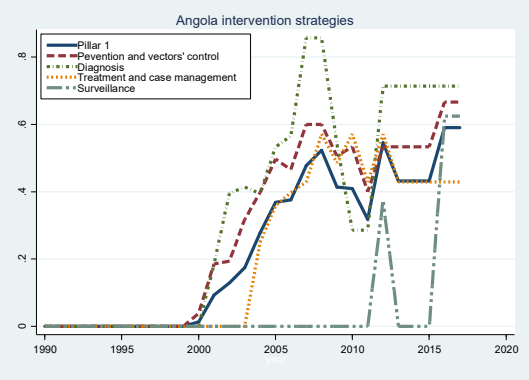
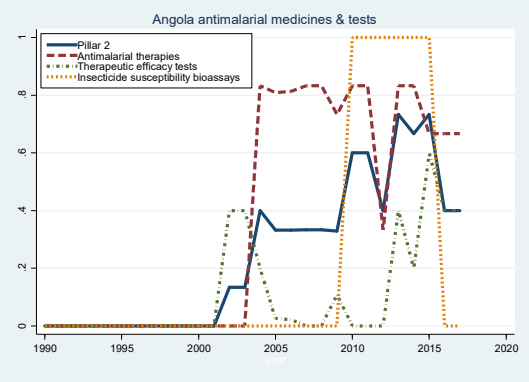


Fig.4: Antimalarial medicines and tests (Pillar 2) in Angola



Benin

Benin is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Benin, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Benin experienced a stability in its malaria incidence around 368 per 1,000 populations at risk and decreased the malaria deaths rate from 106.6 to 81.4 per 100,000 populations (Fig.1).

In 2017, according to the MaPI, Benin occupies the 10th position (together with Angola, Somalia, Mali and Tanzania) in our sample of 44 SSA countries, with a score of 0.51 (Fig.2), following Uganda and Nigeria and preceding Sudan, Mozambique and Ghana. In Pillar 1 (Malaria Intervention Strategies), the country ranks 26th over 44 (with Burkina Faso and Comoros), with a score of 0.45, whereas it occupies the 2nd place over 44 in Pillar 2 (Antimalarial Medicines and Tests) with a score of 0.6 (as in Ghana, Madagascar, Ethiopia and Nigeria).

Since 2000, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women. From this year on, the country has increased on average its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2003, and diagnosis measures in 2008. It should be noted that the big push in Pillar 1 occurs this year, motivated by the application of diagnosis measures. The country started the implementation of surveillance measures in 2013.

Regarding Pillar 2 (Fig.4), before a one-year interruption in 2003, interventions started in early 1998 with the application of therapeutic efficacy tests. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies. Before the relative stability of 2010 punctuated with a one-year decline in 2012 due to the decrease in the antimalarial therapies, the country steadily increased this sort of policies implementation with some prompt pushes in the implementation of more antimalarial measures. The big push in this pillar occurs in 2010, driven by the full enactment of insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1).

Summing up, as it is shown in the Table, in 2017 Benin has implemented: first, regarding Pillar 1, the 53% of prevention policies, 57% of diagnosis, 43% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies, 20% of therapeutic tests and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2006 and 2014.

Benin: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	7.1	10.6	10.3	9.1	9.4
Malaria death ratio (per 100,000 population)	106.6	133.9	110.3	83.7	81.4
MaPI (Index 0-1)	0.02	0.29	0.43	0.49	0.51
Pillar 1: Intervention	0.02	0.23	0.27	0.41	0.45
Cat 1: Prevention	0.05	0.35	0.40	0.40	0.53
Cat 2: Diagnosis	0.00	0.00	0.00	0.57	0.57
Cat 3: Treatment	0.00	0.34	0.43	0.43	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.25	0.25
Pillar 2: Medicines & tests	0.03	0.39	0.67	0.60	0.60
Cat 5: Medicines	0.00	0.81	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.10	0.20	0.20	0.20	0.20
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Benin

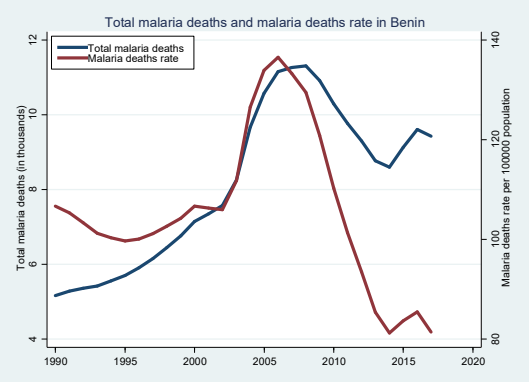


Fig.2: The Malaria Policy Index (MaPI) in Benin

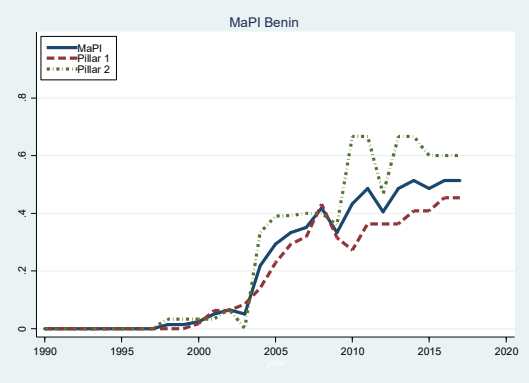


Fig.3: Malaria intervention strategies (Pillar 1) in Benin

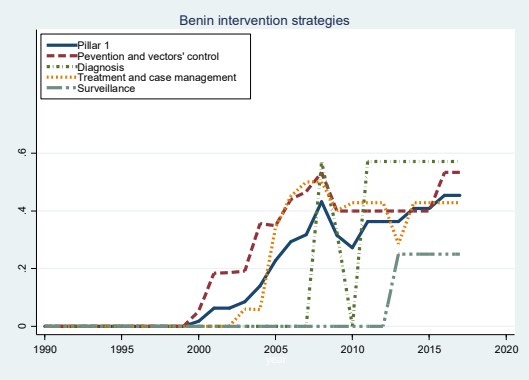
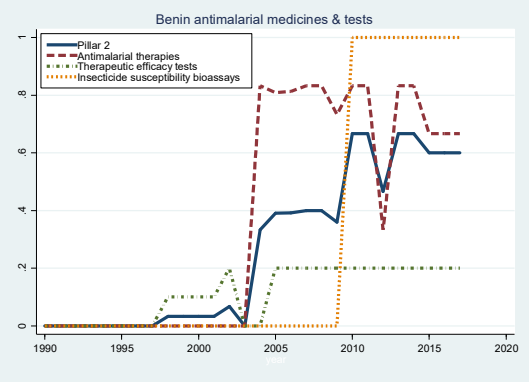


Fig.4: Antimalarial medicines and tests (Pillar 2) in Benin



Botswana

Botswana is a country with low transmission of malaria. Free malaria areas represent 34% of the country. Transmission occurs all year-round, malaria is mainly seasonal in Botswana. Between 2000 and 2017, Botswana reduced the incidence of malaria from 22.82 to 1.97 per 1,000 populations at risk and slightly the already low malaria deaths rate from 0.4 to 0.2 per 100,000 populations (Fig.1).

In 2017, according to the MaPI, Botswana occupies the 6th position (together with Zambia) in our sample of 44 SSA countries, with a score of 0.54 (Fig.2), following Ethiopia and preceding Uganda and Nigeria. In Pillar 1 (Malaria Intervention Strategies), the country occupies the 2nd rank over 44 (with Zimbabwe), with a score of 0.73, whereas it occupies the 38th place over 44 in Pillar 2 (Antimalaria Medicines and Tests) with a score of 0.27 (as in Guinea-Bissau, Togo, Equatorial Guinea and South Africa).

Since 1950, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics and the use of DDT for IRS in public health. This engagement remained relatively stable until 1974 when the country started implementing diagnosis policies, such as parasitological confirmation to all age groups inpatients. From this year on, the country has increased on average its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 1998, and surveillance measures in 2003. However, the first and the second big pushes in Pillar 1 occurs respectively in 2007 and 2012, both motivated by the notable rise in the enactment of all these measures.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 1997. From this particular year, the country accomplished a punctual 4 years' therapeutic efficacy tests. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies. Before the decline of 2013, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. However, the big push in this pillar occurs in 2011, driven by the beginning of insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). The country had stopped carrying out therapeutic efficacy tests by 2000, and insecticide bioassays tests by 2014.

Summing up, as it is shown in the Table, in 2017 Botswana has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, 71% of treatment and 100% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 1999 and 2017.

Botswana: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.01	0.01	0.01	0.01	0.01
Malaria death ratio (per 100,000 population)	0.38	0.34	0.31	0.25	0.25
MaPI (Index 0-1)	0.12	0.26	0.41	0.47	0.54
Pillar 1: Intervention	0.18	0.25	0.36	0.61	0.73
Cat 1: Prevention	0.30	0.46	0.53	0.67	0.67
Cat 2: Diagnosis	0.23	0.20	0.29	0.57	0.57
Cat 3: Treatment	0.12	0.18	0.43	0.64	0.71
Cat 4: Surveillance	0.00	0.02	0.00	0.50	1.00
Pillar 2: Medicines & tests	0.03	0.27	0.47	0.27	0.27
Cat 5: Medicines	0.00	0.67	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.10	0.00	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.50	0.00	0.00

Fig.1: Malaria mortality in Botswana

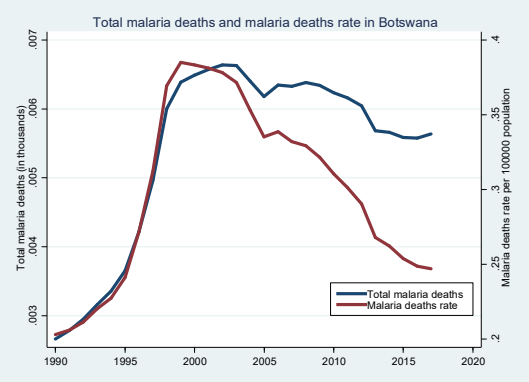


Fig.2: The Malaria Policy Index (MaPI) in Botswana

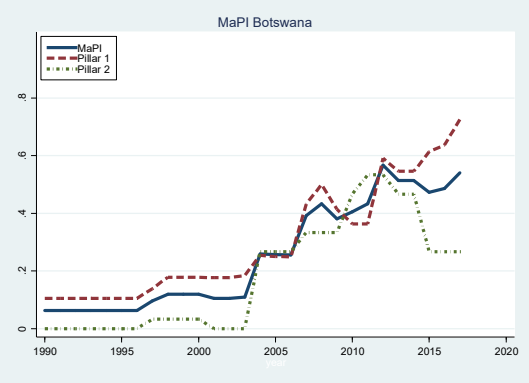


Fig.3: Malaria intervention strategies (Pillar 1) in Botswana

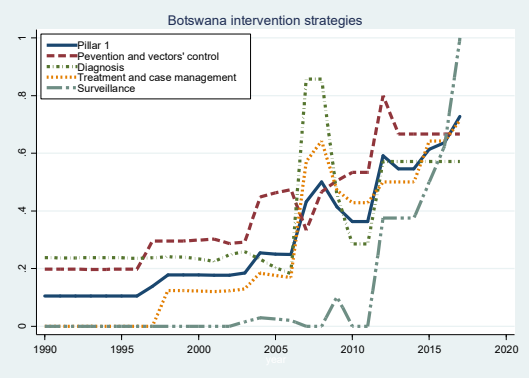
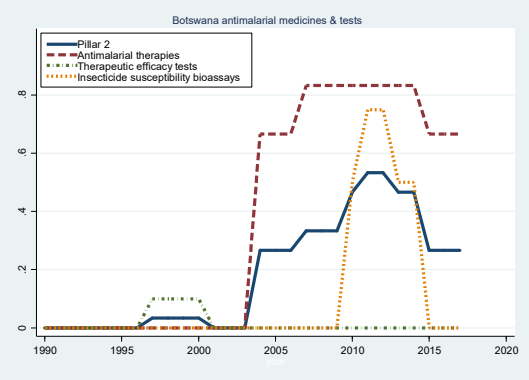


Fig.4: Antimalarial medicines and tests (Pillar 2) in Botswana



Burkina Faso

Burkina Faso is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal and more intense in the southern third of the country, with potential epidemics between December and April. Between 2000 and 2017, Burkina Faso reduced the incidence of malaria from 607.1 to 412 per 1,000 population at risk and the malaria deaths rate from 237.5 to 144.8 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Burkina Faso occupies the 19th position (together with Cabo Verde) in our sample of 44 SSA countries, with a score of 0.49 (Fig.2), following Sao Tome and Principe and preceding Congo Democratic Republic, Niger and Eritrea. In Pillar 1 (Malaria Intervention Strategies), the country ranks 26th over 44 (with Benin and Comoros), with a score of 0.45, whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53 (as in Zimbabwe, Rwanda, Gabon, Cameroon, Burundi, Uganda, Senegal, Zambia, Mozambique and Mali).

Since 1998, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies (such as the distribution of ITNs/LLINs to all age groups), diagnosis policies (such as parasitological confirmation to all age groups inpatients) and treatment and case management policies (such as the oversight regulation of case management in the private sectors). From this year on, the country has gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses. The big push in Pillar 1 occurs in 2005, motivated by the increase in prevention and vector control and treatment and case management interventions. The country started the implementation of surveillance measures in 2016.

Regarding Pillar 2 (Fig.4), the interventions started in 1996 with the application of therapeutic efficacy tests. Before the stability that led to the decline of 2013, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. However, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2014, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Burkina Faso has implemented: first, regarding Pillar 1, the 53% of prevention policies, 57% of diagnosis, 43% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies and 75% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2003 and 2017.

Burkina Faso: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	29.2	33.3	38.5	33.2	30.6
Malaria death ratio (per 100,000 population)	237.5	231.5	228.3	167.3	144.8
MaPI (Index 0-1)	0.09	0.34	0.51	0.54	0.49
Pillar 1: Intervention	0.11	0.26	0.36	0.50	0.45
Cat 1: Prevention	0.17	0.39	0.53	0.80	0.53
Cat 2: Diagnosis	0.23	0.22	0.29	0.57	0.57
Cat 3: Treatment	0.06	0.28	0.43	0.43	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.07	0.46	0.73	0.60	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.20	0.37	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.75

Fig.1: Malaria mortality in Burkina Faso

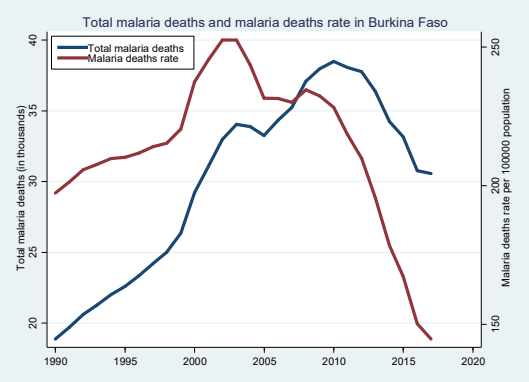


Fig.2: The Malaria Policy Index (MaPI) in Burkina Faso

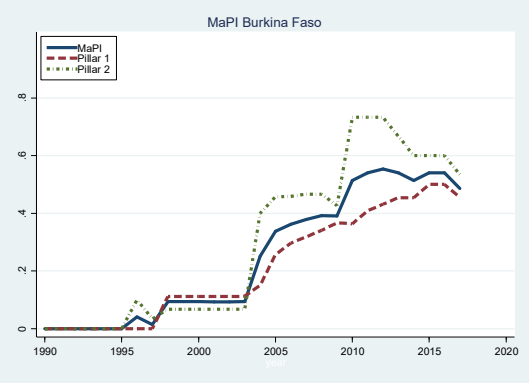


Fig.3: Malaria intervention strategies (Pillar 1) in Burkina Faso

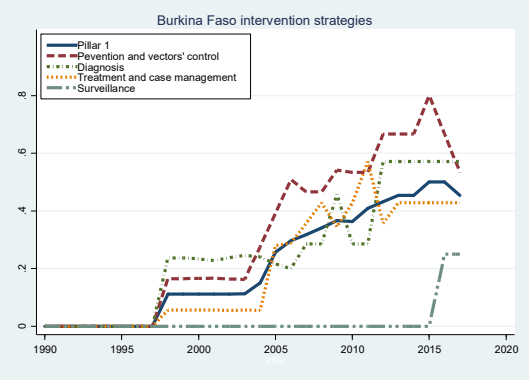
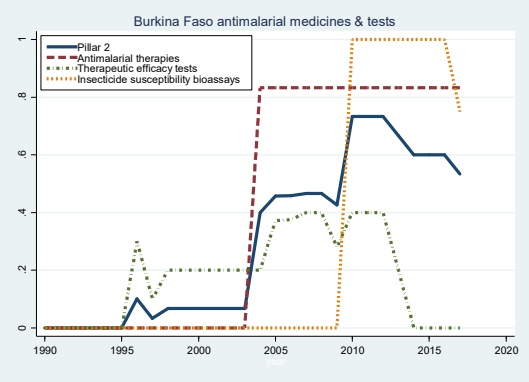


Fig.4: Antimalarial medicines and tests (Pillar 2) in Burkina Faso



Burundi

Burundi is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Burundi. Between 2000 and 2017, Burundi reduced the incidence of malaria from 418.6 to 194.5 per 1,000 population at risk and the malaria deaths rate from 239.5 to 79.4 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Burundi occupies the 28th position (together with Mauritania, Chad and Comoros) in our sample of 44 SSA countries, with a score of 0.43 (Fig.2), following Kenya and Gambia and preceding Liberia and Guinea. In Pillar 1 (Malaria Intervention Strategies), the country ranks 40th over 44 (with Central African Republic), with a score of 0.36, whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests) with a score of 0.53. (as in Zimbabwe, Rwanda, Gabon, Cameroon, Uganda, Senegal, Zambia, Mozambique, Mali and Burkina Faso).

Since 2001, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through mass campaigns and the use of IRS for prevention and control of epidemics. Before the relative stability of 2009, the country had increased on average and on the yearly base its policies implementation in this pillar with some punctual impetuses in diagnosis measures in 2002, and treatment and case management interventions in 2003. However, the big push in Pillar 1 occurs from 2006 to 2008, motivated by the notable rise in all measures applied on this date. The country started the implementation of surveillance measures in 2013.

Regarding Pillar 2 (Fig.4), the interventions started in 2001 with a one-year punctual implementation of therapeutic efficacy tests. In 2003, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies. This implementation remained stable until 2014 when the country started executing insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). It should be noted that before interrupting again in 2017, the country re-engaged therapeutic efficacy tests between 2015 and 2016.

Summing up, as it is shown in the Table, in 2017 Burundi has implemented: first, regarding Pillar 1, the 40% of prevention policies, 29% of diagnosis, 43% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1996 and 2014.

Burundi: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	15.0	10.6	8.5	7.4	8.7
Malaria death ratio (per 100,000 population)	239.5	145.8	94.6	72.5	79.4
MaPI (Index 0-1)	0.00	0.23	0.27	0.42	0.43
Pillar 1: Intervention	0.00	0.20	0.27	0.30	0.36
Cat 1: Prevention	0.00	0.35	0.40	0.27	0.40
Cat 2: Diagnosis	0.00	0.16	0.29	0.29	0.29
Cat 3: Treatment	0.00	0.17	0.29	0.50	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.00	0.27	0.27	0.60	0.53
Cat 5: Medicines	0.00	0.67	0.67	0.67	0.67
Cat 6: Therapeutic tests	0.00	0.00	0.00	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	1.00	1.00

Fig.1: Malaria mortality in Burundi

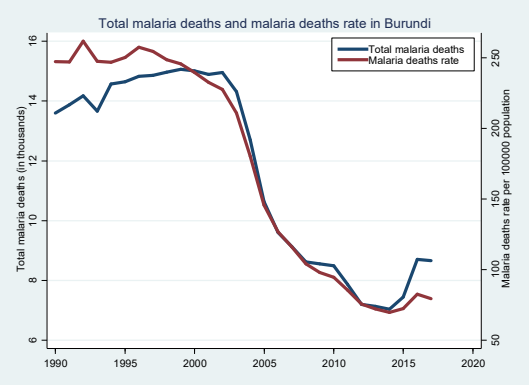


Fig.2: The Malaria Policy Index (MaPI) in Burundi

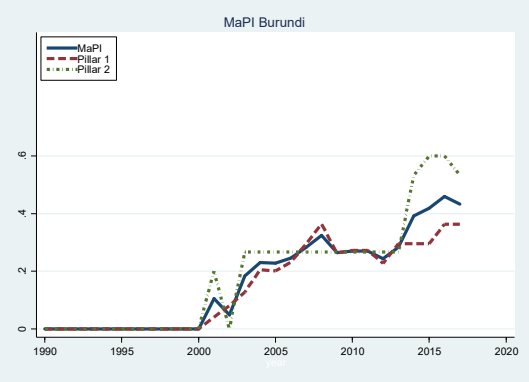


Fig.3: Malaria intervention strategies (Pillar 1) in Burundi

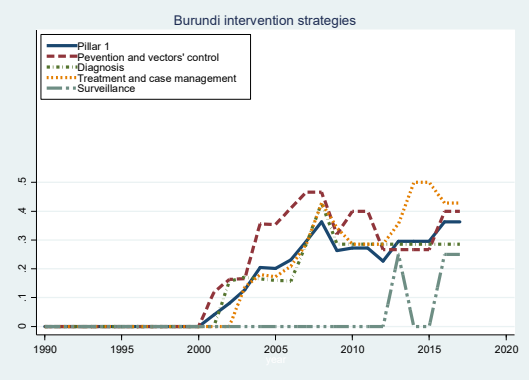
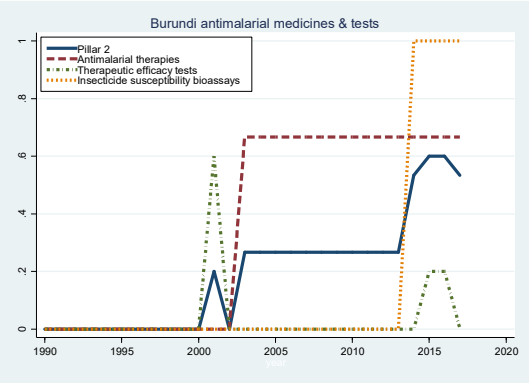


Fig.4: Antimalarial medicines and tests (Pillar 2) in Burundi



Cabo Verde

Cabo Verde is a country with very low transmission of malaria. There are no high transmission areas in the country. Between 2000 and 2017, Cabo Verde experienced a slight increase in its incidence of malaria from 1.27 to 2.98 per 1,000 population at risk but has slightly decreased the already low malaria deaths rate from 0.8 to 0.4 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Cabo Verde occupies the 19th position (together with Burkina Faso) in our sample of 44 SSA countries, with a score of 0.49 (Fig.2), following Sao Tome and Principe and preceding Congo Democratic Republic, Niger and Eritrea. In Pillar 1 (Malaria Intervention Strategies), the country ranks 20th over 44 (with Chad and Mali), with a score of 0.5, whereas it occupies the 18th place over 44 in Pillar 2 (Antimalaria Medicines and Tests) with a score of 0.47. (as in Congo, Kenya and Somalia).

Since 1975, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies, such as the free of charge malaria diagnosis in the public sector measures. This engagement remained relatively stable until 1998 when the country started to increase its policies implementation gradually in this pillar, with some punctual impetuses in prevention measures in 1998, surveillance measures in 2001, and treatment and case management interventions in 2004. However, the big push in Pillar 1 occurs from 2011 to 2014, a period in which not only all policies and measures rise notably, but also after several sequences of interruptions, the country fully implemented surveillance measures.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 2004. From this particular year, the country started implementing antimalarial therapies policies. It should be noted that until 2017, the country was only implementing this group of measures in this pillar. No therapeutic bioassays test has been implemented in Cabo Verde until this date. The country started the implementation of insecticide bioassays tests in 2013 s, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1).

Summing up, as it is shown in the Table, in 2017 Cabo Verde has implemented: first, regarding Pillar 1, the 27% of prevention policies, 57% of diagnosis, 50% of treatment and 88% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 75% of insecticide bioassays. Regarding mortality rate, there has been a continuous slight decrease between 1999 and 2017.

Cabo Verde: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.004	0.003	0.003	0.002	0.002
Malaria death ratio (per 100,000 population)	0.83	0.62	0.50	0.41	0.37
MaPI (Index 0-1)	0.07	0.22	0.30	0.43	0.49
Pillar 1: Intervention	0.11	0.14	0.27	0.55	0.50
Cat 1: Prevention	0.13	0.15	0.13	0.27	0.27
Cat 2: Diagnosis	0.43	0.41	0.57	0.57	0.57
Cat 3: Treatment	0.00	0.04	0.43	0.57	0.50
Cat 4: Surveillance	0.00	0.07	0.00	1.00	0.88
Pillar 2: Medicines & tests	0.00	0.33	0.33	0.27	0.47
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.00	0.00	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.75

Fig.1: Malaria mortality in Cabo Verde

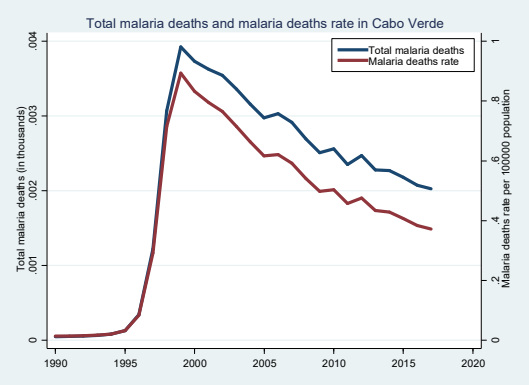


Fig.2: The Malaria Policy Index (MaPI) in Cabo Verde

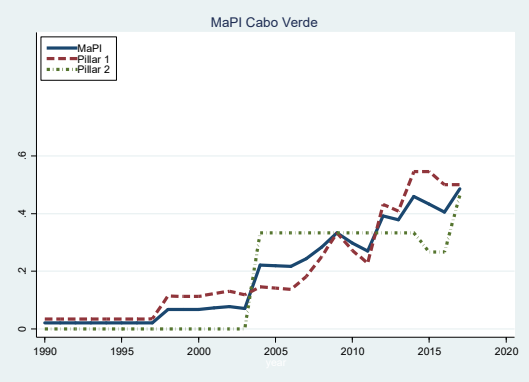


Fig.3: Malaria intervention strategies (Pillar 1) in Cabo Verde

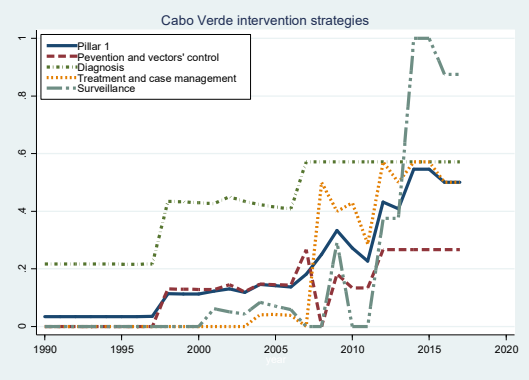
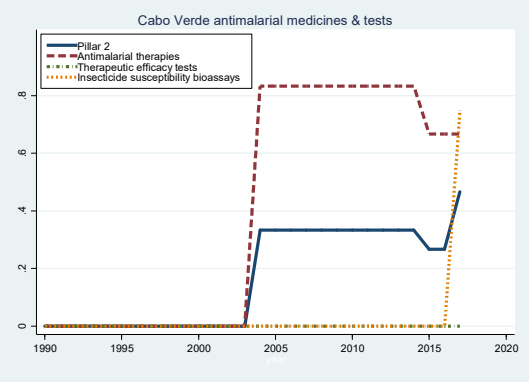


Fig.4: Antimalarial medicines and tests (Pillar 2) in Cabo Verde



Cameroon

Cameroon is a country with high transmission of malaria. There are no free malaria areas in the country and the disease is more intense in the south. Although transmission occurs all year-round, malaria is mainly seasonal in Cameroon, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Cameroon reduced the incidence of malaria from 376.9 to 303.8 per 1,000 population at risk and the malaria deaths rate from 132.9 to 79.4 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Cameroon occupies the 24th position (together with South Africa) in our sample of 44 SSA countries, with a score of 0.46 (Fig.2), following Congo Democratic Republic, Niger and Eritrea and preceding Kenya and Gambia. In Pillar 1 (Malaria Intervention Strategies), the country ranks 33rd over 44 (with Cote d'Ivoire, Equatorial Guinea, Guinea-Bissau and Togo), with a score of 0.41, whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zimbabwe, Rwanda, Gabon, Burundi, Uganda, Senegal, Zambia, Mozambique, Mali and Burkina Faso).

Since 2003, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women. From this year on, the country has increased on average its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2004, and diagnosis measures in 2007. However, the first big push in Pillar 1 occurs in 2011, a period in which all policies and measures rise notably. The second big improvement occurs in 2017, motivated by the implementation of surveillance measures, which were not implemented before this date.

Regarding Pillar 2 (Fig.4), the interventions started in 1994 with the application of therapeutic efficacy tests. It is not until 2010 and before the stability that led to the decline of 2014 due to a break in the execution of therapeutic tests, that the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. However, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1).

Summing up, as it is shown in the Table, in 2017 Cameroon has implemented: first, regarding Pillar 1, the 40% of prevention policies, 57% of diagnosis, 43% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2004 and 2017.

Cameroon: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	19.9	31.7	23.2	23.6	22.0
Malaria death ratio (per 100,000 population)	132.9	173.0	104.4	90.2	79.4
MaPI (Index 0-1)	0.05	0.27	0.49	0.39	0.46
Pillar 1: Intervention	0.00	0.17	0.32	0.30	0.41
Cat 1: Prevention	0.00	0.36	0.53	0.40	0.40
Cat 2: Diagnosis	0.00	0.00	0.00	0.29	0.57
Cat 3: Treatment	0.00	0.13	0.43	0.36	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.13	0.41	0.73	0.53	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.40	0.25	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Cameroon

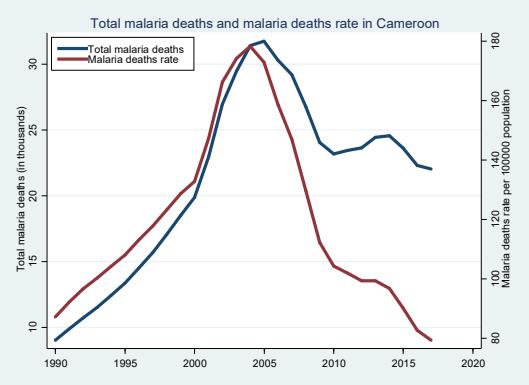


Fig.2: The Malaria Policy Index (MaPI) in Cameroon

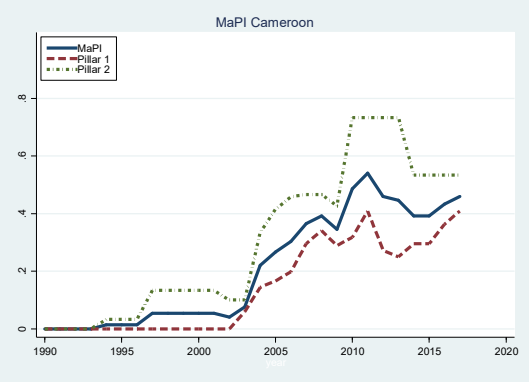


Fig.3: Malaria intervention strategies (Pillar 1) in Cameroon

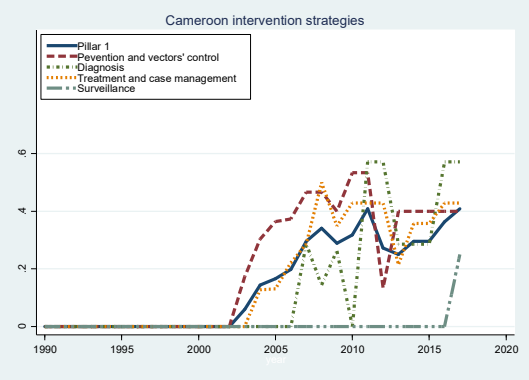
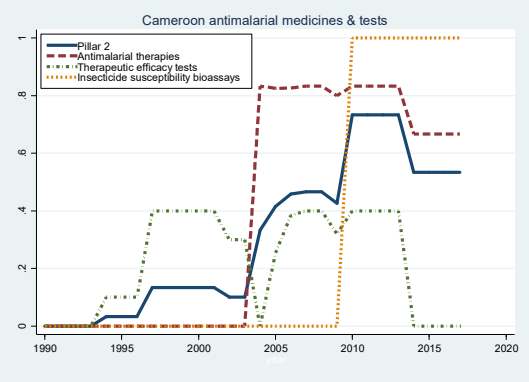


Fig.4: Antimalarial medicines and tests (Pillar 2) in Cameroon



Central African Republic

The Central African Republic is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the Central African Republic. Between 2000 and 2017, The Central African Republic reduced the incidence of malaria from 395.7 to 387.3 per 1,000 population at risk and the malaria deaths rate from 114.3 to 82.3 per 100,000 population (Fig.1).

In 2017, according to the MaPI, The Central African Republic occupies the 38th position (together with Rwanda, Cote d'Ivoire and Gabon) in our sample of 44 SSA countries, with a score of 0.38 (Fig.2), following Sierra Leone, Congo and Malawi and preceding Equatorial Guinea, Guinea-Bissau and Togo. In Pillar 1 (Malaria Intervention Strategies), the country ranks 40th over 44 (with Burundi), with a score of 0.36, whereas it occupies the 22nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.4. (as in Angola, Malawi, Comoros and Guinea).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies, such as parasitological confirmation to all age groups inpatients. From this year on, the country has increased on average and on the yearly base its policies implementation in this pillar with some punctual impetuses in prevention interventions in 2001, and treatment and case management interventions in 2004. However, the big push in Pillar 1 occurs between 2012 and 2014, motivated by the notable rise in all these measures. The country started the implementation of surveillance measures in 2016.

Regarding Pillar 2 (Fig.4), before the 5 years interruption from 1999 to 2003, the interventions started in 1997 with the application of therapeutic efficacy tests. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies. From this year on, policies implementation experienced a relative stability until 2014, a year in which there is a punctual peak due to one-year execution of insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1).

Summing up, as it is shown in the Table, in 2017 The Central African Republic has implemented: first, regarding Pillar 1, the 40% of prevention policies, 29% of diagnosis, 43% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies and 20% of therapeutic tests. Regarding mortality rate, there has been a continuous decrease between 2006 and 2017.

Central African Rep.: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	4.1	5.7	5.3	4.0	3.8
Malaria death ratio (per 100,000 population)	114.3	142.8	121.0	89.1	83.3
MaPI (Index 0-1)	0.02	0.28	0.41	0.41	0.38
Pillar 1: Intervention	0.03	0.24	0.36	0.41	0.36
Cat 1: Prevention	0.00	0.37	0.40	0.53	0.40
Cat 2: Diagnosis	0.17	0.16	0.57	0.57	0.29
Cat 3: Treatment	0.00	0.26	0.43	0.43	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.00	0.35	0.47	0.40	0.40
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.00	0.06	0.40	0.20	0.20
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.00

Fig.1: Malaria mortality in Central African Republic

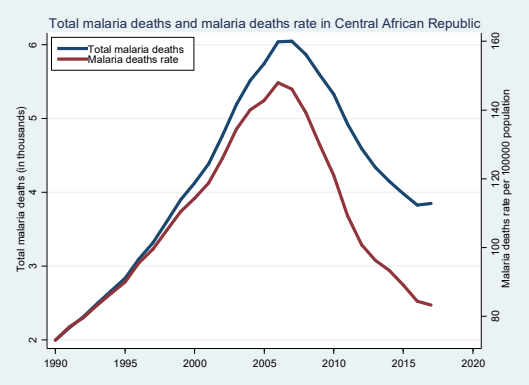


Fig.2: The Malaria Policy Index (MaPI) in Central African Republic

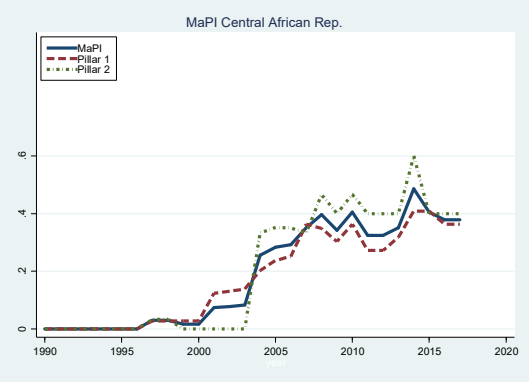


Fig.3: Malaria intervention strategies (Pillar 1) in Central African Republic

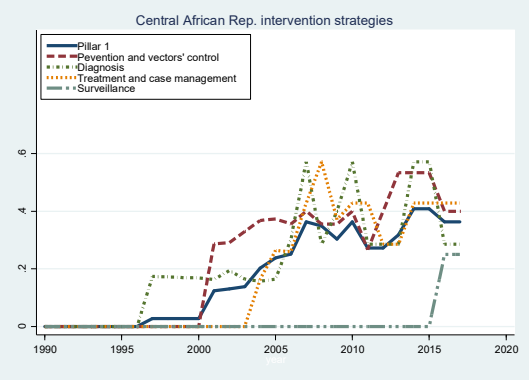
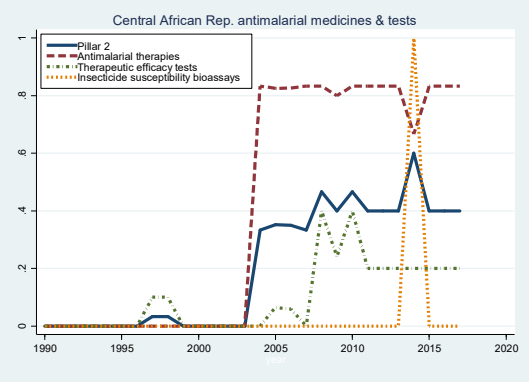


Fig.4: Antimalarial medicines and tests (Pillar 2) in Central African Republic



Chad

Chad is a country with high transmission of malaria. Free malaria areas in the country represent 1%. Malaria transmission is more intense in the south. Although transmission occurs all year-round, malaria is mainly seasonal in Chad, with potential epidemics occurring between May and December. Between 2000 and 2017, Chad reduced the incidence of malaria from 221 to 188.6 per 1,000 population at risk and the malaria deaths rate from 79.9 to 50.4 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Chad occupies the 28th position (together with Mauritania, Burundi and Comoros) in our sample of 44 SSA countries, with a score of 0.43 (Fig.2), following Kenya and Gambia and preceding Liberia and Guinea. In Pillar 1 (Malaria Intervention Strategies), the country ranks 20th over 44 (with Mali and Cabo Verde), with a score of 0.5, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Niger, Cote d'Ivoire, Eritrea, Namibia, Gambia, Tanzania and Sierra Leone).

Since 1998, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women. From this year on, the country has gradually increased its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2004, and diagnosis measures a year later. However, the big push in Pillar 1 occurs from 2005 to 2008, motivated by the notable rise in the enactment of all these measures. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), the interventions started in 1999 with the application of therapeutic efficacy tests. Until 2011 and before the stability that led to the decline of 2014, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more measures. However, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs from 2010 to 2011, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). The country had stopped carrying out insecticide tests by 2015 and therapeutic tests by 2016.

Summing up, as it is shown in the Table, in 2017 Chad has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, and 57% of treatment policies; second, regarding Pillar 2, the 83% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2009 and 2017.

Chad: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	6.6	7.8	11.3	8.0	7.7
Malaria death ratio (per 100,000 population)	79.9	79.8	95.4	56.3	50.4
MaPI (Index 0-1)	0.04	0.31	0.35	0.43	0.43
Pillar 1: Intervention	0.04	0.27	0.27	0.45	0.50
Cat 1: Prevention	0.11	0.37	0.27	0.53	0.67
Cat 2: Diagnosis	0.00	0.61	0.57	0.57	0.57
Cat 3: Treatment	0.00	0.15	0.29	0.57	0.57
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.03	0.36	0.47	0.40	0.33
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.10	0.20	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.25	0.00	0.00

Fig.1: Malaria mortality in Chad

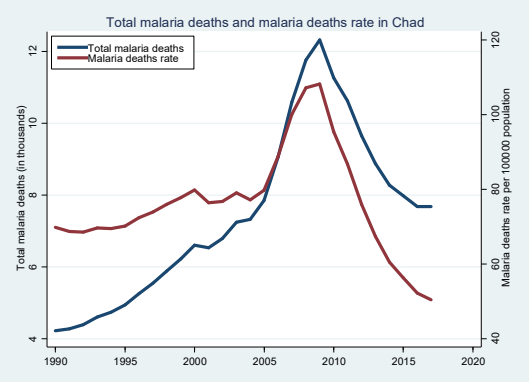


Fig.2: The Malaria Policy Index (MaPI) in Chad

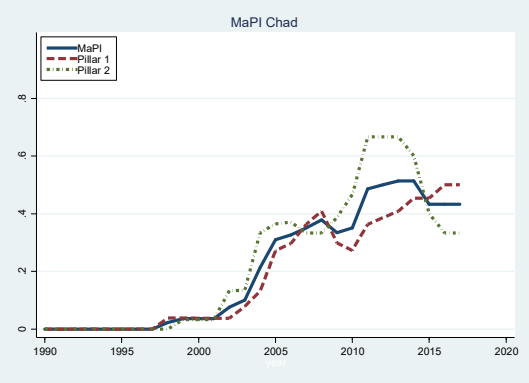


Fig.3: Malaria intervention strategies (Pillar 1) in Chad

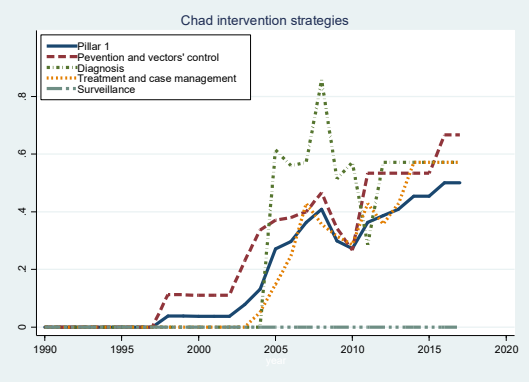
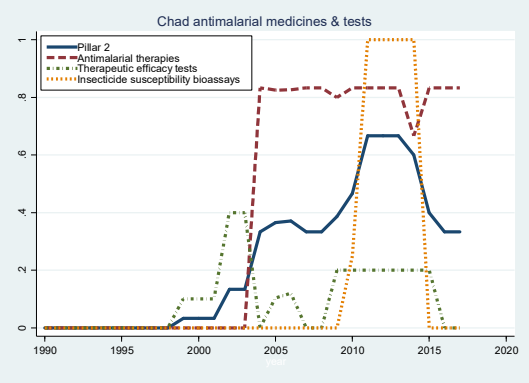


Fig.4: Antimalarial medicines and tests (Pillar 2) in Chad



Comoros

Comoros is a country with low transmission of malaria for the most part. There are no free malaria areas in the country. Between 2000 and 2017, Comoros reduced the incidence of malaria from 65.1 to 3.97 per 1,000 population at risk and slightly reduced the already low malaria deaths rate from 0.8 to 0.1 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Comoros occupies the 28th position (together with Mauritania, Burundi and Chad) in our sample of 44 SSA countries, with a score of 0.43 (Fig.2), following Kenya and Gambia and preceding Liberia and Guinea. In Pillar 1 (Malaria Intervention Strategies), the country ranks 26th over 44 (with Benin and Burkina Faso), with a score of 0.45, whereas it occupies the 22nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.4. (as in Angola, Malawi, Central African Republic and Guinea).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies (such as parasitological confirmation to all age groups inpatients) and treatment and case management policies (such as the provision of pre-referral treatment with parenteral quinine or artemisinin derivatives or artesunate suppositories). From this year on, the country has gradually increased its policies implementation in this pillar on the yearly base with some punctual impetuses in prevention interventions in 2000, and the increase in the latter policies implementation. However, the big push in Pillar 1 occurs in 2011, motivated by the increase in prevention and vector control and treatment and case management interventions. The country started the implementation of surveillance measures in 2013.

Regarding Pillar 2 (Fig.4), the interventions started in 1997 with the application of therapeutic efficacy tests before a one-year interruption in 2002. Before another break in 2004, the country re-engaged the implementation of antimalarial therapies policies and therapeutic efficacy tests in 2003. After a small push in 2007 due to the increase in antimalarial therapies, this pillar remained relatively stable until 2014 when the country started to execute insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). However, after two years of execution (by 2016), the country stopped carrying out these insecticide tests.

Summing up, as it is shown in the Table, in 2017 Comoros has implemented: first, regarding Pillar 1, the 40% of prevention policies, 57% of diagnosis, 57% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies and 20% of therapeutic tests. Regarding mortality rate, there has been a continuous and slight decrease between 2001 and 2008.

Comoros: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.005	0.001	0.003	0.001	0.001
Malaria death ratio (per 100,000 population)	0.85	0.21	0.39	0.15	0.15
MaPI (Index 0-1)	0.06	0.28	0.30	0.50	0.43
Pillar 1: Intervention	0.08	0.24	0.23	0.52	0.45
Cat 1: Prevention	0.04	0.31	0.27	0.67	0.40
Cat 2: Diagnosis	0.25	0.26	0.29	0.57	0.57
Cat 3: Treatment	0.09	0.29	0.29	0.50	0.57
Cat 4: Surveillance	0.00	0.00	0.00	0.25	0.25
Pillar 2: Medicines & tests	0.03	0.33	0.40	0.47	0.40
Cat 5: Medicines	0.00	0.67	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.20	0.20	0.20	0.20
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.25	0.00

Fig.1: Malaria mortality in Comoros

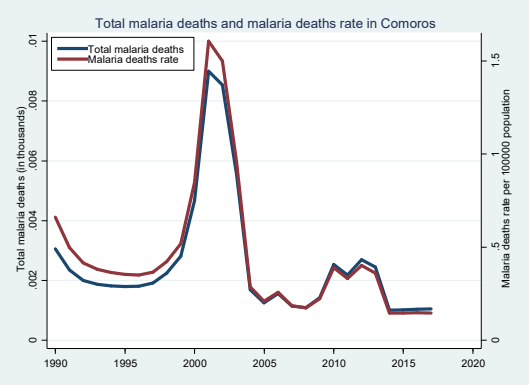


Fig.2: The Malaria Policy Index (MaPI) in Comoros

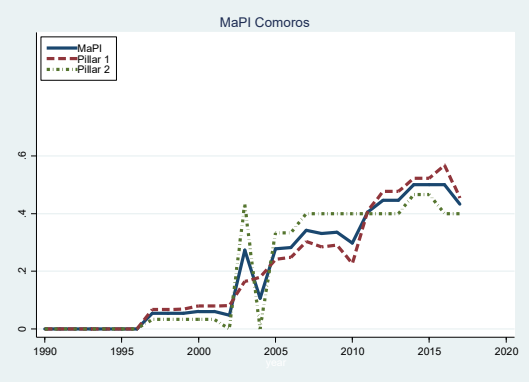


Fig.3: Malaria intervention strategies (Pillar 1) in Comoros

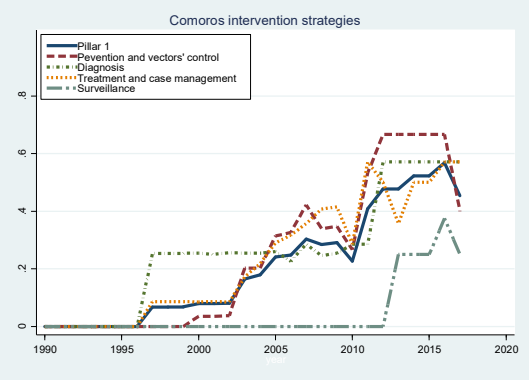
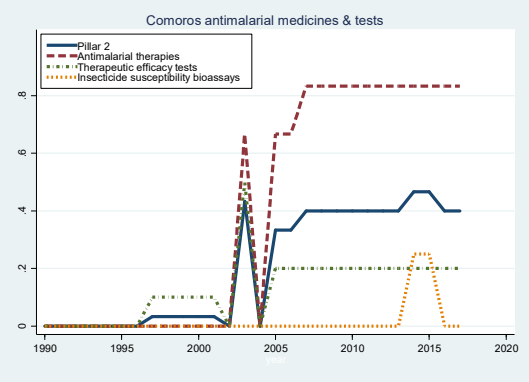


Fig.4: Antimalarial medicines and tests (Pillar 2) in Comoros



Congo Democratic Republic

The Congo Democratic Republic is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the country, with potential epidemics during the rainy season (May to November). The Congo Democratic Republic accounted for 11% of all estimated malaria cases worldwide in 2017. Between 2000 and 2017, Congo Democratic Republic reduced the incidence of malaria from 463.5 to 307.6 per 1,000 population at risk and the malaria deaths rate from 202.3 to 100.4 per 100,000 population (Fig.1).

In 2017, according to the MaPI, The Congo Democratic Republic occupies the 21st position (together with Niger and Eritrea) in our sample of 44 SSA countries, with a score of 0.47 (Fig.2), following Burkina Faso and Cabo Verde and preceding Cameroon and South Africa. In Pillar 1 (Malaria Intervention Strategies), the country ranks 11th over 44 (with Niger and Eritrea), with a score of 0.57, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Niger, Cote d'Ivoire, Eritrea, Chad, Namibia, Gambia, Tanzania and Sierra Leone).

Since 1998, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the larval control. From this year on, the country has gradually increased its policies implementation in this pillar on the yearly base with some punctual impetuses in treatment and case management interventions in 2004, surveillance measures in 2005, and diagnosis measures in 2007. However, the big push in Pillar 1 occurs from 2008, motivated by the notable rise in all implemented policies.

Regarding Pillar 2 (Fig.4), the interventions started in 2000 with the application of therapeutic efficacy tests before the decline observed from 2014, the country steadily increased this sort of policies implementation with some prompt pushes in the implementation of more measures. However, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 The Congo Democratic Republic has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, 50% of treatment and 50% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 25% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2004 and 2017.

Congo, Dem. Rep.: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	101.2	119.8	101.1	80.8	81.2
Malaria death ratio (per 100,000 population)	202.3	207.9	151.8	105.4	100.4
MaPI (Index 0-1)	0.07	0.28	0.51	0.53	0.47
Pillar 1: Intervention	0.07	0.15	0.41	0.52	0.57
Cat 1: Prevention	0.20	0.31	0.67	0.67	0.67
Cat 2: Diagnosis	0.00	0.00	0.57	0.57	0.57
Cat 3: Treatment	0.00	0.13	0.29	0.50	0.50
Cat 4: Surveillance	0.00	0.03	0.00	0.25	0.50
Pillar 2: Medicines & tests	0.07	0.46	0.67	0.53	0.33
Cat 5: Medicines	0.00	0.82	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.20	0.40	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.75	1.00	0.25

Fig.1: Malaria mortality in Congo Democratic Republic

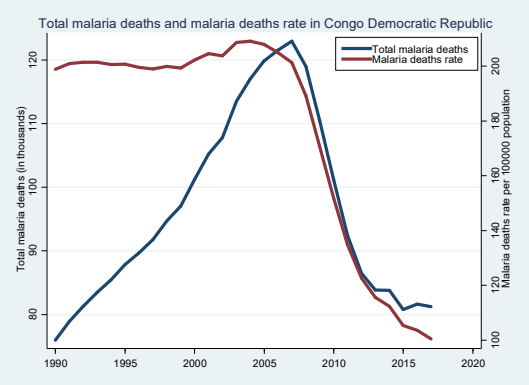


Fig.2: The Malaria Policy Index (MaPI) in Congo Democratic Republic

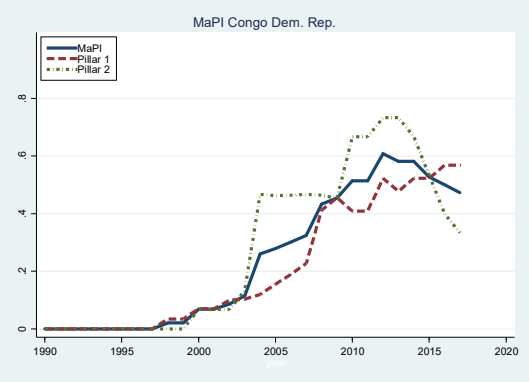


Fig.3: Malaria intervention strategies (Pillar 1) in Congo Democratic Republic

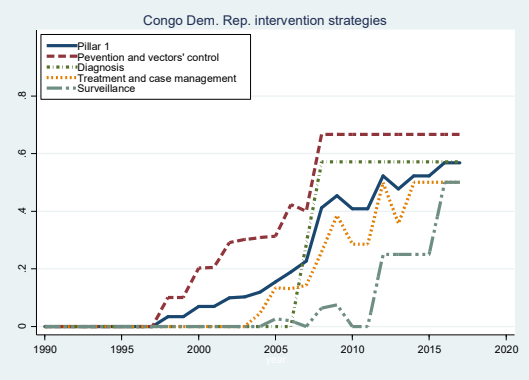
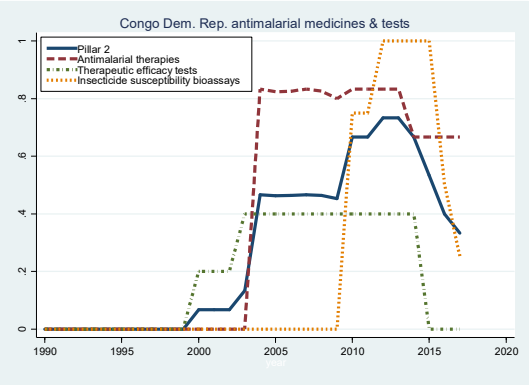


Fig.4: Antimalarial medicines and tests (Pillar 2) in Congo Democratic Republic



The republic of Congo

Congo is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Congo, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Congo reduced the incidence of malaria from 344.9 to 197.6 per 1,000 population at risk and the malaria deaths rate from 94 to 45.7 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Congo occupies the 35th position (together with Sierra Leone and Malawi) in our sample of 44 SSA countries, with a score of 0.39 (Fig.2), following Eswatini and preceding Rwanda, Central African Republic, Cote d'Ivoire and Gabon. In Pillar 1 (Malaria Intervention Strategies), the country ranks 41st over 44, with a score of 0.34, whereas it occupies the 18th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.47. (as in Kenya, Somalia and Cabo Verde).

Since 2002, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women. This engagement remained relatively stable until 2007 when the country started increasing gradually its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2004, and diagnosis measures in 2011. However, the first big push in Pillar 1 occurs in 2007, motivated by the increase in prevention and treatment interventions. The second big improvement occurs in 2011 with the starting of diagnosis measures. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), the interventions started in 1999 with the application of therapeutic efficacy tests. Before the stability that led to the decline of 2015, the country steadily increased this sort of policies implementation with some prompt pushes in the implementation of more antimalarial measures. However, the first big push in this pillar occurs in 2004, driven by the restarting of therapeutic efficacy tests after a short break in 2003 and also the beginning of antimalarial therapies. The second big improvement occurs in 2013, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). Two years after the implementation, the country had stopped carrying out these insecticide tests.

Summing up, as it is shown in the Table, in 2017 Congo has implemented: first, regarding Pillar 1, the 53% of prevention policies, 29% of diagnosis, and 36% of treatment; second, regarding Pillar 2, the 83% of antimalarial therapies and 40% of therapeutic tests. Regarding mortality rate, there has been a continuous decrease between 2003 and 2017.

Congo: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	3.0	3.2	2.3	2.2	2.2
Malaria death ratio (per 100,000 population)	94.0	88.7	54.7	46.9	45.7
MaPI (Index 0-1)	0.03	0.22	0.27	0.38	0.39
Pillar 1: Intervention	0.00	0.05	0.14	0.32	0.34
Cat 1: Prevention	0.00	0.10	0.27	0.53	0.53
Cat 2: Diagnosis	0.00	0.00	0.00	0.29	0.29
Cat 3: Treatment	0.00	0.04	0.14	0.29	0.36
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.07	0.47	0.47	0.47	0.47
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.20	0.40	0.40	0.40	0.40
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.00

Fig.1: Malaria mortality in Congo

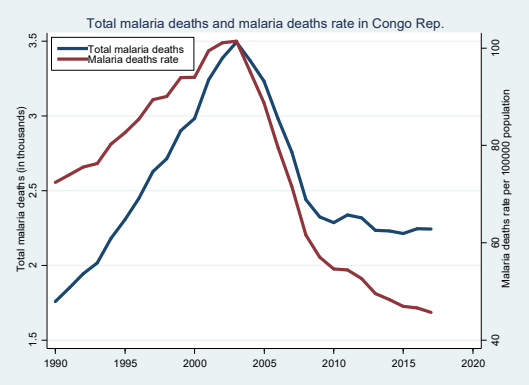


Fig.2: The Malaria Policy Index (MaPI) in Congo

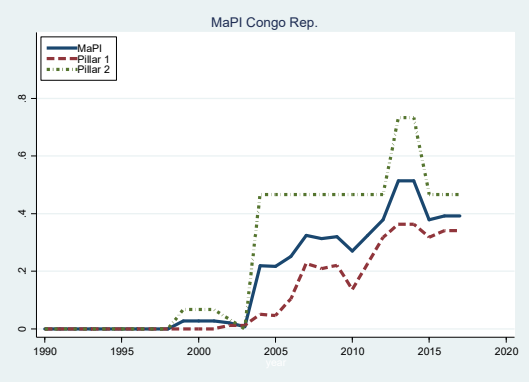


Fig.3: Malaria intervention strategies (Pillar 1) in Congo

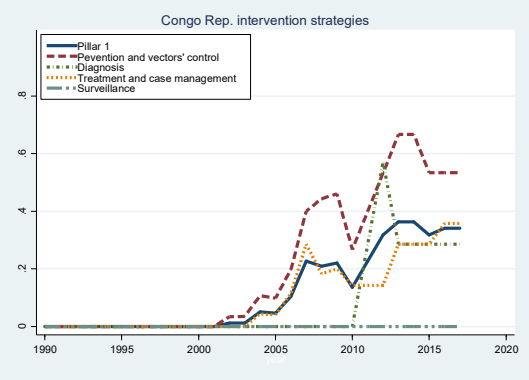
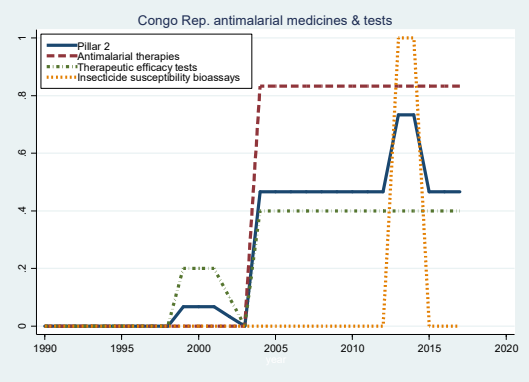


Fig.4: Antimalarial medicines and tests (Pillar 2) in Congo



Côte d'Ivoire

Côte d'Ivoire is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the north of the country, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Côte d'Ivoire reduced the incidence of malaria from 514.6 to 138.9 per 1,000 population at risk and the malaria deaths rate from 164.2 to 65.1 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Côte d'Ivoire occupies the 38th position (together with Rwanda, Central African Republic and Gabon) in our sample of 44 SSA countries, with a score of 0.38 (Fig.2), following Sierra Leone, Congo and Malawi and preceding Equatorial Guinea, Guinea-Bissau and Togo. In Pillar 1 (Malaria Intervention Strategies), the country ranks 33rd over 44 (with Equatorial Guinea, Guinea-Bissau, Cameroon and Togo), with a score of 0.41, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Niger, Eritrea, Chad, Namibia, Gambia, Tanzania and Sierra Leone).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies, such as parasitological confirmation to all age groups inpatients. This engagement remained relatively stable until 2004 when the country started increasing gradually its policies implementation in this pillar on the yearly base with some interruptions from 2009 to 2012 more related to diagnosis measures. However, the big push in Pillar 1 occurs in 2013, motivated by the notable rise in all policies and measures. The country started the implementation of surveillance measures in 2016.

Regarding Pillar 2 (Fig.4), the interventions started in 1997 with the application of therapeutic efficacy tests. Before the continued drastic decline of 2015, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. However, the first big push in this pillar occurs in 2003, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). The country had stopped carrying out therapeutic efficacy tests by 2015, and insecticide bioassays tests by 2017.

Summing up, as it is shown in the Table, in 2017 Côte d'Ivoire has implemented: first, regarding Pillar 1, the 27% of prevention policies, 57% of diagnosis, 57% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2003 and 2017.

Côte d'Ivoire: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	28.1	31.8	32.4	16.3	16.3
Malaria death ratio (per 100,000 population)	164.2	164.2	150.1	67.9	65.1
MaPI (Index 0-1)	0.03	0.26	0.41	0.46	0.38
Pillar 1: Intervention	0.03	0.16	0.18	0.36	0.41
Cat 1: Prevention	0.05	0.27	0.40	0.27	0.27
Cat 2: Diagnosis	0.07	0.13	0.00	0.57	0.57
Cat 3: Treatment	0.00	0.13	0.14	0.57	0.57
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.03	0.42	0.73	0.60	0.33
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.27	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.00

Fig.1: Malaria mortality in Côte d'Ivoire

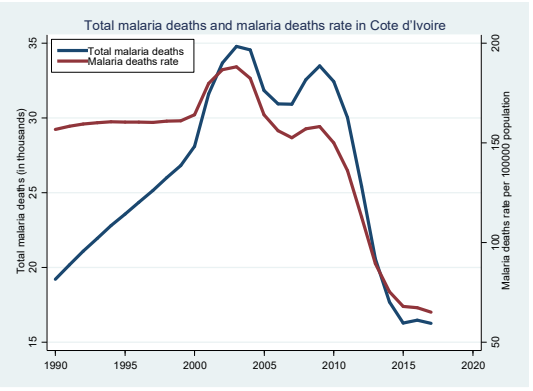


Fig.2: The Malaria Policy Index (MaPI) in Côte d'Ivoire

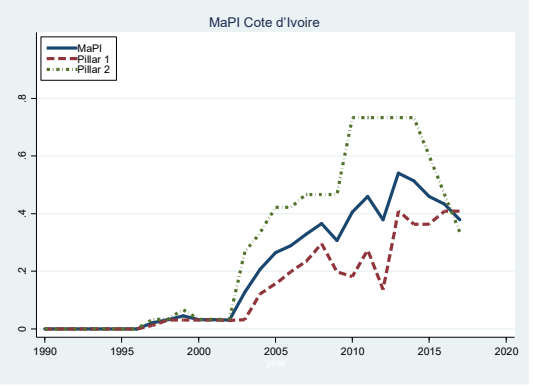


Fig.3: Malaria intervention strategies (Pillar 1) in Côte d'Ivoire

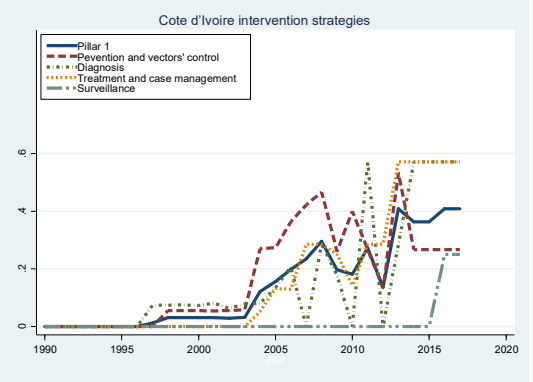
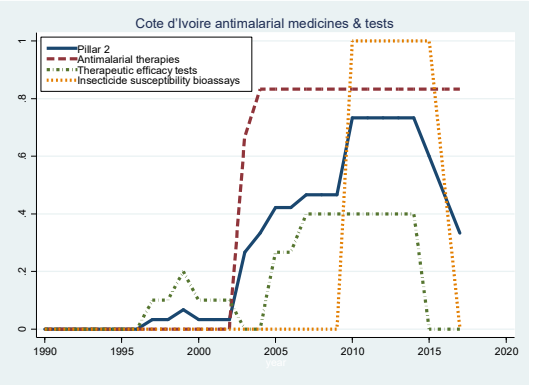


Fig.4: Antimalarial medicines and tests (Pillar 2) in Côte d'Ivoire



Equatorial Guinea

Equatorial Guinea is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Equatorial Guinea, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Equatorial Guinea reduced the incidence of malaria from 397.6 to 343.3 per 1,000 population at risk and the malaria deaths rate from 188.1 to 67.1 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Equatorial Guinea occupies the queue of the distribution (together with Guinea-Bissau and Togo) in our sample of 44 SSA countries, with a score of 0.35 (Fig.2), following Rwanda, Central African Republic, Cote d'Ivoire and Gabon. In Pillar 1 (Malaria Intervention Strategies), the country ranks 33rd over 44 (with Cote d'Ivoire, Guinea-Bissau, Cameroon and Togo), with a score of 0.41, whereas it occupies the 38th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.27. (as in Guinea-Bissau, Togo, South Africa and Botswana).

Since 2003, the country engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies (such as parasitological confirmation to all age groups inpatients) and treatment and case management policies (such as the free of charge or highly subsidized ACT in public sectors). From this year on, the country has increased on average its policies implementation in this pillar with some punctual impetuses in prevention measures in 2004. However, the big push in Pillar 1 occurs in 2008, motivated by the increase in all these measures. This big push happened after a drastic decline in 2007 due to punctual interruptions in prevention and diagnosis interventions. The country started the implementation of surveillance measures in 2012.

Regarding Pillar 2 (Fig.4), the interventions started in 1996 with the application of therapeutic efficacy tests before a 4 years interruption from 2000 to 2003. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies. Before the decline which led to a stability from 2015, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes from 2010 to 2014, in the continuing implementation of antimalarial therapies policies and the engagement of the country in the execution of insecticide susceptibility bioassays tests. These tests are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2012, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Equatorial Guinea has implemented: first, regarding Pillar 1, the 40% of prevention policies, 57% of diagnosis, 50% of treatment and 13% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 1996 and 2017.

Equatorial Guinea: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	1.2	1.2	1.1	0.9	0.9
Malaria death ratio (per 100,000 population)	188.1	147.8	105.9	75.2	67.1
MaPI (Index 0-1)	0.00	0.23	0.41	0.38	0.35
Pillar 1: Intervention	0.00	0.18	0.36	0.45	0.41
Cat 1: Prevention	0.00	0.20	0.27	0.53	0.40
Cat 2: Diagnosis	0.00	0.41	0.57	0.57	0.57
Cat 3: Treatment	0.00	0.16	0.57	0.57	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.13
Pillar 2: Medicines & tests	0.00	0.30	0.47	0.27	0.27
Cat 5: Medicines	0.00	0.67	0.67	0.67	0.67
Cat 6: Therapeutic tests	0.00	0.09	0.20	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.50	0.00	0.00

Fig.1: Malaria mortality in Equatorial Guinea

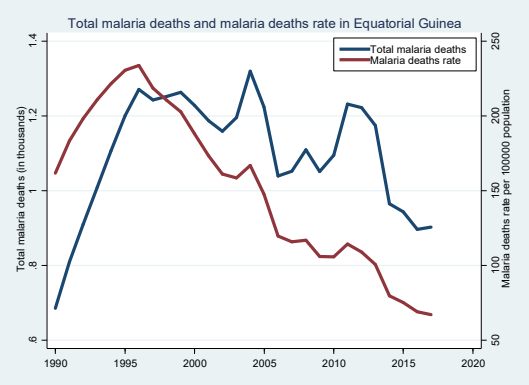


Fig.2: The Malaria Policy Index (MaPI) in Equatorial Guinea

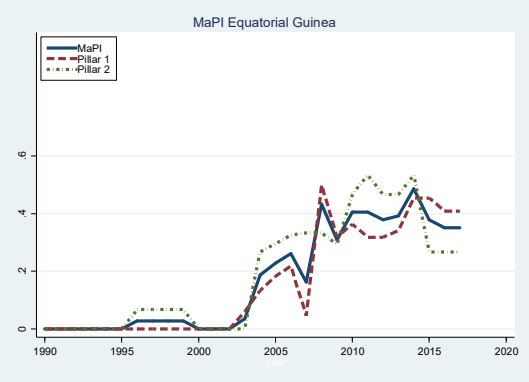


Fig.3: Malaria intervention strategies (Pillar 1) in Equatorial Guinea

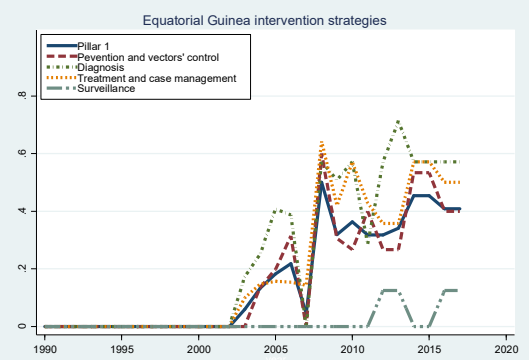
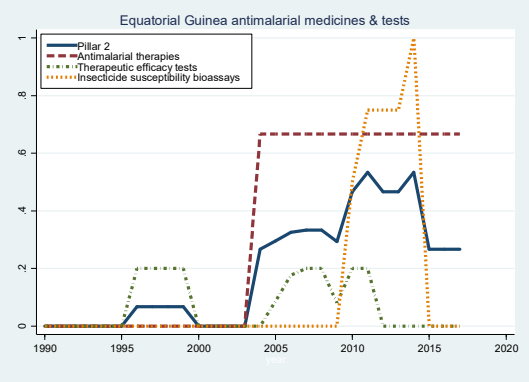


Fig.4: Antimalarial medicines and tests (Pillar 2) in Equatorial Guinea



Eritrea

Eritrea is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Eritrea. Between 2000 and 2017, Eritrea experienced a slight increase in its incidence of malaria from 13.7 to 22.9 per 1,000 population at risk but slightly decreased the already low malaria deaths rate from 0.3 to 0.2 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Eritrea occupies the 24th position (together with Cameroon and South Africa) in our sample of 44 SSA countries, with a score of 0.46 (Fig.2), following Congo Democratic Republic and Niger and preceding Kenya and Gambia. In Pillar 1 (Malaria Intervention Strategies), the country ranks 11th over 44 (with Congo Democratic Republic and Niger), with a score of 0.57, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Niger, Cote d'Ivoire, Chad, Namibia, Gambia, Tanzania and Sierra Leone).

Since 1950, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of DDT for IRS in public health. This engagement remained relatively stable until 1995 when the country started increasing gradually its policies implementation in this pillar on the yearly base with some punctual impetuses in prevention measures, the starting of the diagnosis measures in 1997, and treatment and case management interventions in 2000. However, the big push in Pillar 1 occurs in 2007, motivated by the notable rise in all these measures. The country started an earlier but weaker implementation of surveillance measures in 1991.

Regarding Pillar 2 (Fig.4), the interventions started in 1997 with the application of therapeutic efficacy tests. From this particular year, the country started implementing antimalarial therapies policies. Until 2013 and before the stability that led to the drastic decline of 2017, the country steadily increased its policies implementation on the yearly base with some prompt pushes in reaction to the starting and increase in the implementation of more antimalarial measures. However, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country had stopped carrying out therapeutic efficacy and insecticide bioassays tests.

Summing up, as it is shown in the Table, in 2017 Eritrea has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, 71% of treatment and 13% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 1990 and 2017.

Eritrea: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.009	0.009	0.009	0.009	0.010
Malaria death ratio (per 100,000 population)	0.26	0.19	0.16	0.16	0.16
MaPI (Index 0-1)	0.17	0.36	0.49	0.55	0.47
Pillar 1: Intervention	0.26	0.38	0.45	0.48	0.57
Cat 1: Prevention	0.46	0.55	0.53	0.53	0.67
Cat 2: Diagnosis	0.49	0.71	0.57	0.57	0.57
Cat 3: Treatment	0.06	0.23	0.57	0.57	0.71
Cat 4: Surveillance	0.02	0.02	0.00	0.13	0.13
Pillar 2: Medicines & tests	0.03	0.33	0.53	0.67	0.33
Cat 5: Medicines	0.00	0.67	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.20	0.20	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.50	1.00	0.00

Fig.1: Malaria mortality in Eritrea

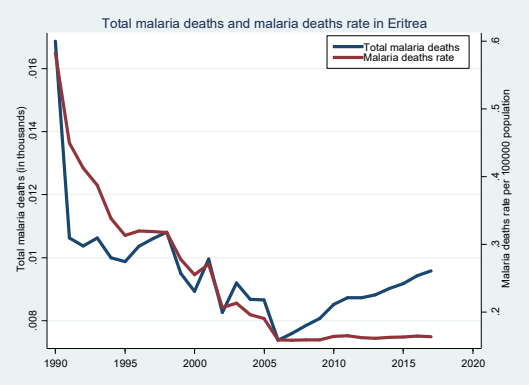


Fig.2: The Malaria Policy Index (MaPI) in Eritrea

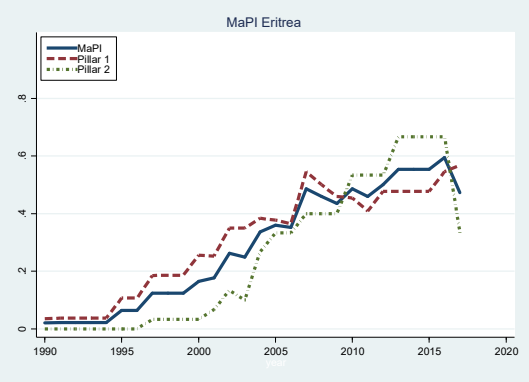


Fig.3: Malaria intervention strategies (Pillar 1) in Eritrea

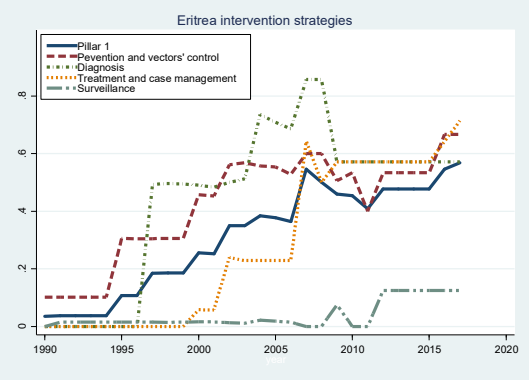
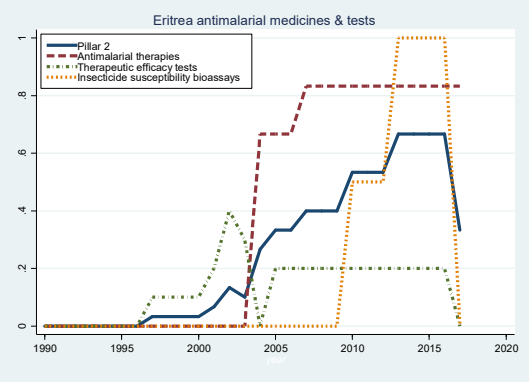


Fig.4: Antimalarial medicines and tests (Pillar 2) in Eritrea



Eswatini

Eswatini is a country with very low transmission (considered 72% free area) of malaria. There are no high malaria transmission areas in the country. Malaria transmission is seasonal in Swaziland and occurs during November to May in all areas except the southeast part of the country. Between 2000 and 2017, Eswatini experienced a relative stability in its incidence of malaria and malaria deaths rate around 2 per 1,000 population at risk and 0.5 per 100,000 population, respectively (Fig.1).

In 2017, according to the MaPI, Eswatini occupies the 34th position in our sample of 44 SSA countries, with a score of 0.41 (Fig.2), following Liberia and Guinea and preceding Sierra Leone, Congo and Malawi. In Pillar 1 (Malaria Intervention Strategies), the country ranks 14th over 44 (with Somalia and Zambia), with a score of 0.55, whereas it occupies the queue of the distribution in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.2 (as in Mauritania).

Since 1946, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics. This implementation remained stable until 1997 when the country started increasing gradually and on the yearly base its policies implementation in this pillar with some punctual impetuses in diagnosis and treatment and case management interventions. However, the big push in Pillar 1 occurs from 2007 to 2009, motivated by the increase in diagnosis and treatment and case management interventions. The country started the implementation of surveillance measures in 2012.

Regarding Pillar 2 (Fig.4), no intervention was carried out before a one-year punctual spreading over of therapeutic efficacy tests in 2000. After a 3 years break, the country re-engaged into the implementation of Pillar 2 policies by applying antimalarial therapies policies without executing another therapeutic test till 2017. Moreover, the only one-year punctual execution of 50% of insecticide susceptibility bioassays tests which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1) took place in 2011. This execution of insecticide tests and the full implementation of antimalarial therapies led to the two respective peaks in the pillar of 2011 and 2013.

Summing up, as it is shown in the Table, in 2017 Eswatini has implemented: first, regarding Pillar 1, the 40% of prevention policies, 57% of diagnosis, 43% of treatment and 100% of surveillance policies; second, regarding Pillar 2, the 50% of antimalarial therapies. Regarding mortality rate, there has been a continuous slight decrease between 2001 and 2017.

Eswatini: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.006	0.006	0.006	0.005	0.005
Malaria death ratio (per 100,000 population)	0.61	0.60	0.56	0.49	0.47
MaPI (Index 0-1)	0.14	0.27	0.35	0.39	0.41
Pillar 1: Intervention	0.21	0.30	0.41	0.52	0.55
Cat 1: Prevention	0.33	0.58	0.53	0.53	0.40
Cat 2: Diagnosis	0.53	0.51	0.57	0.57	0.57
Cat 3: Treatment	0.06	0.06	0.43	0.50	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.50	1.00
Pillar 2: Medicines & tests	0.03	0.23	0.27	0.20	0.20
Cat 5: Medicines	0.00	0.57	0.67	0.50	0.50
Cat 6: Therapeutic tests	0.10	0.00	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.00

Fig.1: Malaria mortality in Eswatini

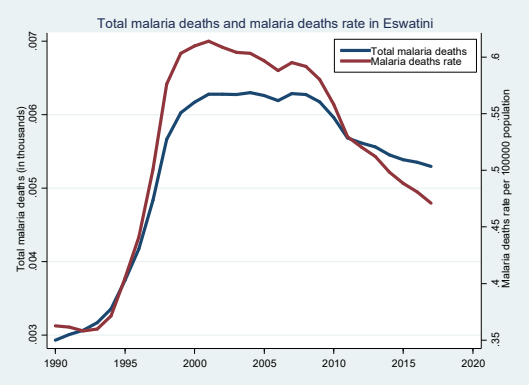


Fig.2: The Malaria Policy Index (MaPI) in Eswatini

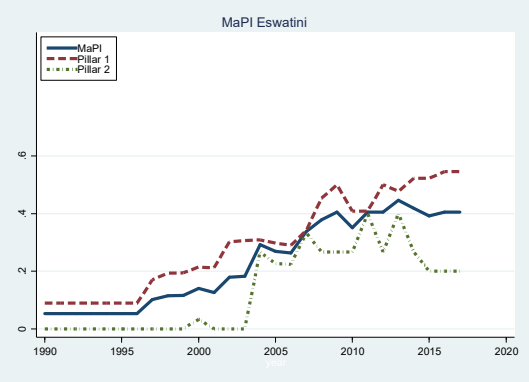


Fig.3: Malaria intervention strategies (Pillar 1) in Eswatini

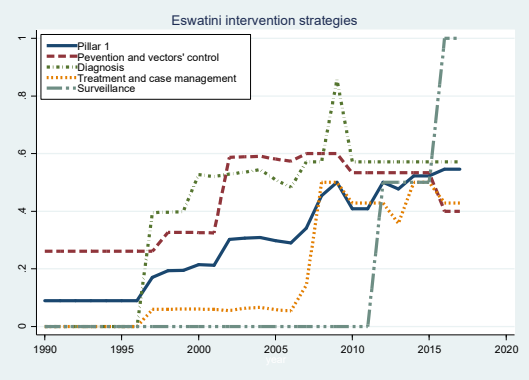
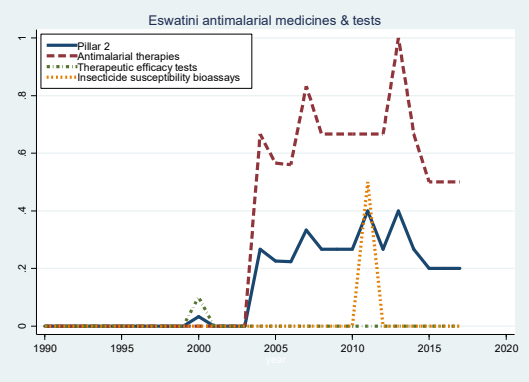


Fig.4: Antimalarial medicines and tests (Pillar 2) in Eswatini



Ethiopia

Ethiopia is a country with high transmission of malaria (only considered 27% high transmission). Free malaria areas represent 37% of the country. Malaria is present everywhere except in the central highlands. Although transmission occurs year-round, Malaria is mainly seasonal in Ethiopia, with potential and frequent epidemics, the last having occurred in 2016 with 2,927,266 new cases. Between 2000 and 2017, Ethiopia reduced the incidence of malaria from 110.8 to 37.4 per 1,000 population at risk and the malaria deaths rate from 28.1 to 2.7 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Ethiopia occupies the 5th position in our sample of 44 SSA countries, with a score of 0.55 (Fig.2), following Senegal and Namibia and preceding Zambia and Botswana. In Pillar 1 (Malaria Intervention Strategies), the country ranks 17th over 44 (with Gambia and Uganda), with a score of 0.52, whereas it occupies the 2nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.6. (as in Benin, Ghana, Madagascar and Nigeria).

Since 1960, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies (such as the use of IRS for prevention and control of epidemics and the larval control) and diagnosis policies (such as free of charge parasitological confirmation to all age groups inpatients). This engagement remained relatively stable until 1997 when the country started increasing on average its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions. This year marked the first big push in this pillar. Before the decline of 2007, the country experienced a second big push in Pillar 1 due to the rise in all the implemented policies. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 1996. From this particular year, interventions started with the application of therapeutic efficacy tests. The first big push in the implementation of policies of this pillar occurs in 2004, driven by the beginning and urgent implementation of antimalarial therapies measures. The second big improvement occurs in 2010, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Ethiopia has implemented: first, regarding Pillar 1, the 53% of prevention policies, 57% of diagnosis, 64% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1990 and 2017.

Ethiopia: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	19.2	21.5	2.4	2.1	2.8
Malaria death ratio (per 100,000 population)	28.1	28.1	2.8	2.1	2.7
MaPI (Index 0-1)	0.21	0.46	0.55	0.51	0.55
Pillar 1: Intervention	0.33	0.47	0.41	0.41	0.52
Cat 1: Prevention	0.40	0.55	0.40	0.53	0.53
Cat 2: Diagnosis	0.49	0.71	0.57	0.57	0.57
Cat 3: Treatment	0.35	0.53	0.57	0.43	0.64
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.03	0.46	0.77	0.67	0.60
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.37	0.50	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Ethiopia

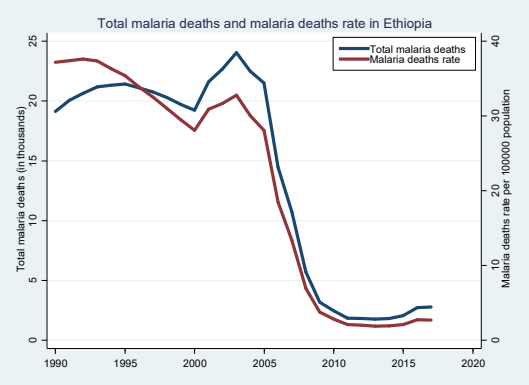


Fig.2: The Malaria Policy Index (MaPI) in Ethiopia

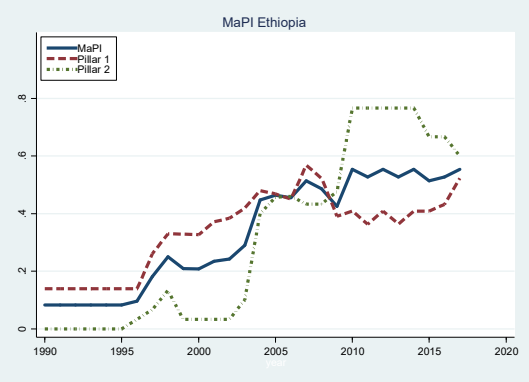


Fig.3: Malaria intervention strategies (Pillar 1) in Ethiopia

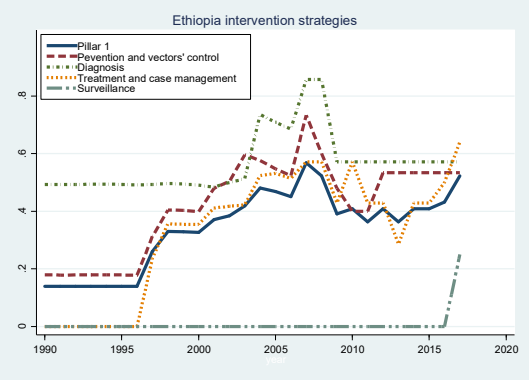
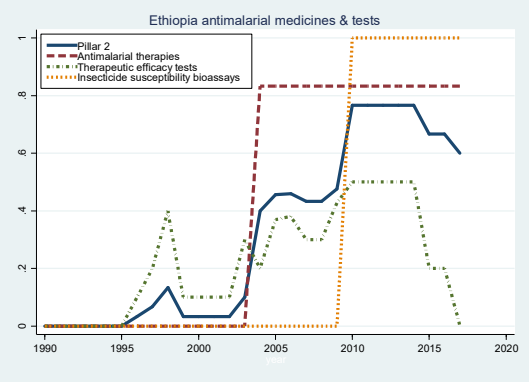


Fig.4: Antimalarial medicines and tests (Pillar 2) in Ethiopia



Gabon

Gabon is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Gabon, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Gabon reduced the incidence of malaria from 327.9 to 168.9 per 1,000 population at risk and the malaria deaths rate from 76.1 to 41.4 per 100,000 population (Fig.1).

In 2017, according to the MaPI, and Gabon occupies the 38th position (together with Rwanda, Central African Republic and Cote d'Ivoire) in our sample of 44 SSA countries, with a score of 0.38 (Fig.2), following Sierra Leone, Congo and Malawi and preceding Equatorial Guinea, Guinea-Bissau and Togo. In Pillar 1 (Malaria Intervention Strategies), the country occupies the queue of the distribution (with Rwanda), with a score of 0.27, whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53.(as in Zimbabwe, Rwanda, Cameroon, Burundi, Uganda, Senegal, Zambia, Mozambique, Mali and Burkina Faso).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies, such as the free of charge malaria diagnosis in the public sector. The big push in the implementation of Pillar 1 policies occurs in 2003, motivated by the increase in prevention and vector control measures and the starting of the enactment of treatment and case management interventions. From this year on, the country experienced a relative stability in its policies implementation in this pillar with some punctual impetuses in all these implemented policies. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), the interventions started in 1997 with the application of therapeutic efficacy tests. The first big push in the implementation of policies of this pillar occurs from 2003 to 2005, driven by the beginning and rapid increase in the implementation of antimalarial therapies. After a decline from 2015 to 2016 explained by the decrease in antimalarial therapies and the break in therapeutic tests, the country experienced a second big improvement in 2017 due to the total execution of insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2016, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Gabon has implemented: first, regarding Pillar 1, the 27% of prevention policies, 29% of diagnosis, 29% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1992 and 2007.

Gabon: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.94	0.68	0.72	0.71	0.70
Malaria death ratio (per 100,000 population)	76.1	49.6	47.9	43.2	41.4
MaPI (Index 0-1)	0.08	0.37	0.43	0.35	0.38
Pillar 1: Intervention	0.06	0.31	0.41	0.32	0.27
Cat 1: Prevention	0.04	0.39	0.40	0.53	0.27
Cat 2: Diagnosis	0.31	0.32	0.57	0.29	0.29
Cat 3: Treatment	0.00	0.40	0.57	0.29	0.29
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.10	0.47	0.47	0.40	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.30	0.40	0.40	0.40	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	1.00

Fig.1: Malaria mortality in Gabon

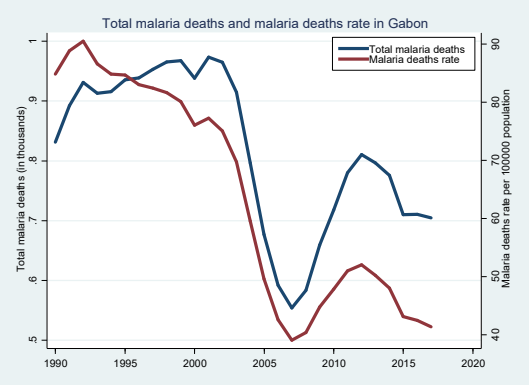


Fig.2: The Malaria Policy Index (MaPI) in Gabon

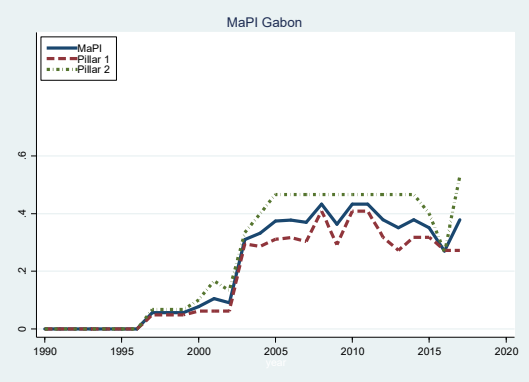


Fig.3: Malaria intervention strategies (Pillar 1) in Gabon

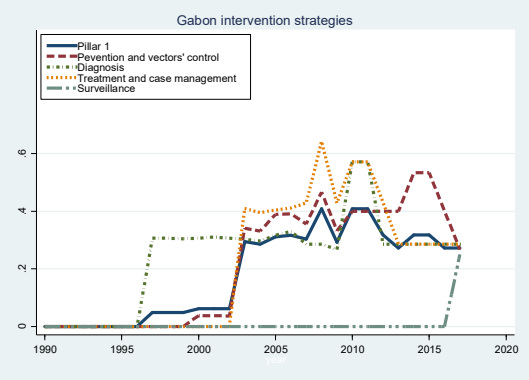
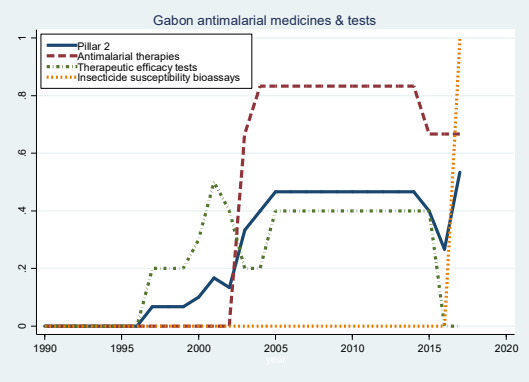


Fig.4: Antimalarial medicines and tests (Pillar 2) in Gabon



Gambia

Gambia is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs year-round, malaria is mainly seasonal in Gambia, with potential epidemics during the rainy season (June to November). Gambia reduced the incidence of malaria from 377.9 to 56.7 per 1,000 population at risk and the malaria deaths rate from 62.8 to 6.3 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Gambia occupies the 26th position (together with Kenya) in our sample of 44 SSA countries, with a score of 0.45 (Fig.2), following Cameroon and South Africa and preceding Mauritania, Burundi, Chad and Comoros. In Pillar 1 (Malaria Intervention Strategies), the country ranks 17th over 44 (with Ethiopia and Uganda), with a score of 0.52, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Niger, Cote d'Ivoire, Eritrea, Chad, Namibia, Tanzania and Sierra Leone).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies (such as parasitological confirmation to all age groups inpatients) and treatment and case management policies (such as the provision pre-referral treatment with parenteral quinine or artemisinin derivatives or artesunate suppositories). From this year on, the country has gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses in prevention measures in 1998, and surveillance measures in 2016. However, the first big push in Pillar 1 occurs in 2008, motivated by the increase in prevention and vector control and diagnosis interventions. The second big improvement occurs from 2014 to 2016 due to the notable rise in prevention policies and the starting of surveillance measures.

Regarding Pillar 2 (Fig.4), the interventions started in 1998 with the application of therapeutic efficacy tests. The big push in the implementation of policies of this pillar occurs in 2004, driven by the beginning and urgent implementation of antimalarial therapies. From this year on, the country observed a stability in the implementation of policies of this pillar. The country started the implementation of insecticide susceptibility bioassays test in 2017, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Gambia has implemented: first, regarding Pillar 1, the 80% of prevention policies, 57% of diagnosis, 36% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 1990 and 2017.

Gambia: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.85	0.43	0.35	0.14	0.13
Malaria death ratio (per 100,000 population)	62.8	28.1	20.1	6.8	6.3
MaPI (Index 0-1)	0.14	0.32	0.43	0.43	0.45
Pillar 1: Intervention	0.19	0.26	0.45	0.45	0.52
Cat 1: Prevention	0.23	0.36	0.67	0.80	0.80
Cat 2: Diagnosis	0.31	0.28	0.29	0.57	0.57
Cat 3: Treatment	0.19	0.31	0.57	0.29	0.36
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.07	0.40	0.40	0.40	0.33
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.20	0.20	0.20	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.00

Fig.1: Malaria mortality in Gambia

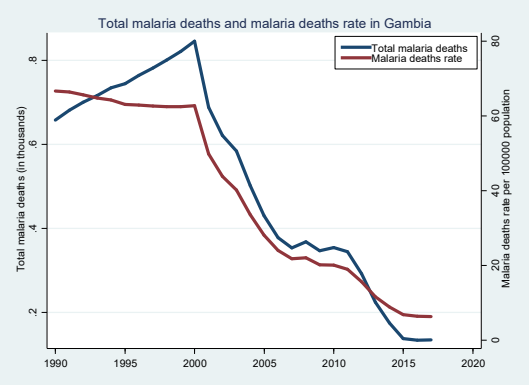


Fig.2: The Malaria Policy Index (MaPI) in Gambia

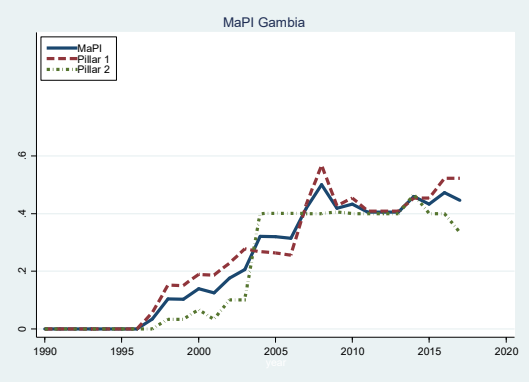


Fig.3: Malaria intervention strategies (Pillar 1) in Gambia

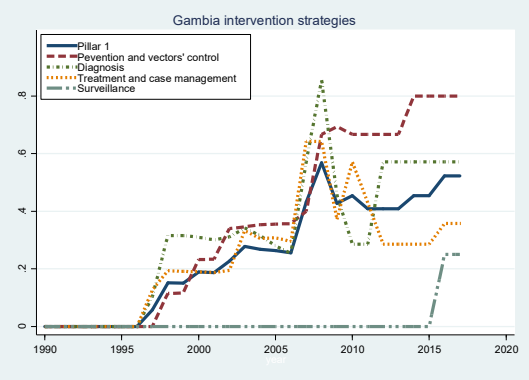
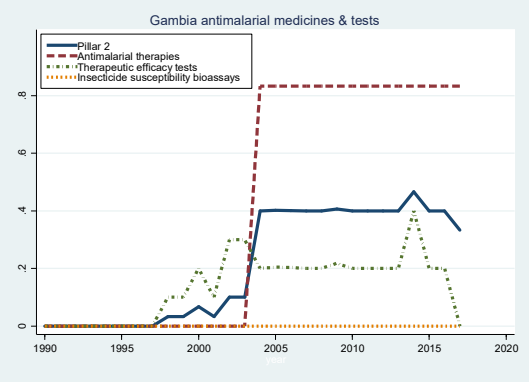


Fig.4: Antimalarial medicines and tests (Pillar 2) in Gambia



Ghana

Ghana is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Ghana, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Ghana reduced the incidence of malaria from 405.1 to 270.7 per 1,000 population at risk and the malaria deaths rate from 124.0 to 62.1 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Ghana occupies the 15th position (together with Sudan and Mozambique) in our sample of 44 SSA countries, with a score of 0.5 (Fig.2), following Angola, Somalia, Mali, Tanzania and Benin and preceding Sao Tome and Principe. In Pillar 1 (Malaria Intervention Strategies), the country ranks 29th over 44 (with Guinea, Kenya and Sierra Leone), with a score of 0.43, whereas it occupies the 2nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.6. (as in Benin, Madagascar, Ethiopia and Nigeria).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies (such as the free or subsidizing distribution of ITNs/LLNs), diagnosis policies (such as parasitological confirmation for patients of 5 years and above) and treatment and case management policies (such as the oversight regulation of case management in the private sectors). From this year to 2011, the country slowly increased its policies implementation on the yearly base with punctual pushes in implementation of diagnosis and treatment and case management interventions in 2007, and the rise in prevention interventions in 2016. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), the interventions started in 1998 with the application of therapeutic efficacy tests. Before the stability that led to the decline of 2015, the country steadily increased this sort of policies implementation with some prompt pushes in the implementation of more antimalarial measures. The first big push in the implementation of policies of this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Ghana has implemented: first, regarding Pillar 1, the 80% of prevention policies, 29% of diagnosis, and 36% of treatment; second, regarding Pillar 2, the 83% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2003 and 2017.

Ghana: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	23.7	30.0	30.1	21.4	18.8
Malaria death ratio (per 100,000 population)	124.0	136.3	119.3	74.6	62.1
MaPI (Index 0-1)	0.14	0.35	0.54	0.47	0.50
Pillar 1: Intervention	0.19	0.28	0.41	0.39	0.43
Cat 1: Prevention	0.32	0.58	0.53	0.67	0.80
Cat 2: Diagnosis	0.11	0.11	0.57	0.29	0.29
Cat 3: Treatment	0.20	0.19	0.43	0.36	0.36
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.07	0.47	0.73	0.60	0.60
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.20	0.40	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Ghana

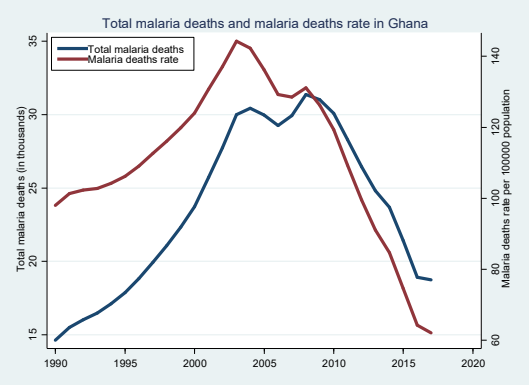


Fig.2: The Malaria Policy Index (MaPI) in Ghana

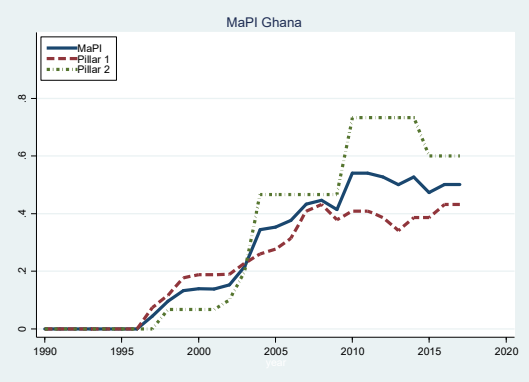


Fig.3: Malaria intervention strategies (Pillar 1) in Ghana

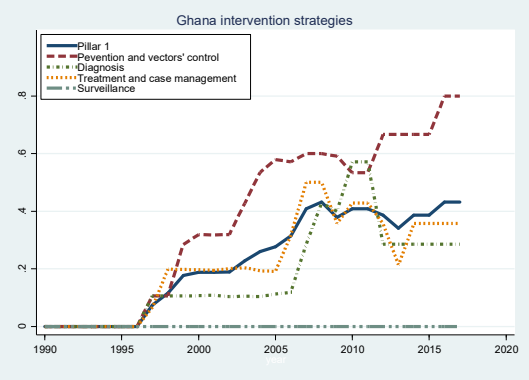
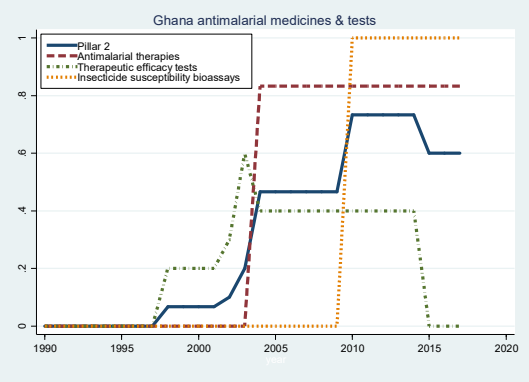


Fig.4: Antimalarial medicines and tests (Pillar 2) in Ghana



Guinea

Guinea is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Guinea, with potential epidemics from June to December. Between 2000 and 2017, Guinea reduced the incidence of malaria from 452.5 to 336.7 per 1,000 population at risk and the malaria deaths rate from 127.4 to 96.1 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Guinea occupies the 32nd position (together with Liberia) in our sample of 44 SSA countries, with a score of 0.42 (Fig.2), following Mauritania, Burundi, Chad and Comoros and preceding Eswatini. In Pillar 1 (Malaria Intervention Strategies), the country ranks 29th over 44 (with Kenya, Sierra Leone and Ghana), with a score of 0.43, whereas it occupies the 22nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.4.(as in Angola, Malawi, Central African Republic and Comoros).

Since 2000, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through EPI routine and campaign and the use of IRS for prevention and control of epidemics. From this year on, the country has gradually increased on the yearly base with some punctual pushes in treatment and case management interventions in 2004, and diagnosis measures a year later. Even if 2004 marked a first important push in this pillar, it should be noted that the short increase in prevention and treatment measures has generated another notable push in 2014. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), before a 2 years interruption from 2002 to 2003, the interventions started in 1997 with the application of therapeutic efficacy tests. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies and therapeutic tests. From this year on, the country experienced relative stability in this pillar. The big push in the implementation of policies of this pillar occurs in 2012, driven by the beginning of the enactment of insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country had stopped carrying out these later.

Summing up, as it is shown in the Table, in 2017 Guinea has implemented: first, regarding Pillar 1, the 27% of prevention policies, 57% of diagnosis, 64% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies and 20% of therapeutic tests. Regarding mortality rate, there has been a continuous decrease between 2004 and 2017.

Guinea: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	10.3	15.1	14.9	11.7	11.4
Malaria death ratio (per 100,000 population)	127.4	169.5	149.2	104.3	96.1
MaPI (Index 0-1)	0.04	0.30	0.35	0.54	0.42
Pillar 1: Intervention	0.04	0.27	0.36	0.50	0.43
Cat 1: Prevention	0.12	0.53	0.53	0.67	0.27
Cat 2: Diagnosis	0.00	0.06	0.29	0.57	0.57
Cat 3: Treatment	0.00	0.24	0.43	0.57	0.64
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.03	0.34	0.33	0.60	0.40
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.01	0.00	0.20	0.20
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.75	0.00

Fig.1: Malaria mortality in Guinea

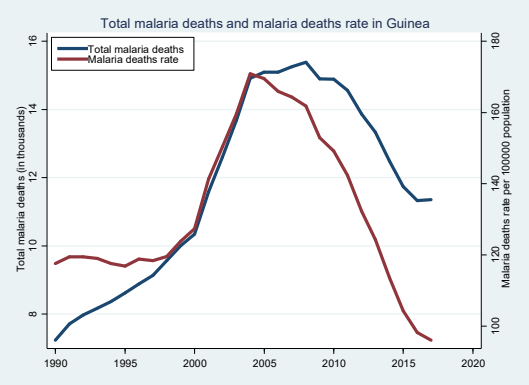


Fig.2: The Malaria Policy Index (MaPI) in Guinea

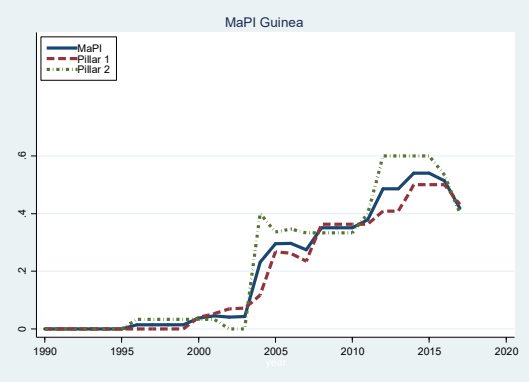


Fig.3: Malaria intervention strategies (Pillar 1) in Guinea

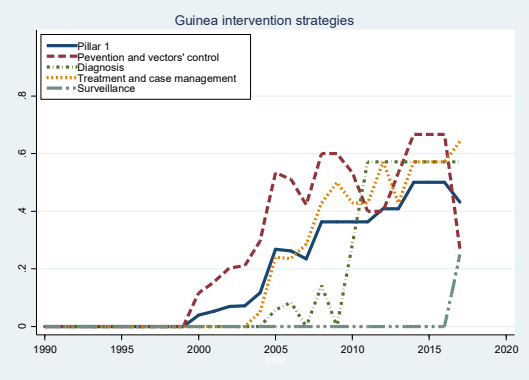
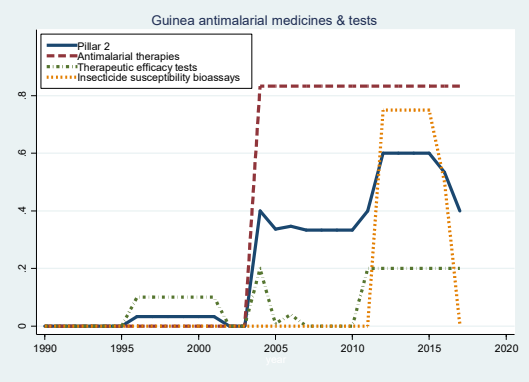


Fig.4: Antimalarial medicines and tests (Pillar 2) in Guinea



Guinea-Bissau

Guinea-Bissau is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the country, with potential epidemics from June to December. Between 2000 and 2017, Guinea-Bissau reduced the incidence of malaria from 295.3 to 58 per 1,000 population at risk and the malaria deaths rate from 94.1 to 12.7 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Guinea-Bissau occupies the queue of the distribution (together with Equatorial Guinea and Togo) in our sample of 44 SSA countries, with a score of 0.35 (Fig.2), following Rwanda, Central African Republic, Cote d'Ivoire and Gabon. In Pillar 1 (Malaria Intervention Strategies), the country ranks 33rd over 44 (with Cote d'Ivoire, Equatorial Guinea, Cameroon and Togo), with a score of 0.41, whereas it occupies the 38th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.27. (as in Togo, Equatorial Guinea, South Africa and Botswana).

Since 2002, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women. From this year on, the country has increased on average its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2003, and diagnosis measures in 2008. The big push in the implementation of Pillar 1 policies occurs in 2008, motivated by this starting of diagnosis measures and also the increase in prevention and vector control and treatment and case management interventions. The country started the implementation of surveillance measures in 2016.

Regarding Pillar 2 (Fig.4), the interventions started in 2001 with the application of therapeutic efficacy tests. After the break from 2002 to 2003, the country restarted the implementation of policies regarding this pillar with antimalarial therapies in 2004, and therapeutic efficacy tests a year after. This pillar remained relatively stable until the decline observed in 2015. The country started the implementation of insecticide susceptibility bioassays tests in 2017, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2016, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Guinea-Bissau has implemented: first, regarding Pillar 1, the 40% of prevention policies, 57% of diagnosis, 43% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2000 and 2017.

Guinea-Bissau: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	1.17	0.42	0.44	0.24	0.23
Malaria death ratio (per 100,000 population)	94.1	30.4	27.7	13.8	12.7
MaPI (Index 0-1)	0.00	0.24	0.32	0.31	0.35
Pillar 1: Intervention	0.00	0.15	0.27	0.30	0.41
Cat 1: Prevention	0.00	0.33	0.40	0.27	0.40
Cat 2: Diagnosis	0.00	0.00	0.29	0.57	0.57
Cat 3: Treatment	0.00	0.13	0.29	0.36	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.00	0.36	0.40	0.33	0.27
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.00	0.07	0.20	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.00

Fig.1: Malaria mortality in Guinea-Bissau

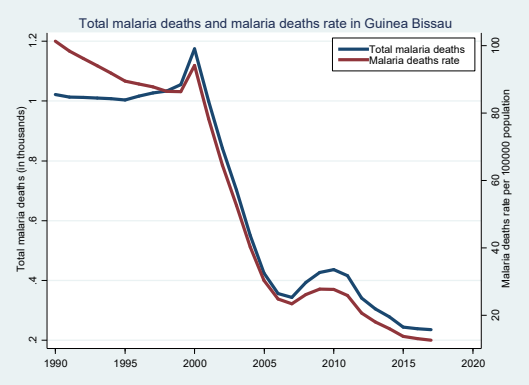


Fig.2: The Malaria Policy Index (MaPI) in Guinea-Bissau

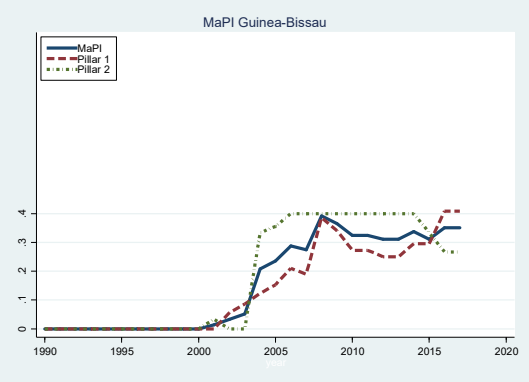


Fig.3: Malaria intervention strategies (Pillar 1) in Guinea-Bissau

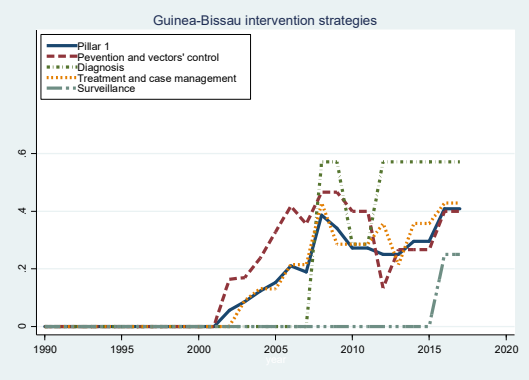
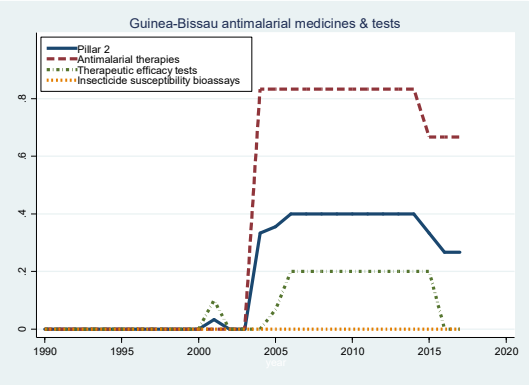


Fig.4: Antimalarial medicines and tests (Pillar 2) in Guinea-Bissau



Kenya

Kenya is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Kenya. Between 2000 and 2017, Kenya reduced the incidence of malaria from 216.7 to 70.8 per 1,000 population at risk and the malaria deaths rate from 50.4 to 9.7 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Kenya occupies the 26th position (together with Gambia) in our sample of 44 SSA countries, with a score of 0.45 (Fig.2), following Cameroon and South Africa and preceding Mauritania, Burundi, Chad and Comoros. In Pillar 1 (Malaria Intervention Strategies), the country ranks 29th over 44 (with Guinea, Sierra Leone and Ghana), with a score of 0.43, whereas it occupies the 18th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.47. (as in Congo, Somalia and Cabo Verde).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies, such as parasitological confirmation to all age groups inpatients. From this year on, and before the relative stability from 2008, the country has gradually increased its policies implementation in this pillar with some punctual impetuses in prevention measures in 2001, and treatment and case management interventions in 2004. The big push in the Pillar 1 policies occurs effectively in 2008, motivated by the important implementation of prevention measures and the increase in diagnosis and treatment and case management measures. The country started the implementation of surveillance measures in 2016.

Regarding Pillar 2 (Fig.4), the interventions started in 1996 with the application of therapeutic efficacy tests. Before the decline of 2012, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. The first big push in the implementation of policies of this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Kenya has implemented: first, regarding Pillar 1, the 53% of prevention policies, 29% of diagnosis, 50% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 75% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1999 and 2017.

Kenya: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	15.6	14.1	4.0	5.5	4.7
Malaria death ratio (per 100,000 population)	50.4	39.7	9.8	11.9	9.7
MaPI (Index 0-1)	0.05	0.29	0.54	0.47	0.45
Pillar 1: Intervention	0.01	0.21	0.41	0.43	0.43
Cat 1: Prevention	0.00	0.53	0.53	0.53	0.53
Cat 2: Diagnosis	0.07	0.08	0.29	0.57	0.29
Cat 3: Treatment	0.00	0.06	0.57	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.10	0.41	0.73	0.53	0.47
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.30	0.24	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.75

Fig.1: Malaria mortality in Kenya

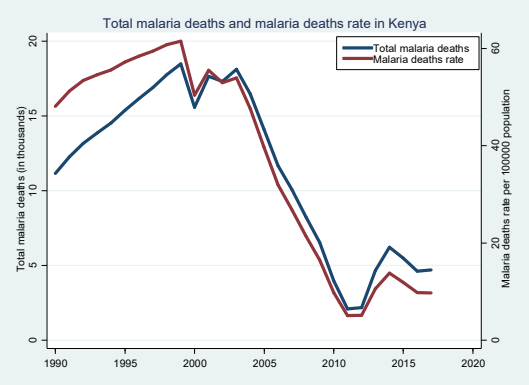


Fig.2: The Malaria Policy Index (MaPI) in Kenya

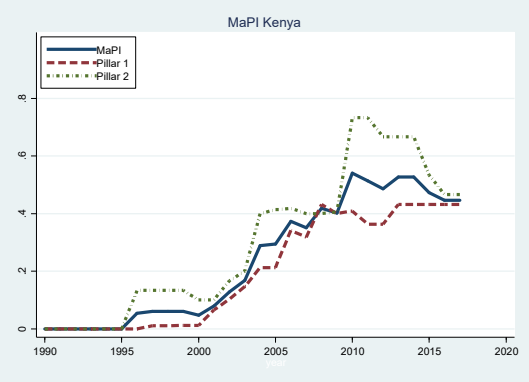


Fig.3: Malaria intervention strategies (Pillar 1) in Kenya

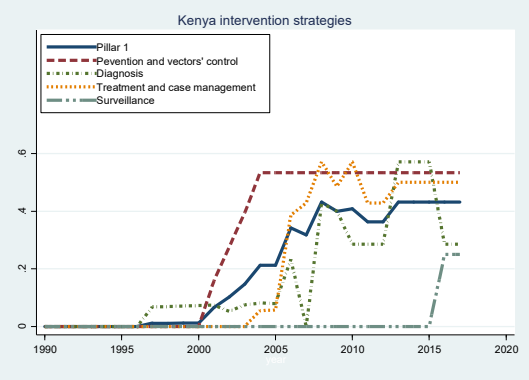
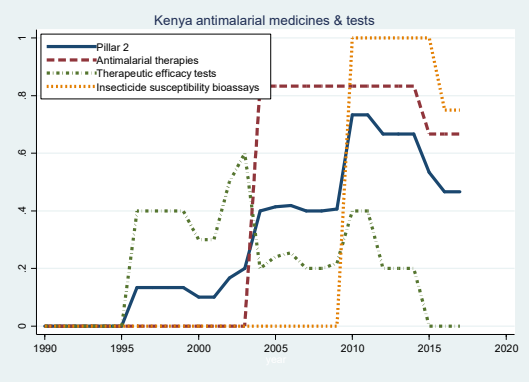


Fig.4: Antimalarial medicines and tests (Pillar 2) in Kenya



Liberia

Liberia is a country with high transmission of malaria. There are no free malaria areas in the country. Malaria transmission is perennial in most of the country, particularly in the central and southern regions, and is intense for most months of the year. Between 2000 and 2017, Liberia reduced the incidence of malaria from 333.5 to 192.6 per 1,000 population at risk and the malaria deaths rate from 141.2 to 59.5 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Liberia occupies the 32nd position (together with Guinea) in our sample of 44 SSA countries, with a score of 0.42 (Fig.2), following Mauritania, Burundi, Chad and Comoros and preceding Eswatini. In Pillar 1 (Malaria Intervention Strategies), the country ranks 23rd over 44 (with Mozambique and Nigeria), with a score of 0.48, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Congo Democratic Republic, Niger, Cote d'Ivoire, Eritrea, Chad, Namibia, Gambia, Tanzania and Sierra Leone).

Since 2001, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IPT to prevent malaria during pregnancy. From this year on, the country has gradually increased its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2004, and diagnosis measures a year later. Thus, the first big push in Pillar 1 occurs this later year, motivated by the starting of these new measures. The second big improvement occurs between 2007 and 2009 following a yearly punctual stop in the implementation of prevention and vector control and diagnosis measures in 2007. The country started the implementation of surveillance measures in 2016.

Regarding Pillar 2 (Fig.4), before the interruptions of 2000 and from 2002 to 2003, the interventions started in 1999 with the application of therapeutic efficacy tests. The country re-engaged the implementation of policies regarding this pillar with antimalarial therapies in 2004, and the re-introduction of therapeutic tests a year after. Before the decline of 2012, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes. The big improvement occurs in 2010, a period in which the country involved in the insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2012, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Liberia has implemented: first, regarding Pillar 1, the 53% of prevention policies, 57% of diagnosis, 50% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 25% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2005 and 2017.

Liberia: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	4.1	5.1	4.6	2.8	2.8
Malaria death ratio (per 100,000 population)	141.2	159.4	112.5	62.1	59.5
MaPI (Index 0-1)	0.00	0.28	0.46	0.47	0.42
Pillar 1: Intervention	0.00	0.24	0.36	0.43	0.48
Cat 1: Prevention	0.00	0.32	0.53	0.53	0.53
Cat 2: Diagnosis	0.00	0.36	0.29	0.57	0.57
Cat 3: Treatment	0.00	0.23	0.43	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.00	0.33	0.60	0.53	0.33
Cat 5: Medicines	0.00	0.67	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.00	0.20	0.20	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.75	1.00	0.25

Fig.1: Malaria mortality in Liberia

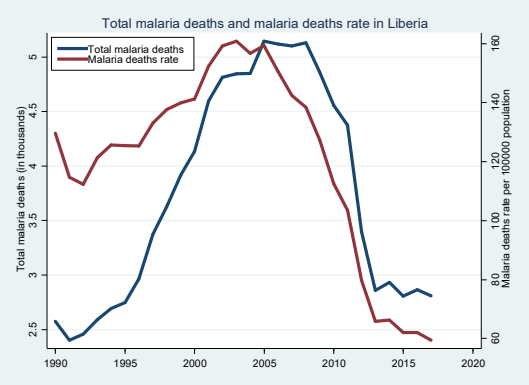


Fig.2: The Malaria Policy Index (MaPI) in Liberia

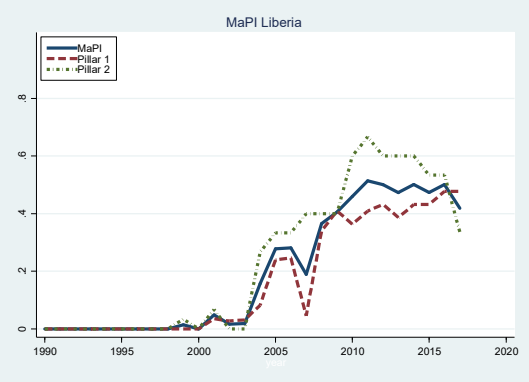


Fig.3: Malaria intervention strategies (Pillar 1) in Liberia

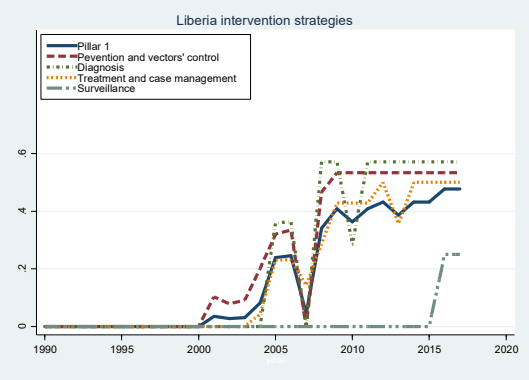
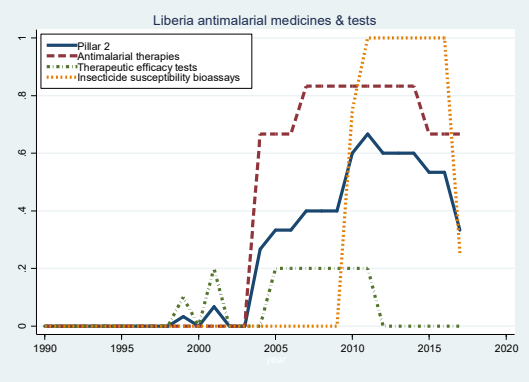


Fig.4: Antimalarial medicines and tests (Pillar 2) in Liberia



Madagascar

Madagascar is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the north of the country, with potential epidemics between September and June elsewhere. Between 2000 and 2017, Madagascar experienced an increase of its incidence of malaria from 57.3 to 90.9 per 1,000 population at risk but reduced the malaria deaths rate from 31.3 to 22.2 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Madagascar occupies the top of the distribution in our sample of 44 SSA countries, with a score of 0.66 (Fig.2), preceding Zimbabwe at the 2nd rank. In Pillar 1 (Malaria Intervention Strategies), the country ranks 4th over 44, with a score of 0.70, whereas it occupies the 2nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.6. (as in Benin, Ghana, Madagascar, Ethiopia and Nigeria).

Since 1993, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies (such as the use of IRS for prevention and control of epidemics) and the surveillance policies (such as the use of active case detection (ACD) at community level of febrile cases (pro-active) or for case investigation (reactive)). From this year on, the country has gradually increased its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 1998, and diagnosis measures in 2006. Thus, the first big push in Pillar 1 occurs between 2004 and 2007, motivated by the starting of this diagnosis measures and the increase in prevention and treatment interventions. The second big improvement occurs in 2017, a period in which all policies and measures rise notably.

Regarding Pillar 2 (Fig.4), the interventions started in 1997 with the application of therapeutic efficacy tests. Before the relative stability of 2010, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. The first big improvement in this pillar occurs in 2003, driven by the beginning of antimalarial therapies. The second big advance occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Madagascar has implemented: first, regarding Pillar 1, the 53% of prevention policies, 57% of diagnosis, 79% of treatment and 100% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2005 and 2017.

Madagascar: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	5.0	10.9	6.0	5.6	5.8
Malaria death ratio (per 100,000 population)	31.3	59.0	28.2	22.8	22.2
MaPI (Index 0-1)	0.08	0.29	0.49	0.62	0.66
Pillar 1: Intervention	0.12	0.24	0.36	0.59	0.70
Cat 1: Prevention	0.29	0.56	0.53	0.53	0.53
Cat 2: Diagnosis	0.00	0.00	0.57	0.57	0.57
Cat 3: Treatment	0.04	0.12	0.29	0.71	0.79
Cat 4: Surveillance	0.03	0.04	0.00	0.50	1.00
Pillar 2: Medicines & tests	0.03	0.38	0.67	0.67	0.60
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.13	0.20	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Madagascar

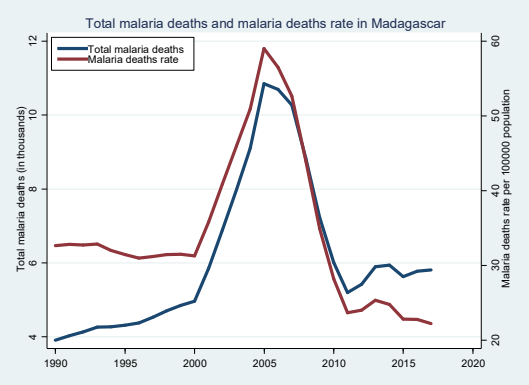


Fig.2: The Malaria Policy Index (MaPI) in Madagascar

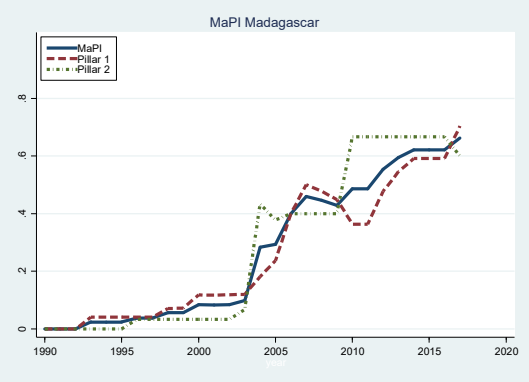


Fig.3: Malaria intervention strategies (Pillar 1) in Madagascar

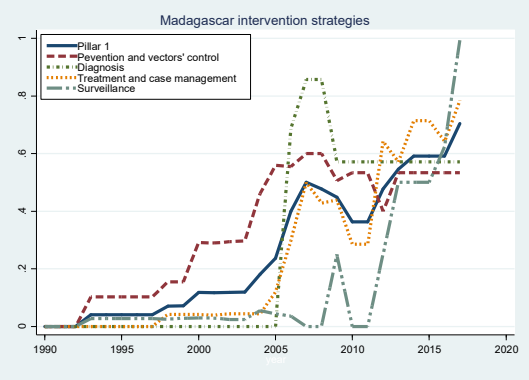
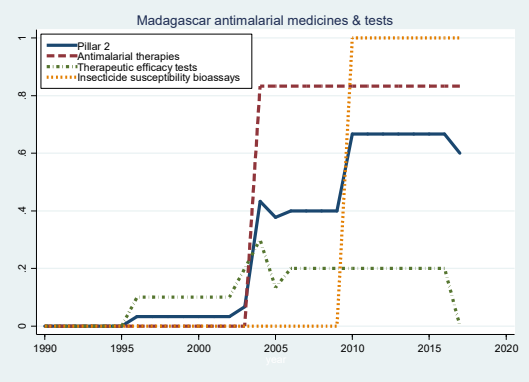


Fig.4: Antimalarial medicines and tests (Pillar 2) in Madagascar



Malawi

Malawi is a country with high transmission of malaria. There are no free malaria areas in the country. Malaria is endemic in all parts of the country. Although transmission occurs year-round, malaria is mainly seasonal in Malawi, with potential epidemics between December and June. Between 2000 and 2017, Malawi reduced the incidence of malaria from 498.5 to 231.1 per 1,000 population at risk and the malaria deaths rate from 154.6 to 40.0 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Malawi occupies the 35th position (together with Sierra Leone and Congo) in our sample of 44 SSA countries, with a score of 0.39 (Fig.2), following Eswatini and preceding Rwanda, Central African Republic, Cote d'Ivoire and Gabon. In Pillar 1 (Malaria Intervention Strategies), the country ranks 38th over 44 (with Sudan), with a score of 0.39, whereas it occupies the 22nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.4. (as in Angola, Central African Republic, Comoros and Guinea).

Since 1993, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IPT to prevent malaria during pregnancy. Before the relative stability of 2012, the country gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2004, and diagnosis measures in 2007. Thus, the big push in Pillar 1 occurs in 2007, motivated by this starting of diagnosis measures and the increase in treatment and case management interventions. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), before a one-year interruption in 2003, the interventions started in 1998 with the application of therapeutic efficacy tests. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies and therapeutic tests a year later. Previously to the relative stability that led to the decline of 2015, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. The big improvement occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Malawi has implemented: first, regarding Pillar 1, the 53% of prevention policies, 28% of diagnosis and 50% of treatment; second, regarding Pillar 2, the 83% of antimalarial therapies and 25% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1994 and 2017.

Malawi: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	17.3	12.1	8.3	7.4	6.9
Malaria death ratio (per 100,000 population)	154.6	95.6	58.1	45.4	40.0
MaPI (Index 0-1)	0.04	0.27	0.49	0.47	0.39
Pillar 1: Intervention	0.04	0.13	0.32	0.39	0.39
Cat 1: Prevention	0.11	0.33	0.53	0.53	0.53
Cat 2: Diagnosis	0.00	0.00	0.00	0.29	0.29
Cat 3: Treatment	0.00	0.05	0.43	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.03	0.47	0.73	0.60	0.40
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.40	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.25

Fig.1: Malaria mortality in Malawi

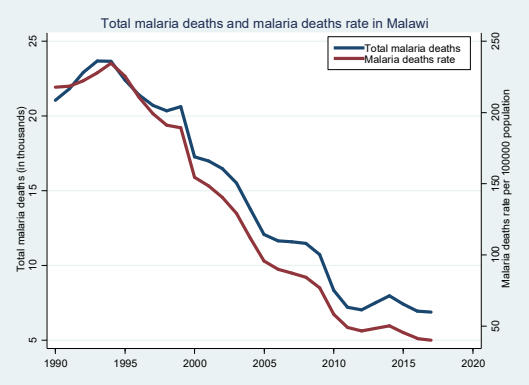


Fig.2: The Malaria Policy Index (MaPI) in Malawi

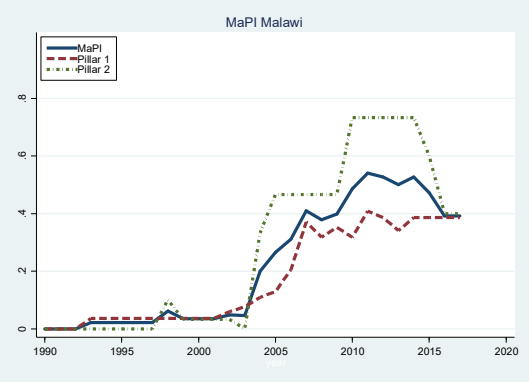


Fig.3: Malaria intervention strategies (Pillar 1) in Malawi

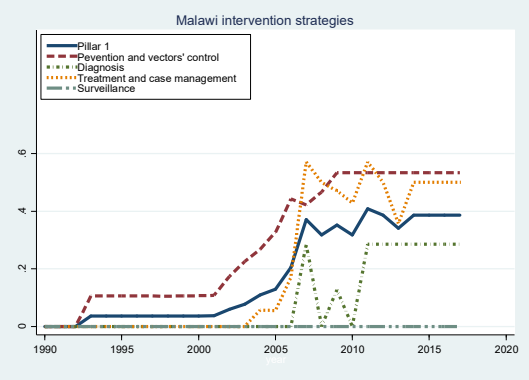
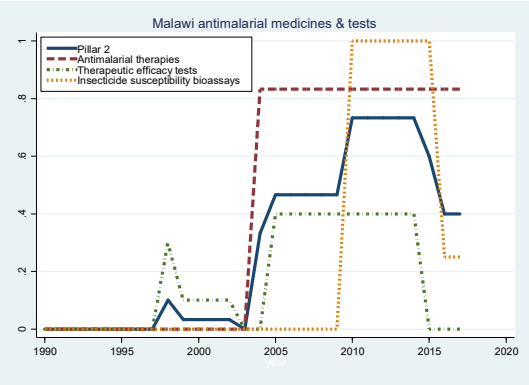


Fig.4: Antimalarial medicines and tests (Pillar 2) in Malawi



Mali

Mali is a country with very high transmission of malaria. There are no free malaria areas in the country. While the entire population is at risk, over 90% of the population live in high-transmission areas. Although transmission occurs year-round, malaria is mainly seasonal, with more intensity and potential epidemics in the southern part of the country. Between 2000 and 2017, Mali reduced the incidence of malaria from 405.4 to 386.2 per 1,000 population at risk and the malaria deaths rate from 177.6 to 123.8 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Mali occupies the 10th position (together with Angola, Somalia, Tanzania and Benin) in our sample of 44 SSA countries, with a score of 0.51 (Fig.2), following Uganda and Nigeria and preceding Sudan, Mozambique and Ghana. In Pillar 1 (Malaria Intervention Strategies), the country ranks 20th over 44 (with Chad and Cabo Verde), with a score of 0.73, whereas it occupies the 7th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zimbabwe, Rwanda, Gabon, Cameroon, Burundi, Uganda, Senegal, Zambia, Mozambique and Burkina Faso).

Since 1993, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of treatment and case management policies, such as the routinely admission of uncomplicated P. falciparum cases. In 1997, the country established diagnosis policies, such as parasitological confirmation to all age groups inpatients. The establishment of prevention and vector control policies occurred in 2000. However, the first big push in the implementation of Pillar 1 policies occurs from 2006 to 2008, motivated by the increase in all these groups. The second big improvement occurs in 2012, a period in which the country really engaged in surveillance policies after its punctual introduction in 2009.

Regarding Pillar 2 (Fig.4), the interventions started in 1996 with the application of therapeutic efficacy tests. Before the relative stability that led to the decline of 2015, the country steadily increased this sort of policies implementation with some prompt pushes in the implementation of more antimalarial measures. Thus, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country carried out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Mali has implemented: first, regarding Pillar 1, the 53% of prevention policies, 57% of diagnosis, 43% of treatment and 50% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies and 75% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2005 and 2010.

Mali: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	19.6	28.4	27.8	30.6	25.1
Malaria death ratio (per 100,000 population)	177.6	215.7	174.9	162.4	123.8
MaPI (Index 0-1)	0.04	0.31	0.46	0.51	0.51
Pillar 1: Intervention	0.05	0.24	0.32	0.45	0.50
Cat 1: Prevention	0.05	0.40	0.40	0.53	0.53
Cat 2: Diagnosis	0.11	0.31	0.57	0.57	0.57
Cat 3: Treatment	0.04	0.17	0.29	0.43	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.25	0.50
Pillar 2: Medicines & tests	0.03	0.42	0.67	0.60	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.25	0.20	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.75

Fig.1: Malaria mortality in Mali

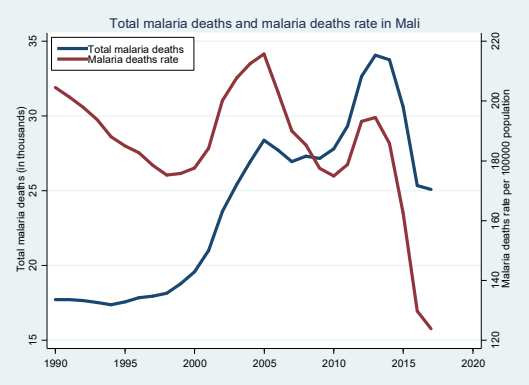


Fig.2: The Malaria Policy Index (MaPI) in Mali

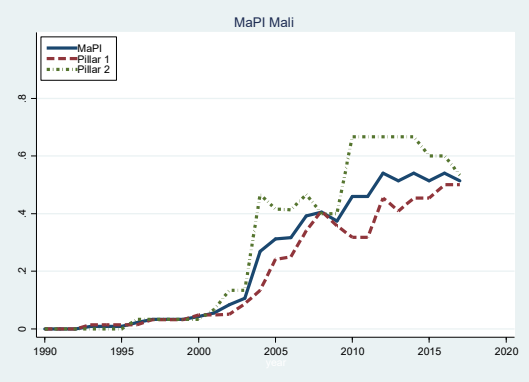


Fig.3: Malaria intervention strategies (Pillar 1) in Mali

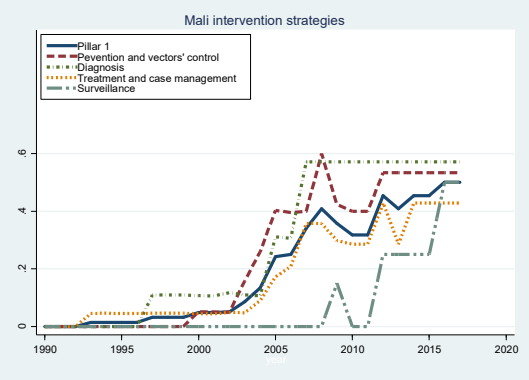
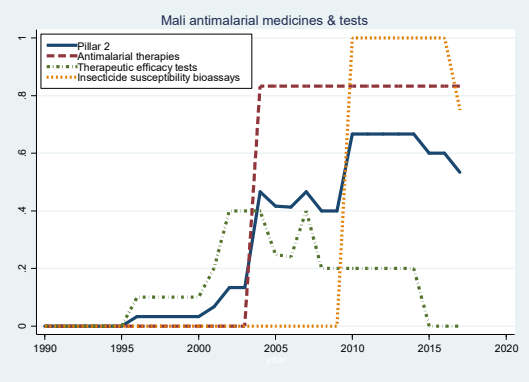


Fig.4: Antimalarial medicines and tests (Pillar 2) in Mali



Mauritania

Mauritania is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is greatly seasonal in the south of the country, with potential epidemics. Between 2000 and 2017, Mauritania reduced the incidence of malaria from 62 to 53.9 per 1,000 population at risk and the malaria deaths rate from 10.6 to 6.9 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Mauritania occupies the 28th position (together with Burundi, Chad and Comoros) in our sample of 44 SSA countries, with a score of 0.43 (Fig.2), following Kenya and Gambia and preceding Liberia and Guinea. In Pillar 1 (Malaria Intervention Strategies), the country ranks 8th over 44 (with South Africa and Angola), with a score of 0.59, whereas it shares the queue of the distribution with Mauritania in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.2.

Since 1998, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the free distribution of ITNs/LLINs through antenatal care programs. The implementation of Pillar 1 policies experienced an increase from the beginning with more push in prevention measures and also at the starting of treatment and case management measures in 2004, and diagnosis measures in 2009. However, the big push in Pillar 1 occurs in 2012, motivated by the increase in prevention and vector control, diagnosis and treatment and case management interventions and the starting of diagnosis measures.

Regarding Pillar 2 (Fig.4), the interventions started in 1998 with the application of therapeutic efficacy tests. After this punctual implementation, in 2004, the country restarted the implementation of Pillar 2 policies with antimalarial therapies, and therapeutic efficacy tests in 2005, which were carried out for 3 consecutive years. From this year on, this pillar remained relatively stable with insignificant peaks reflecting some punctual and yearly isolated policies implementation. The country started a punctual enactment of insecticide bioassays tests in 2015., which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1).

Summing up, as it is shown in the Table, in 2017 Mauritania has implemented: first, regarding Pillar 1, the 53% of prevention policies, 71% of diagnosis, 71% of treatment and 38% of surveillance policies; second, regarding Pillar 2, the 50% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2005 and 2017.

Mauritania: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.28	0.48	0.23	0.27	0.27
Malaria death ratio (per 100,000 population)	10.6	16.2	6.9	7.3	6.9
MaPI (Index 0-1)	0.04	0.14	0.30	0.46	0.43
Pillar 1: Intervention	0.07	0.10	0.36	0.50	0.59
Cat 1: Prevention	0.19	0.24	0.40	0.40	0.53
Cat 2: Diagnosis	0.00	0.00	0.57	0.71	0.71
Cat 3: Treatment	0.00	0.05	0.43	0.71	0.71
Cat 4: Surveillance	0.00	0.00	0.00	0.13	0.38
Pillar 2: Medicines & tests	0.00	0.20	0.20	0.40	0.20
Cat 5: Medicines	0.00	0.50	0.50	0.50	0.50
Cat 6: Therapeutic tests	0.00	0.01	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.75	0.00

Fig.1: Malaria mortality in Mauritania

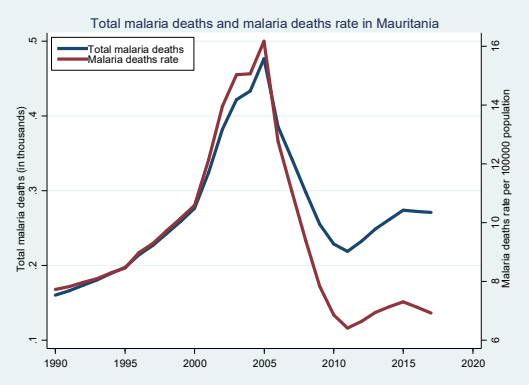


Fig.2: The Malaria Policy Index (MaPI) in Mauritania

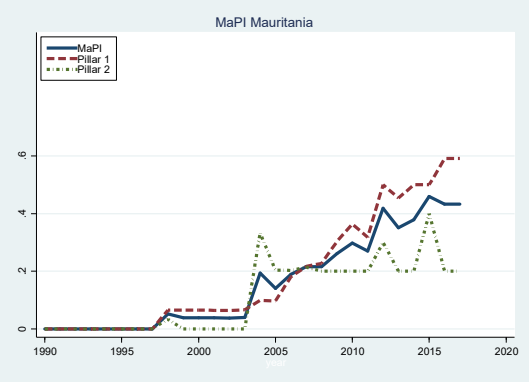


Fig.3: Malaria intervention strategies (Pillar 1) in Mauritania

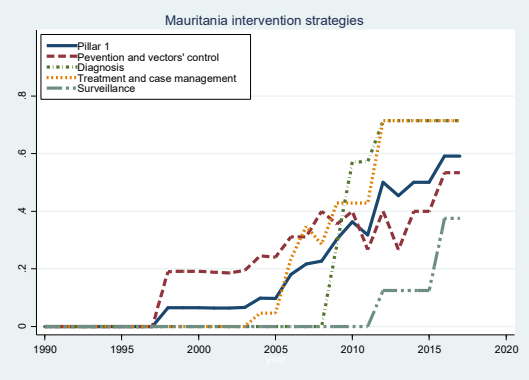
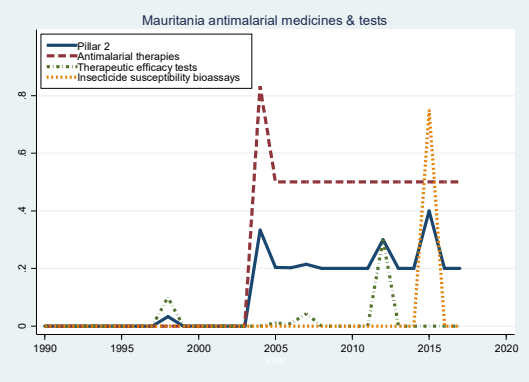


Fig.4: Antimalarial medicines and tests (Pillar 2) in Mauritania



Mozambique

Mozambique is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in Mozambique, with potential epidemics from November to July. Mozambique accounted for 5% of all estimated malaria cases worldwide in 2017. Between 2000 and 2017, Mozambique reduced the incidence of malaria from 457.4 to 337.9 per 1,000 population at risk and the malaria deaths rate from 189.2 to 61.3 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Mozambique occupies the 15th position (together with Sudan and Ghana) in our sample of 44 SSA countries, with a score of 0.50 (Fig.2), following Angola, Somalia, Mali, Tanzania and Benin and preceding Sao Tome and Principe. In Pillar 1 (Malaria Intervention Strategies), the country ranks 23rd over 44 (with Liberia and Nigeria), with a score of 0.48, whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zimbabwe, Rwanda, Gabon, Cameroon, Burundi, Uganda, Senegal, Zambia, Mali, Burkina Faso).

Since 1992, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics and the distribution of ITNs/LLINs to all age groups. From this year to 2008, the country gradually increased its policies implementation in this pillar with some punctual impetuses in r treatment and case management interventions in 2002, and diagnosis measures in 2005.Pillar 1 remained relatively constant after a big push from 2003 to 2008 which was motivated by the increase in prevention, diagnosis and treatment interventions. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), before a one-year interruption in 2003, the country started the implementation of surveillance measures in 1998. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies. Before the decline of 2014, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. The big push in this pillar occurs from 2009 to 2011, a period in which the country quickly rose from 75% to 100% the insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2016, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Mozambique has implemented: first, regarding Pillar 1, only the 67% of prevention policies, 57% of diagnosis and 50% of treatment; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1990 and 2017.

Mozambique: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	32.8	28.1	24.2	19.6	18.4
Malaria death ratio (per 100,000 population)	189.2	141.6	103.2	70.1	61.3
MaPI (Index 0-1)	0.05	0.39	0.51	0.50	0.50
Pillar 1: Intervention	0.04	0.40	0.50	0.48	0.48
Cat 1: Prevention	0.12	0.67	0.67	0.67	0.67
Cat 2: Diagnosis	0.00	0.21	0.57	0.57	0.57
Cat 3: Treatment	0.00	0.42	0.57	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.07	0.37	0.53	0.53	0.53
Cat 5: Medicines	0.00	0.74	0.67	0.50	0.67
Cat 6: Therapeutic tests	0.20	0.23	0.20	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.75	1.00	1.00

Fig.1: Malaria mortality in Mozambique

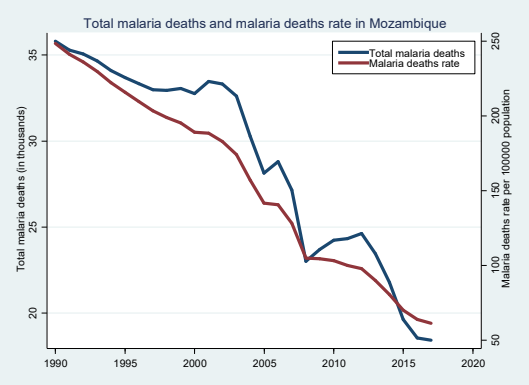


Fig.2: The Malaria Policy Index (MaPI) in Mozambique

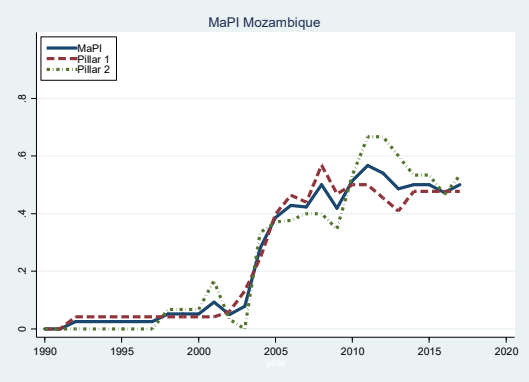


Fig.3: Malaria intervention strategies (Pillar 1) in Mozambique

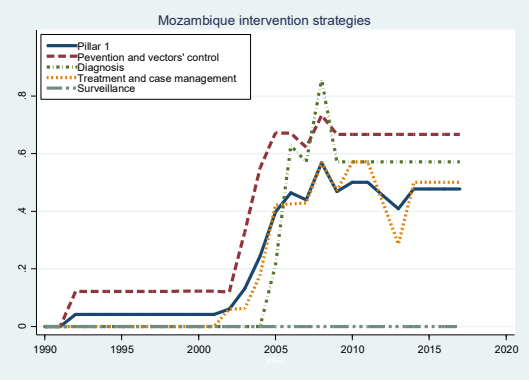
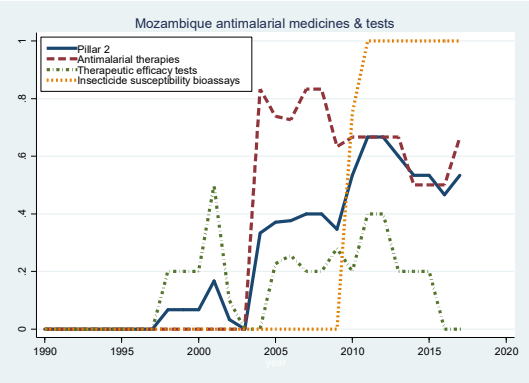


Fig.4: Antimalarial medicines and tests (Pillar 2) in Mozambique



Namibia

Namibia is a country with intermediate transmission of malaria. Free malaria areas represent 21% of the country. Malaria transmission is confined to the north-east part of Namibia where malaria is endemic and about 72% of the population of the country is at risk, while the rest of the population lives in malaria-free areas. Between 2000 and 2017, Namibia reduced the incidence of malaria from 70.7 to 44.6 per 1,000 population at risk and slightly the already low malaria deaths rate from 0.7 to 0.3 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Namibia occupies the 3rd position (together with Senegal) in our sample of 44 SSA countries, with a score of 0.61 (Fig.2), following Zimbabwe and preceding Ethiopia. In Pillar 1 (Malaria Intervention Strategies), the country is at the top of the distribution, with a score of 0.8, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Cote d'Ivoire, Eritrea, Chad, Namibia, Gambia, Tanzania and Sierra Leone).

Since 1965, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics and the use of DDT for IRS in public health. These engagements remained relatively stable until 1997, when the country started increasing gradually its policies implementation in this pillar, following the first diversification of 1990 with the implementation of diagnosis policies. Thus, the first big push in the implementation of Pillar 1 policies occurs from 2006 to 2008, motivated by the increase in prevention and vector control and treatment and case management interventions. The second big improvement occurs from 2012, a period in which the country started to implement surveillance policies and experienced a notable rise in all other policies and measures.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 1997. From this particular year, the country started to carry out therapeutic efficacy tests. Before the relative stability that led to the decline of 2015, probably due to the break in insecticide tests, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes. Thus, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2004, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Namibia has implemented: first, regarding Pillar 1, the 80% of prevention policies, 57% of diagnosis, 79% of treatment and 100% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies. Regarding mortality rate, there has been a continuous slight decrease between 2000 and 2017.

Namibia: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.012	0.010	0.008	0.008	0.008
Malaria death ratio (per 100,000 population)	0.67	0.48	0.38	0.35	0.35
MaPI (Index 0-1)	0.18	0.34	0.43	0.51	0.61
Pillar 1: Intervention	0.26	0.38	0.36	0.64	0.80
Cat 1: Prevention	0.57	0.55	0.53	0.80	0.80
Cat 2: Diagnosis	0.39	0.56	0.29	0.57	0.57
Cat 3: Treatment	0.00	0.31	0.43	0.71	0.79
Cat 4: Surveillance	0.00	0.00	0.00	0.25	1.00
Pillar 2: Medicines & tests	0.07	0.29	0.53	0.33	0.33
Cat 5: Medicines	0.00	0.73	1.00	0.83	0.83
Cat 6: Therapeutic tests	0.20	0.00	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.50	0.00	0.00

Fig.1: Malaria mortality in Namibia

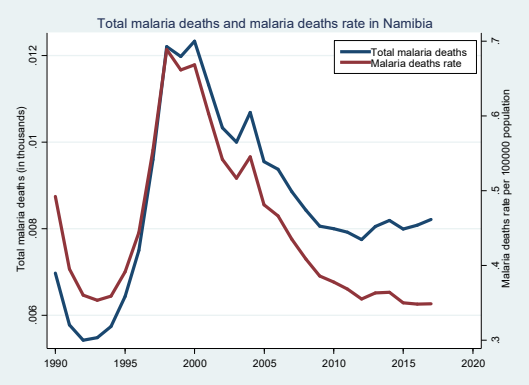


Fig.2: The Malaria Policy Index (MaPI) in Namibia

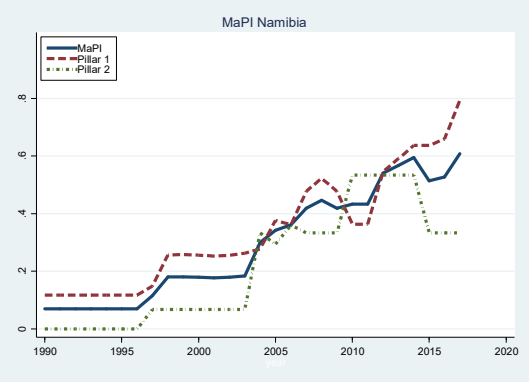


Fig.3: Malaria intervention strategies (Pillar 1) in Namibia

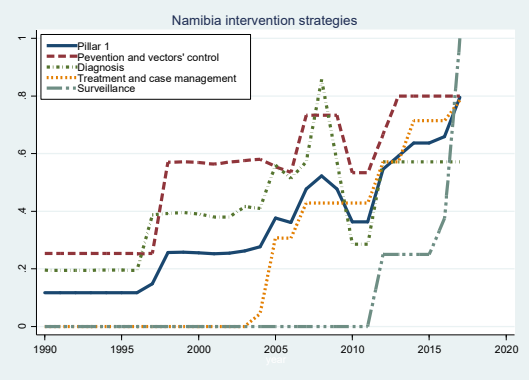
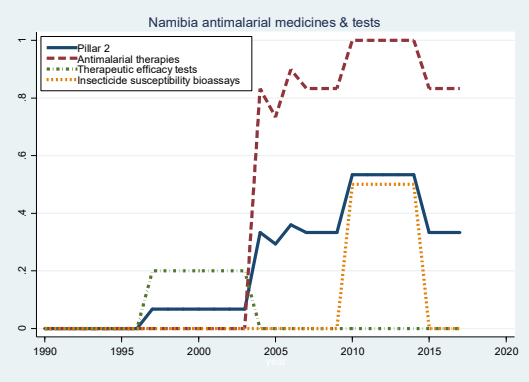


Fig.4: Antimalarial medicines and tests (Pillar 2) in Namibia



Niger

Niger is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in most parts of the country. Thus, malaria transmission is more intensive in the south, the desert areas in the north are malaria-free. Between 2000 and 2017, Niger experienced an increase of its incidence of malaria from 316.7 to 358.7 per 1,000 population at risk but has reduced the malaria deaths rate from 158.2 to 142.6 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Niger occupies the 21st position (together with Congo Democratic Republic and Eritrea) in our sample of 44 SSA countries, with a score of 0.47 (Fig.2), following Burkina Faso and Cabo Verde and preceding Cameroon and South Africa. In Pillar 1 (Malaria Intervention Strategies), the country ranks 11th over 44 (with Congo Democratic Republic and Eritrea), with a score of 0.73, whereas it occupies the 28th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Cote d'Ivoire, Eritrea, Chad, Namibia, Gambia, Tanzania and Sierra Leone).

Since 1998, the country engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies (such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women) and diagnosis policies (such as parasitological confirmation to all age groups inpatients). From this year on, the country has gradually increased its policies implementation in this pillar until 2008, before experiencing a decline due to the decrease in treatment measures. However, after another decline in 2011 a big improvement in the implementation of Pillar 1 policies occurs motivated by the rise in all policies and measures already implemented. The country started the implementation of surveillance measures in 2016.

Regarding Pillar 2 (Fig.4), before a 2 years interruption from 2002 to 2003, the interventions started in 1998 with the application of therapeutic efficacy tests. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies before continuing a year later with therapeutic tests. From this year on, policies implementation in this pillar remained relatively stable with an isolated peak in 2013, due to a quick and single yearly punctual execution of insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2012, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Niger has implemented: first, regarding Pillar 1, the 80% of prevention policies, 57% of diagnosis, 50% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2011 and 2017.

Niger: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	17.8	24.4	33.5	33.4	30.5
Malaria death ratio (per 100,000 population)	158.2	179.9	204.4	168.6	142.6
MaPI (Index 0-1)	0.09	0.34	0.32	0.43	0.47
Pillar 1: Intervention	0.13	0.31	0.27	0.50	0.57
Cat 1: Prevention	0.13	0.42	0.40	0.80	0.80
Cat 2: Diagnosis	0.27	0.40	0.29	0.57	0.57
Cat 3: Treatment	0.14	0.31	0.29	0.43	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.03	0.39	0.40	0.33	0.33
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.17	0.20	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.00

Fig.1: Malaria mortality in Niger

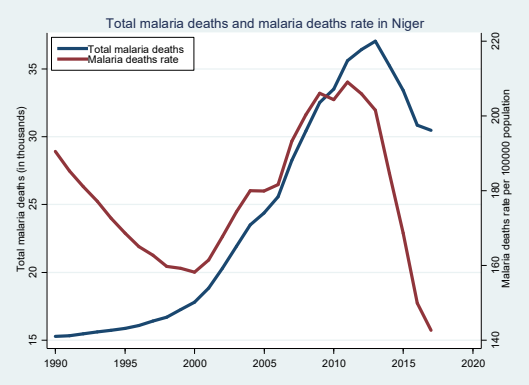


Fig.2: The Malaria Policy Index (MaPI) in Niger

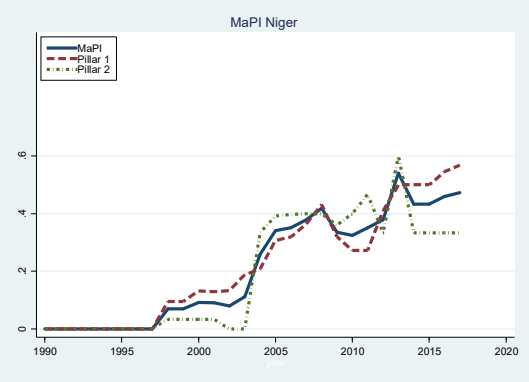


Fig.3: Malaria intervention strategies (Pillar 1) in Niger

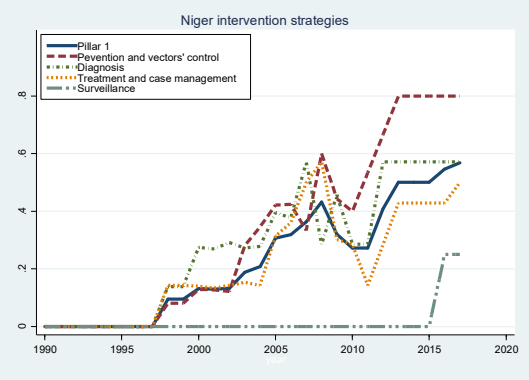
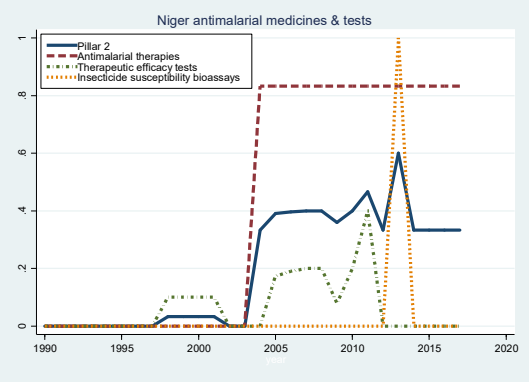


Fig.4: Antimalarial medicines and tests (Pillar 2) in Niger



Nigeria

Nigeria is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in most parts of the country, with potential epidemics during the rainy season (April to October). Nigeria accounted for one fourth of all estimated malaria cases worldwide in 2017. Transmission occurs all year round in the south but is more seasonal in the north. Between 2000 and 2017, Nigeria reduced the incidence of malaria from 378.3 to 281.2 per 1,000 population at risk and the malaria deaths rate from 164.5 to 73.9 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Nigeria occupies the 8th position (together with Uganda) in our sample of 44 SSA countries, with a score of 0.53 (Fig.2), following Zambia and Botswana and preceding Angola, Somalia, Mali, Tanzania and Benin. In Pillar 1 (Malaria Intervention Strategies), the country ranks 23rd over 44 (with Mozambique and Liberia), with a score of 0.48, whereas it occupies the 2nd place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.6. (as in Benin, Ghana, Madagascar and Ethiopia).

Since 1997, the country engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment diagnosis policies (such as parasitological confirmation for all inpatients) and treatment and case management policies (such as the oversight regulation of case management in the private sectors). From this year on, the country has gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses in prevention measures in 2001. However, the big push in Pillar 1 occurs between 2005 and 2007, motivated by the important increase in diagnosis and treatment and case management interventions. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), the interventions started in 1998 with the application of therapeutic efficacy tests. Before the relative stability from 2012, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. The first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country carried out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Nigeria has implemented: first, regarding Pillar 1, the 80% of prevention policies, 29% of diagnosis and 50% of treatment; second, regarding Pillar 2, the 83% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2003 and 2017.

Nigeria: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	200.4	229.5	209.3	181.7	152.2
Malaria death ratio (per 100,000 population)	164.5	161.1	125.8	93.6	73.9
MaPI (Index 0-1)	0.04	0.28	0.51	0.55	0.53
Pillar 1: Intervention	0.04	0.16	0.36	0.52	0.48
Cat 1: Prevention	0.00	0.36	0.53	0.80	0.80
Cat 2: Diagnosis	0.10	0.09	0.29	0.57	0.29
Cat 3: Treatment	0.06	0.06	0.43	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.03	0.45	0.73	0.60	0.60
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.35	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Nigeria

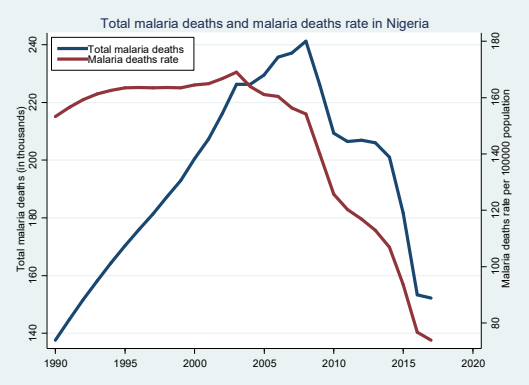


Fig.2: The Malaria Policy Index (MaPI) in Nigeria

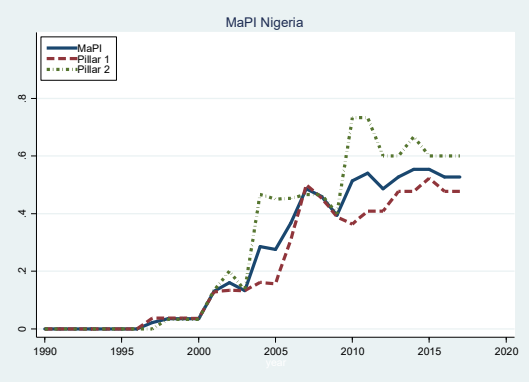


Fig.3: Malaria intervention strategies (Pillar 1) in Nigeria

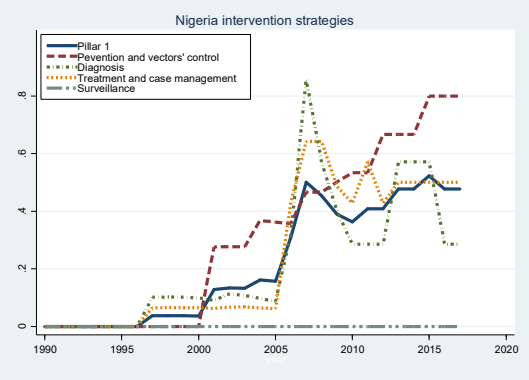
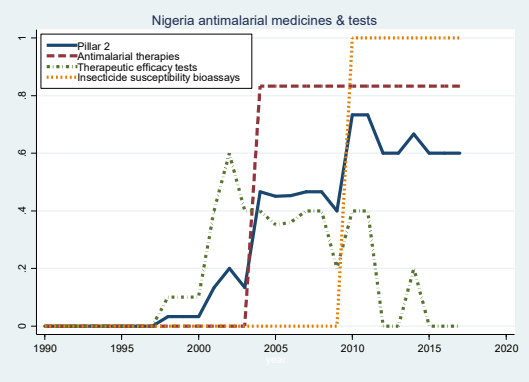


Fig.4: Antimalarial medicines and tests (Pillar 2) in Nigeria



Rwanda

Rwanda is a country with high transmission of malaria. There are no free malaria areas in the country. The entire population of Rwanda is at risk of malaria. Although transmission occurs all year-round, malaria is mainly seasonal and more intense in the eastern and southwest parts of the country. Between 2000 and 2017, Rwanda experienced an increase in its incidence of malaria from 131.6 to 505.6 per 1,000 population at risk but reduced the malaria deaths rate from 108.5 to 24.3 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Rwanda occupies the 38th position (together with Central African Republic, Cote d'Ivoire and Gabon) in our sample of 44 SSA countries, with a score of 0.38 (Fig.2), following Sierra Leone, Congo and Malawi and preceding Equatorial Guinea, Guinea-Bissau and Togo. In Pillar 1 (Malaria Intervention Strategies), the country shared the queue of the distribution with Gabon (with a score of 0.27), whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zimbabwe, Gabon, Cameroon, Burundi, Uganda, Senegal, Zambia, Mozambique, Mali, Burkina Faso).

Since 1998, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics. Before the decline of 2009, the country gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2001, and diagnosis measures in 2006. However, the big push in Pillar 1 occurs between 2005 and 2007, motivated by the increase in prevention and treatment interventions and the starting and rapid increase in the enactment of diagnosis measures. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), before a one-year interruption in 2003, the interventions started in 1997 with the application of therapeutic efficacy tests. In 2004, the country re-engaged the implementation of policies regarding this pillar with antimalarial therapies and therapeutic tests. From this year on, the country has steadily increased its policies implementation on the yearly base with some prompt pushes. Thus, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs from 2010, a period in which the country involved in the enactment of the insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2010, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Rwanda has implemented: first, regarding Pillar 1, the 27% of prevention policies, 29% of diagnosis and 43% of treatment; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1993 and 2017.

Rwanda: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	8.8	2.0	2.2	2.4	3.1
Malaria death ratio (per 100,000 population)	108.5	21.6	21.6	20.5	24.3
MaPI (Index 0-1)	0.07	0.24	0.38	0.38	0.38
Pillar 1: Intervention	0.04	0.15	0.27	0.27	0.27
Cat 1: Prevention	0.13	0.33	0.27	0.40	0.27
Cat 2: Diagnosis	0.00	0.00	0.57	0.29	0.29
Cat 3: Treatment	0.00	0.12	0.29	0.29	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.10	0.38	0.53	0.53	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.30	0.14	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.75	1.00	1.00

Fig.1: Malaria mortality in Rwanda

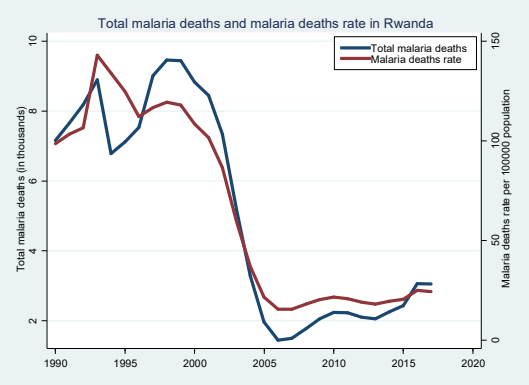


Fig.2: The Malaria Policy Index (MaPI) in Rwanda

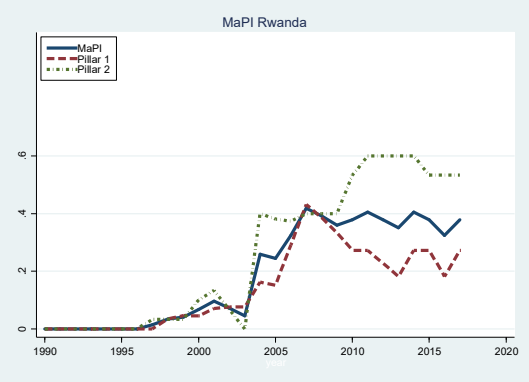


Fig.3: Malaria intervention strategies (Pillar 1) in Rwanda

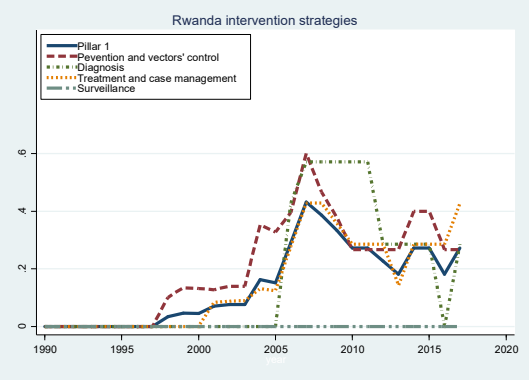
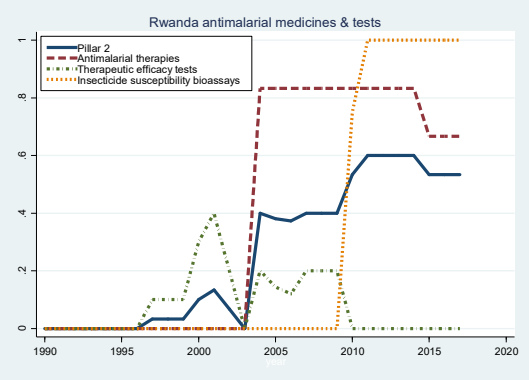


Fig.4: Antimalarial medicines and tests (Pillar 2) in Rwanda



Sao Tome and Principe

Sao Tome and Principe is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the country, with potential epidemics during the rainy season (November to May). Between 2000 and 2017, Sao Tome and Principe reduced the incidence of malaria from 230.7 to 11 per 1,000 population at risk and the relatively low malaria deaths rate from 4.3 to 0.2 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Sao Tome and Principe occupies the 18th position (together with Burkina Faso and Cabo Verde) in our sample of 44 SSA countries, with a score of 0.50 (Fig.2), following Sudan, Mozambique and Ghana and preceding Congo Democratic Republic, Niger and Eritrea. In Pillar 1 (Malaria Intervention Strategies), the country ranks 7th over 44 with a score of 0.60, whereas it occupies the 27th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.35.

Since 2001, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies such as the distribution of ITNs/LLINs through mass campaigns, and diagnosis policies such as parasitological confirmation to all age groups inpatients. From this year on, the country has gradually increased its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2003, and surveillance measures in 2012. Thus, the first big push in the implementation of Pillar 1 policies occurs in 2003, motivated by this starting of treatment and case management interventions and the increase in other implemented measures. The second big improvement occurs in 2013, a period in which all policies and measures rise notably.

Regarding Pillar 2 (Fig.4), the interventions started in 2004 with the application of therapeutic efficacy tests. From this year on, the policies implementation remained constant until 2013. In 2014, the country started implementing insecticide susceptibility bioassays tests slowly, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country has stopped carrying out insecticide bioassays tests.

Summing up, as it is shown in the Table, in 2017 Sao Tome and Principe has implemented: first, regarding Pillar 1, the 61% of prevention policies,66% of diagnosis, 60% of treatment and 50% of surveillance policies; second, regarding Pillar 2, the 77% of antimalarial therapies and 17% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2002 and 2017.

Sao Tome & Principe: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.006	0.001	0.001	0.001	0.000
Malaria death ratio (per 100,000 population)	4.33	0.60	0.30	0.27	0.24
MaPI (Index 0-1)	0.00	0.33	0.35	0.51	0.50
Pillar 1: Intervention	0.00	0.33	0.36	0.64	0.60
Cat 1: Prevention	0.00	0.51	0.40	0.67	0.61
Cat 2: Diagnosis	0.00	0.18	0.29	0.57	0.66
Cat 3: Treatment	0.00	0.41	0.57	0.71	0.60
Cat 4: Surveillance	0.00	0.00	0.00	0.50	0.50
Pillar 2: Medicines & tests	0.00	0.33	0.33	0.33	0.35
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.77
Cat 6: Therapeutic tests	0.00	0.00	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.25	0.17

Fig.1: Malaria mortality in Sao Tome and Principe

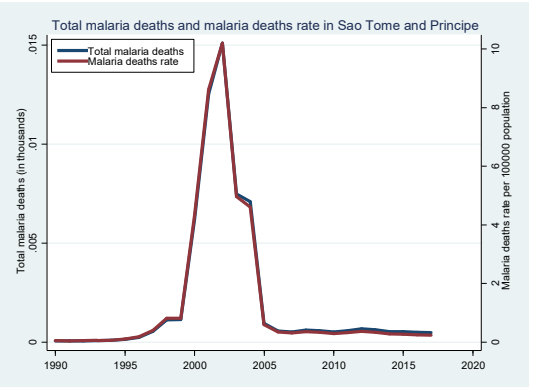


Fig.2: The Malaria Policy Index (MaPI) in Sao Tome and Principe

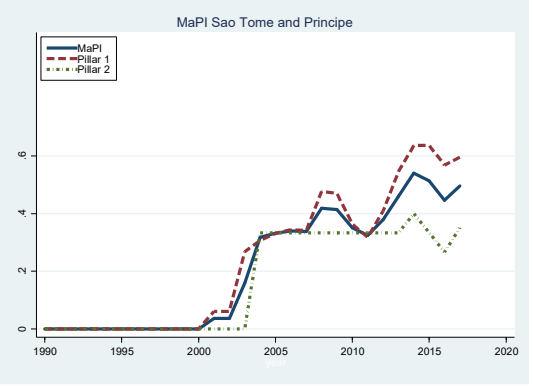


Fig.3: Malaria intervention strategies (Pillar 1) in Sao Tome and Principe

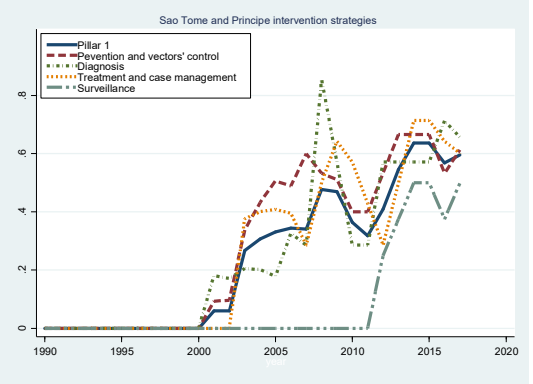
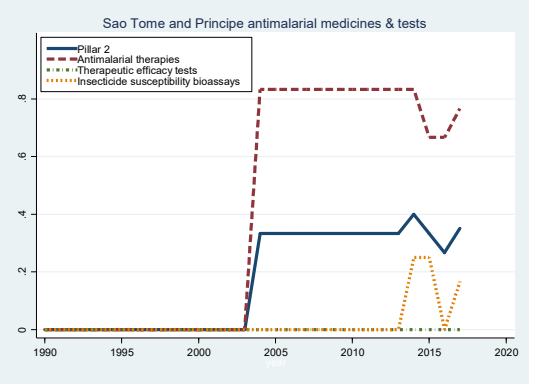


Fig.4: Antimalarial medicines and tests (Pillar 2) in Sao Tome and Principe



Senegal

Senegal is a country with high transmission of malaria. There are no free malaria areas in the country. Malaria is endemic throughout the country. Although transmission occurs year-round, malaria is mainly seasonal in Senegal, with potential epidemics during the rainy season (June to November). Between 2000 and 2017, Senegal reduced the incidence of malaria from 184.8 to 64.6 per 1,000 population at risk and the malaria deaths rate from 89.1 to 14.6 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Senegal occupies the 3rd position (together with Namibia) in our sample of 44 SSA countries, with a score of 0.61 (Fig.2), following Zimbabwe and preceding Ethiopia. In Pillar 1 (Malaria Intervention Strategies), the country ranks 5th over 44 with a score of 0.66, whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zimbabwe, Rwanda, Gabon, Cameroon, Burundi, Uganda, Zambia, Mozambique, Mali and Burkina Faso).

Since 1998, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies such as the distribution of ITNs/LLINs through mass campaigns to children under 5 years and pregnant women. From this year on, the country has gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses. Thus, the first big push in the implementation of Pillar 1 policies occurs in 2007, motivated by the increase in diagnosis measures and, to a lesser extent, in prevention and vector control and treatment and case management interventions. The second big improvement occurs in 2013, a period in which all policies and measures rise notably. The country started the implementation of surveillance measures in 2012.

Regarding Pillar 2 (Fig.4), the interventions started in 1996 with the application of therapeutic efficacy tests. Before the relative stability that led to the decline of 2015, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. Thus, the first big increase in this pillar occurs in 2004, when the country started to implement antimalarial therapies measures. In 2010, the country experienced the second large increase in Pillar 2 due to the establishment of insecticide bioassays tests which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Senegal has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, 71% of treatment and 63% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1990 and 2017.

Senegal: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	8.8	5.9	4.8	2.1	2.1
Malaria death ratio (per 100,000 population)	89.1	53.0	38.3	14.9	14.6
MaPI (Index 0-1)	0.11	0.34	0.51	0.55	0.61
Pillar 1: Intervention	0.15	0.29	0.36	0.57	0.66
Cat 1: Prevention	0.31	0.56	0.53	0.67	0.67
Cat 2: Diagnosis	0.22	0.21	0.57	0.57	0.57
Cat 3: Treatment	0.04	0.20	0.29	0.57	0.71
Cat 4: Surveillance	0.00	0.00	0.00	0.38	0.63
Pillar 2: Medicines & tests	0.03	0.41	0.73	0.53	0.53
Cat 5: Medicines	0.00	0.67	0.67	0.67	0.67
Cat 6: Therapeutic tests	0.10	0.44	0.60	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Senegal

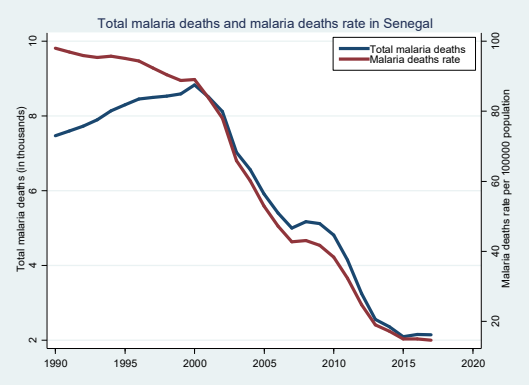


Fig.2: The Malaria Policy Index (MaPI) in Senegal

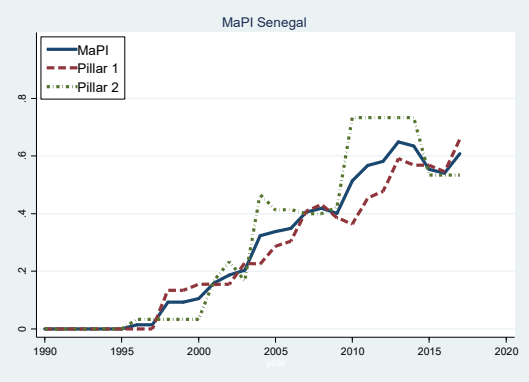


Fig.3: Malaria intervention strategies (Pillar 1) in Senegal

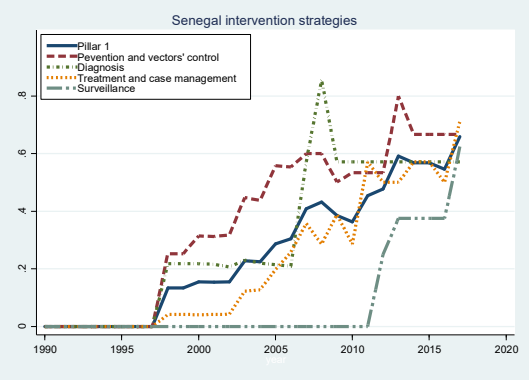
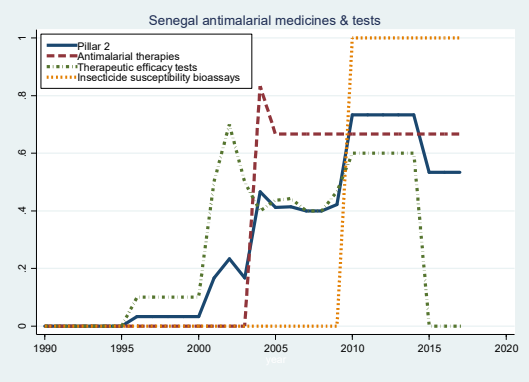


Fig.4: Antimalarial medicines and tests (Pillar 2) in Senegal



Sierra Leone

Sierra Leone is a country with high transmission of malaria. There are no free malaria areas in the country. The entire population of Sierra Leone is at high risk of malaria. Although transmission occurs all year-round, malaria is mainly seasonal in the country, with potential epidemics during the rainy season (May to November). Between 2000 and 2017, Sierra Leone reduced the incidence of malaria from 424.7 to 379.7 per 1,000 population at risk and the malaria deaths rate from 256.4 to 142.0 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Sierra Leone occupies the 35th position (together with Congo and Malawi) in our sample of 44 SSA countries, with a score of 0.39 (Fig.2), following Eswatini and preceding Rwanda, Central African Republic, Cote d'Ivoire and Gabon. In Pillar 1 (Malaria Intervention Strategies), the country ranks 29th over 44 (with Guinea, Kenya and Ghana) with a score of 0.43, whereas it occupies the 28th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Niger, Cote d'Ivoire, Eritrea, Chad, Namibia, Gambia and Tanzania).

Since 1998, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies, such as the parasitological confirmation for all age groups. From this year on and before the relative stability observed after the big push of 2007, the country has gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses in prevention measures in 2000, and treatment and case management interventions in 2003. The big improvement observed in 2007 is motivated by the increase in diagnosis measures and, to a lesser extent, in treatment and case management interventions. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), the interventions started in 1998 with the application of therapeutic efficacy tests. Before the relative stability that led to the decline of 2017, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes. Thus, in 2004, the country experienced a first big push in Pillar 2 due to the beginning of the antimalarial policies. The second big push occurs in 2010 when the country started to carry out insecticide bioassays tests which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country had stopped carrying out therapeutic and insecticide tests.

Summing up, as it is shown in the Table, in 2017 Sierra Leone has implemented: first, regarding Pillar 1, the 53% of prevention policies, 57% of diagnosis and 50% of treatment; second, regarding Pillar 2, the 83% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2004 and 2017.

Sierra Leone: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	11.1	16.0	14.5	10.6	11.1
Malaria death ratio (per 100,000 population)	256.4	293.3	228.6	143.0	142.0
MaPI (Index 0-1)	0.05	0.30	0.49	0.55	0.39
Pillar 1: Intervention	0.05	0.28	0.41	0.43	0.43
Cat 1: Prevention	0.04	0.43	0.53	0.53	0.53
Cat 2: Diagnosis	0.27	0.26	0.57	0.57	0.57
Cat 3: Treatment	0.00	0.28	0.43	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.03	0.34	0.60	0.73	0.33
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.10	0.01	0.00	0.40	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.00

Fig.1: Malaria mortality in Sierra Leone

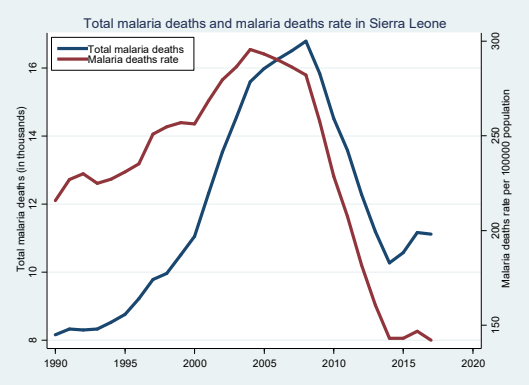


Fig.2: The Malaria Policy Index (MaPI) in Sierra Leone

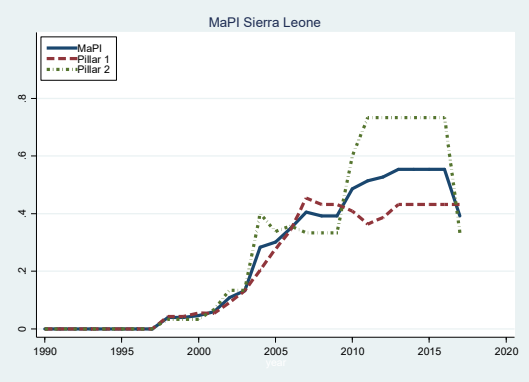


Fig.3: Malaria intervention strategies (Pillar 1) in Sierra Leone

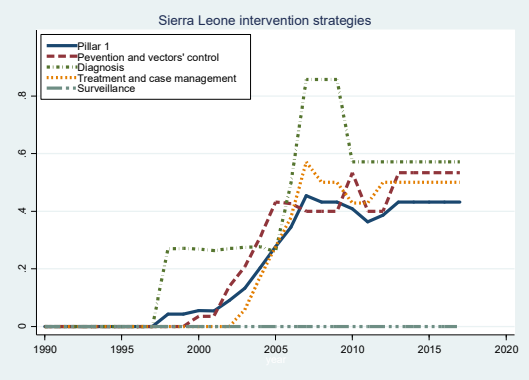
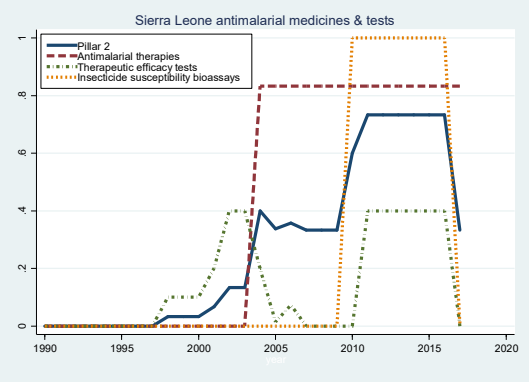


Fig.4: Antimalarial medicines and tests (Pillar 2) in Sierra Leone



Somalia

Somalia is a country with high transmission of malaria. There are no free malaria areas in the country. The entire population of Somalia is at risk of malaria, with 54% at high risk. The intensity of malaria transmission varies in different parts of the country, ranging from unstable and epidemic-prone in Northeast Zone (Puntland) and Northwest Zone (Somaliland), to moderate in Central Zone and moderate to high in the South Zone. Between 2000 and 2017, Somalia reduced the incidence of malaria from 123.6 to 36.8 per 1,000 population at risk and the malaria deaths rate from 39.2 to 6.8 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Somalia shares the 10th position in our sample of 44 SSA countries with Angola, Mali, Tanzania and Benin, with a score of 0.51 (Fig.2), following Uganda and Nigeria and preceding Sudan, Mozambique and Ghana. In Pillar 1 (Malaria Intervention Strategies), the country ranks 14th over 44 (with Eswatini and Zambia) with a score of 0.55, whereas it occupies the 18th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.47. as in Congo, Kenya and Cabo Verde).

Since 2004, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies (such as the use of IRS for prevention and control of epidemics and the distribution of ITNs/LLINs to all age groups) and treatment and case management interventions (such as the oversight regulation of case management in the private sectors). From this year on, the country has increased on average its policies implementation in this pillar with some punctual impetuses in diagnosis measures in 2006, and surveillance measures in 2012. Thus, the first big improvement in pillar 1 policies occurs in 2006 with the beginning of these diagnosis measures. The second big push occurs between 2016 and 2017, a period in which all policies and measures rise notably.

Regarding Pillar 2 (Fig.4), the interventions started in 1997 with the application of therapeutic efficacy tests. Before the decline of 2014, mainly due to the break in insecticide bioassays, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes. Thus, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1).

Summing up, as it is shown in the Table in 2017 Somalia has implemented: first, regarding Pillar 1, the 53% of prevention policies, 71% of diagnosis, 64% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 100% of antimalarial therapies and 20% of therapeutic tests. Regarding mortality rate, there has been a continuous decrease between 1995 and 2017.

Somalia: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	3.8	3.6	0.7	1.0	1.2
Malaria death ratio (per 100,000 population)	39.2	30.9	5.5	6.3	6.8
MaPI (Index 0-1)	0.03	0.28	0.54	0.42	0.51
Pillar 1: Intervention	0.00	0.20	0.41	0.34	0.55
Cat 1: Prevention	0.00	0.54	0.53	0.40	0.53
Cat 2: Diagnosis	0.00	0.00	0.57	0.57	0.71
Cat 3: Treatment	0.00	0.06	0.43	0.29	0.64
Cat 4: Surveillance	0.00	0.00	0.00	0.13	0.25
Pillar 2: Medicines & tests	0.07	0.40	0.73	0.53	0.47
Cat 5: Medicines	0.00	0.83	1.00	1.00	1.00
Cat 6: Therapeutic tests	0.20	0.20	0.20	0.40	0.20
Cat 7: Insecticide bioassays	0.00	0.00	1.00	0.00	0.00

Fig.1: Malaria mortality in Somalia

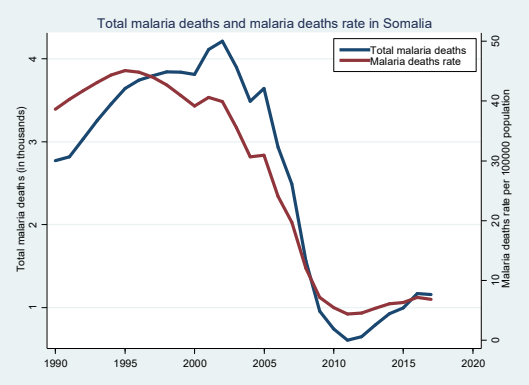


Fig.2: The Malaria Policy Index (MaPI) in Somalia

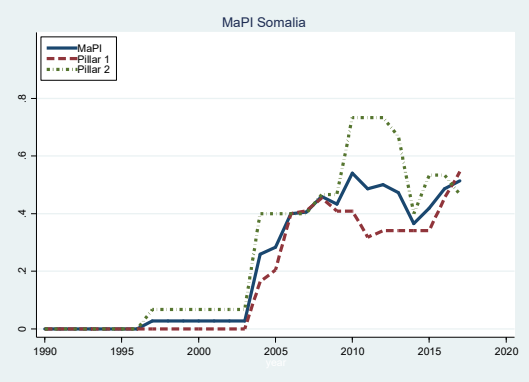


Fig.3: Malaria intervention strategies (Pillar 1) in Somalia

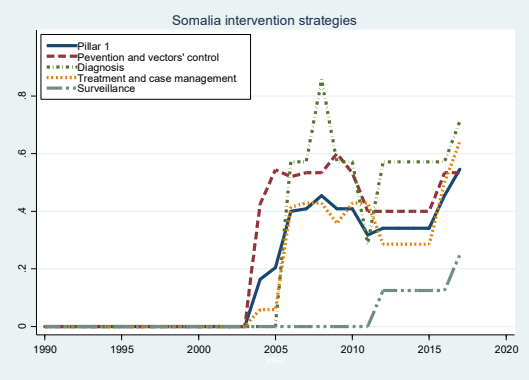
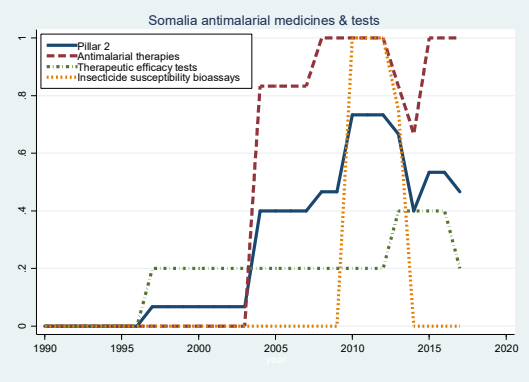


Fig.4: Antimalarial medicines and tests (Pillar 2) in Somalia



South Africa

South Africa is a country with low transmission of malaria. South Africa is considered a 90% free malaria country. There are only 4% high transmission areas in the country. Malaria is present in the three northern provinces of South Africa bordering Mozambique and Swaziland, with seasonal transmission during October–April. Between 2000 and 2017, the low incidence of malaria remained constant (around 4.0 per 1,000 population at risk) and the country slightly reduced the already low malaria deaths rate from 0.6 to 0.1 per 100,000 population (Fig.1).

In 2017, according to the MaPI, South Africa occupies the 24th position (together with Cameroon) in our sample of 44 SSA countries, with a score of 0.46 (Fig.2), following Congo Democratic Republic, Niger and Eritrea and preceding Kenya and Gambia. In Pillar 1 (Malaria Intervention Strategies), the country ranks 8th over 44 (with Mauritania and Angola) with a score of 0.59, whereas it occupies the 38th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.27. (as in Guinea-Bissau, Togo, Equatorial Guinea and Botswana).

Since 1930, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics and DDT for IRS in public health. This engagement remained relatively stable until 1997 when the country started increasing gradually its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions. However, the first big push in Pillar 1 occurs in 2007, motivated by the increase in diagnosis, and treatment and case management measures. After a period of decline in 2009, the country experienced a second important improvement with the implementation of surveillance policies in 2012.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 1997. From this particular year, the country started the application of therapeutic efficacy tests. The big push in Pillar 2 occurs between 2001-2004 motivated by the starting of antimalarial therapies and the increase in therapeutic tests. From this year on, policies implementation in this pillar remained relatively stable until 2014 when the country experienced a punctual push due to the increase in insecticide bioassays tests. Before abandoning its implementation, the country reached 100% of all insecticide susceptibility bioassays tests in 2015. These tests are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). The country had stopped carrying out therapeutic efficacy tests by 2008.

Summing up, as it is shown in the Table, in 2017 South Africa has implemented: first, regarding Pillar 1, the 40% of prevention policies, 57% of diagnosis, 57% of treatment and 100% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial policies. Regarding mortality rate, there has been a continuous slight decrease between 2000 and 2017.

South Africa: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.28	0.18	0.09	0.06	0.07
Malaria death ratio (per 100,000 population)	0.62	0.37	0.18	0.12	0.12
MaPI (Index 0-1)	0.12	0.29	0.30	0.50	0.46
Pillar 1: Intervention	0.18	0.25	0.23	0.48	0.59
Cat 1: Prevention	0.23	0.31	0.27	0.40	0.40
Cat 2: Diagnosis	0.32	0.29	0.29	0.71	0.57
Cat 3: Treatment	0.15	0.29	0.29	0.50	0.57
Cat 4: Surveillance	0.00	0.00	0.00	0.38	1.00
Pillar 2: Medicines & tests	0.03	0.35	0.40	0.53	0.27
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.10	0.05	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.25	1.00	0.00

Fig.1: Malaria mortality in South Africa

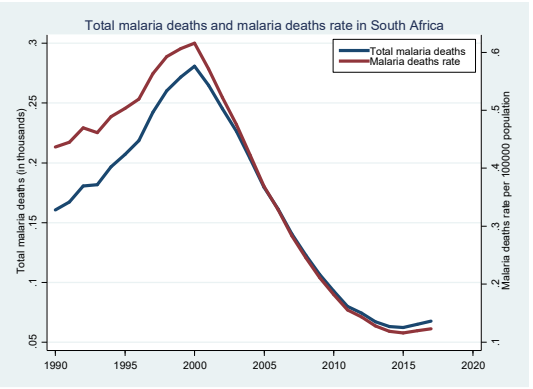


Fig.2: The Malaria Policy Index (MaPI) in South Africa

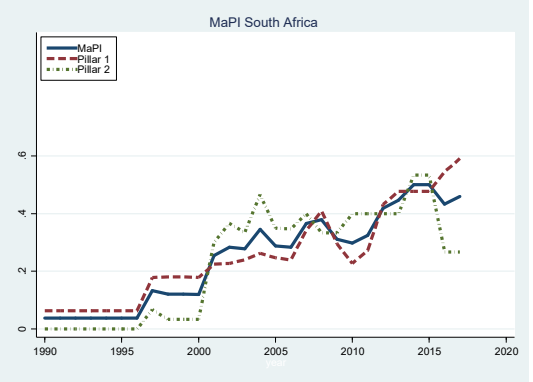


Fig.3: Malaria intervention strategies (Pillar 1) in South Africa

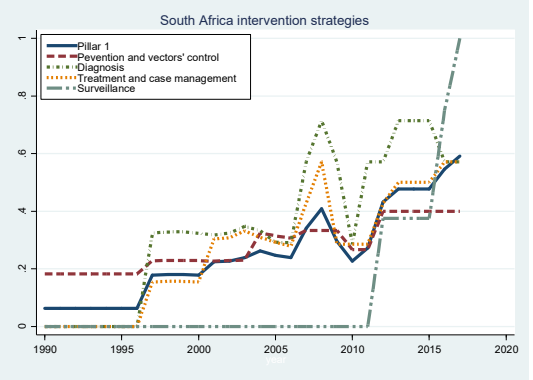
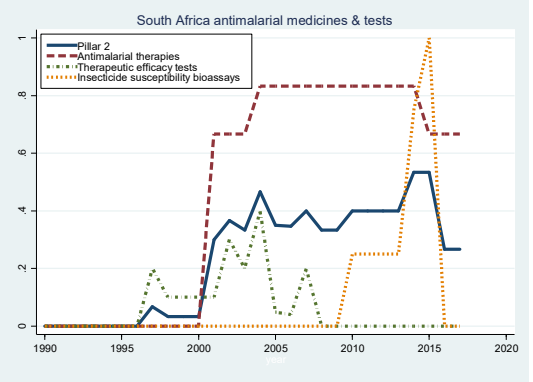


Fig.4: Antimalarial medicines and tests (Pillar 2) in South Africa



Sudan

Sudan is a country with high transmission of Malaria. There are no free malaria areas in the country. Although transmission occurs year-round, this latter is low-to-moderate in the northern, eastern and western states of the country, highly seasonal and occasionally epidemic during the rainy season (April to November). Between 2000 and 2017, Sudan reduced the incidence of Malaria from 65.6 to 37.5 per 1,000 population at risk and the malaria deaths rate from 14.8 to 6.3 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Sudan occupies the 15th position (together with Mozambique and Ghana) in our sample of 44 SSA countries, with a score of 0.5 (Fig.2), following Angola, Somalia, Mali, Tanzania and Benin and preceding Sao Tome and Principe, Burkina Faso and Cabo Verde. In Pillar 1 (Malaria Intervention Strategies), the country ranks 38th over 44 rank (with Malawi) with a score of 0.39, whereas it occupies the 1st position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.67.

Since 1956, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics. This engagement remained relatively stable until 2000 when the country started increasing gradually its policies implementation in this pillar. Before the decline of 2008, this increasing slope yielded two peaks. Thus, the first big push in Pillar 1 policies occurs in 2004, motivated by the increase in prevention and vector control, in diagnosis measures and the beginning of the implementation of treatment and case management interventions. The second big improvement occurs in 2007 with the rise in the enactment of measures within these 3 categories. The country started the implementation of surveillance measures in 2017.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 1996. From this particular year, the country started to carry out therapeutic efficacy tests. Before the relative stability of 2012, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes. Thus, the first big push in this pillar occurs in 2004, driven by the beginning of antimalarial therapies. The second big improvement occurs in 2010, a period in which the country started to carry out insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1).

Summing up, as it is shown in the Table, in 2017 Sudan has implemented: first, regarding Pillar 1, the 53% of prevention policies, 29% of diagnosis and 50% of treatment; second, regarding Pillar 2, the 83% of antimalarial therapies, 20% of therapeutic tests, and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2000 and 2011.

Sudan: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	4.0	3.5	1.9	2.4	2.6
Malaria death ratio (per 100,000 population)	14.8	11.7	5.4	6.3	6.3
MaPI (Index 0-1)	0.08	0.47	0.59	0.53	0.50
Pillar 1: Intervention	0.09	0.43	0.45	0.39	0.39
Cat 1: Prevention	0.18	0.54	0.53	0.53	0.53
Cat 2: Diagnosis	0.21	0.60	0.57	0.29	0.29
Cat 3: Treatment	0.00	0.48	0.57	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.00
Pillar 2: Medicines & tests	0.07	0.52	0.80	0.73	0.67
Cat 5: Medicines	0.00	0.98	1.00	0.83	0.83
Cat 6: Therapeutic tests	0.20	0.40	0.40	0.40	0.20
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Sudan

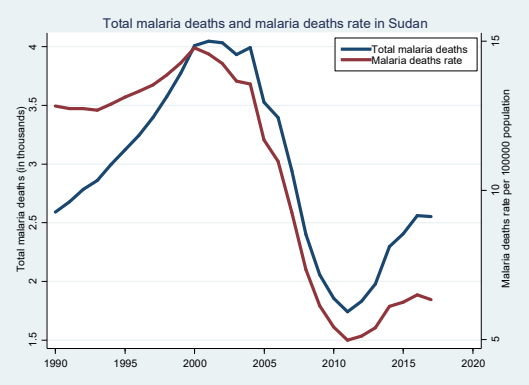


Fig.2: The Malaria Policy Index (MaPI) in Sudan

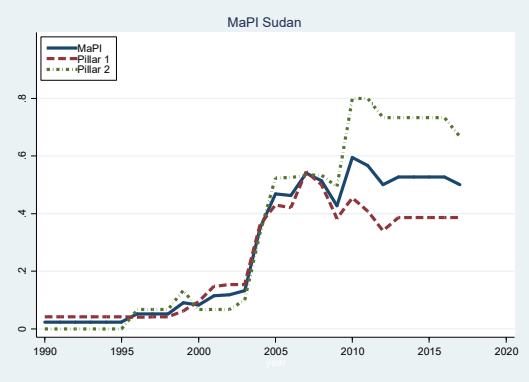


Fig.3: Malaria intervention strategies (Pillar 1) in Sudan

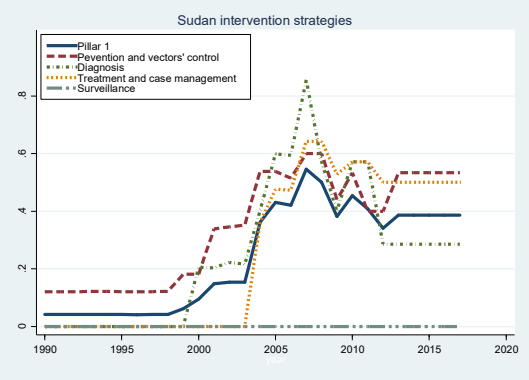
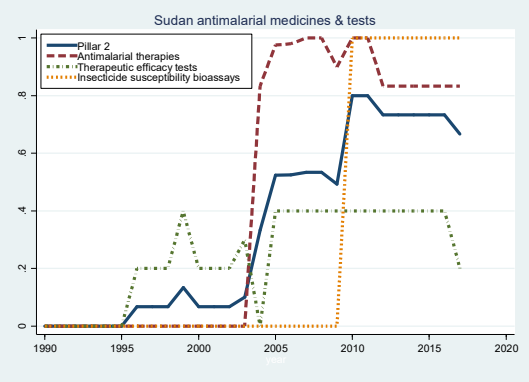


Fig.4: Antimalarial medicines and tests (Pillar 2) in Sudan



Tanzania

Tanzania is a country with very high transmission of malaria. There are no free malaria areas in the country. The transmission of the disease occurs all year-round with seasonal peaks in the large rainy season (November to May). Between 2000 and 2017, Tanzania reduced the incidence of malaria from 295.1 to 113 per 1,000 population at risk and the malaria deaths rate from 101.7 to 28.4 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Tanzania occupies the 10th position (together with Angola, Somalia, Mali and Benin) in our sample of 44 SSA countries, with a score of 0.51 (Fig.2), following Uganda and Nigeria and preceding Sudan, Mozambique and Ghana. In Pillar 1 (Malaria Intervention Strategies), the country ranks 6th over 44 with a score of 0.64, whereas it occupies the 28th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.33. (as in Liberia, Congo Democratic Republic, Niger, Cote d'Ivoire, Eritrea, Chad, Namibia, Gambia and Sierra Leone).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the implementation of measures authorizing free malaria diagnosis in the public sector. From this year on, the country has gradually increased its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 1998, diagnosis measures in 2001, and surveillance measures in 2006. However, the first big push in the implementation of Pillar 1 policies occurs in this later year, mainly motivated by the increase in all implemented policies. The second and third big improvements occur respectively in 2009 and 2012, period following some breaks respectively in diagnosis and surveillance measures. It should be noted that these peak periods also coincided with a notable rise in all policies.

Regarding Pillar 2 (Fig.4), from 1997 until 2003, only therapeutic efficacy tests were carried out. In 2004, the country started implementing measures authorizing antimalarial therapies. This explained the first large increase in this pillar from this particular year. The second large increase in this pillar occurs in 2010 with the application of available insecticide bioassays needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). From this year on, the country experienced a stability in its policies implementation until 2016 when insecticide bioassays were finally reduced and stopped. By 2009, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Tanzania has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, 57% of treatment and 75% of surveillance policies; second, regarding Pillar 2, the 83% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2001 and 2017.

Tanzania: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	34.8	26.0	18.8	14.9	15.3
Malaria death ratio (per 100,000 population)	101.7	66.7	42.2	29.1	28.4
MaPI (Index 0-1)	0.07	0.28	0.49	0.58	0.51
Pillar 1: Intervention	0.05	0.21	0.41	0.57	0.64
Cat 1: Prevention	0.00	0.31	0.53	0.67	0.67
Cat 2: Diagnosis	0.07	0.09	0.29	0.57	0.57
Cat 3: Treatment	0.11	0.28	0.57	0.50	0.57
Cat 4: Surveillance	0.00	0.00	0.00	0.50	0.75
Pillar 2: Medicines & tests	0.10	0.38	0.60	0.60	0.33
Cat 5: Medicines	0.00	0.83	0.83	0.83	0.83
Cat 6: Therapeutic tests	0.30	0.14	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	0.00

Fig.1: Malaria mortality in Tanzania

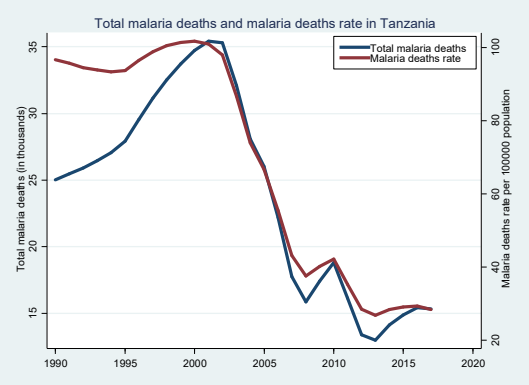


Fig.2: The Malaria Policy Index (MaPI) in Tanzania

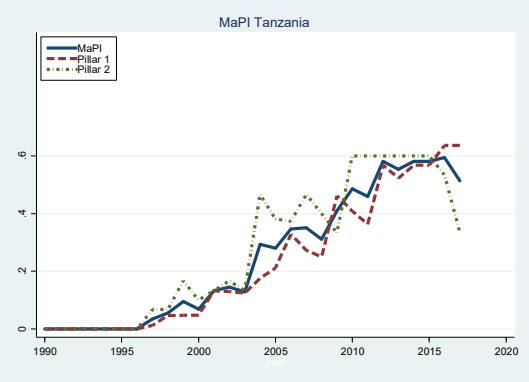


Fig.3: Malaria intervention strategies (Pillar 1) in Tanzania

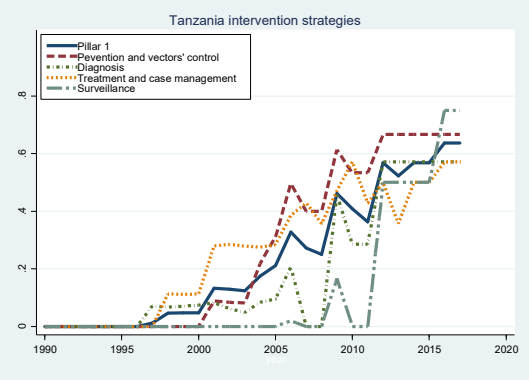
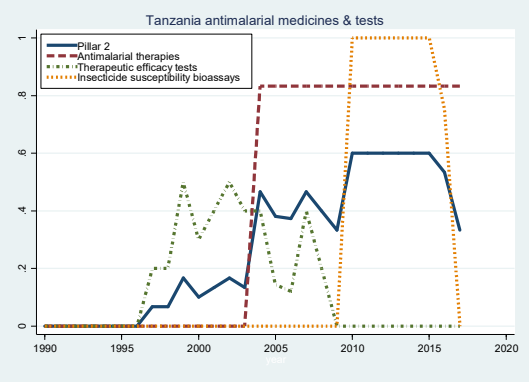


Fig.4: Antimalarial medicines and tests (Pillar 2) in Tanzania



Togo

Togo is a country with high transmission of malaria. There are no free malaria areas in the country. The entire population of Togo is at high risk of malaria. Although transmission occurs all year-round, malaria is mainly seasonal in the country, with potential epidemics during the rainy season (April to October). Between 2000 and 2017, Togo reduced the incidence of malaria from 432.5 to 370.9 per 1,000 population at risk and the malaria deaths rate from 108 to 91.9 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Togo occupies the last position (together with Guinea-Bissau and Equatorial Guinea) in our sample of 44 SSA countries, with a score of 0.35 (Fig.2), following Gabon. In Pillar 1 (Malaria Intervention Strategies), the country ranks 33rd over 44 with a score of 0.41 (with Cote d'Ivoire, Equatorial Guinea, Guinea-Bissau and Cameroon), whereas it occupies the 38th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.27. (as in Guinea-Bissau, Equatorial Guinea, South Africa and Botswana).

Since 2001, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the distribution of ITNs/LLINs through mass campaigns and antenatal care programs to children under 5 years and pregnant women. From this year on, the country has gradually increased on the yearly base its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 2004, and diagnosis measures in 2006. However, the first big push in the implementation of Pillar 1 policies occurs in 2004, motivated by this engagement in favour of treatment and case management measures including the increase observed in prevention and vector control measures. The second big improvement occurs in 2006 with the introduction of diagnosis policies. It is worth noting the short-run punctual implementation of surveillance measures between 2014 and 2015.

Regarding Pillar 2 (Fig.4), after carrying out few therapeutic efficacy tests from 1998 to 2001, the country took a break and re-started implementing measures of this pillar in 2004 (antimalarial therapies). Before the drastic decline of 2014, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes. Thus, the big push in Pillar 2 occurs in 2011, motivated by the execution of all insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2014, the country had stopped carrying out these latter as well as the therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Togo has implemented: first, regarding Pillar 1, the 67% of prevention policies, 29% of diagnosis and 43% of treatment policies; second, regarding Pillar 2, the country 67% of antimalarial therapies. Regarding mortality rate, there has been a continuous decrease between 2005 and 2017.

Togo: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	5.3	7.2	7.3	7.0	6.9
Malaria death ratio (per 100,000 population)	108.0	129.8	113.9	97.3	91.9
MaPI (Index 0-1)	0.01	0.26	0.32	0.41	0.35
Pillar 1: Intervention	0.00	0.16	0.27	0.50	0.41
Cat 1: Prevention	0.00	0.31	0.13	0.53	0.67
Cat 2: Diagnosis	0.00	0.00	0.57	0.57	0.29
Cat 3: Treatment	0.00	0.16	0.43	0.57	0.43
Cat 4: Surveillance	0.00	0.00	0.00	0.25	0.00
Pillar 2: Medicines & tests	0.03	0.40	0.40	0.27	0.27
Cat 5: Medicines	0.00	0.67	0.67	0.67	0.67
Cat 6: Therapeutic tests	0.10	0.40	0.40	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	0.00	0.00

Fig.1: Malaria mortality in Togo

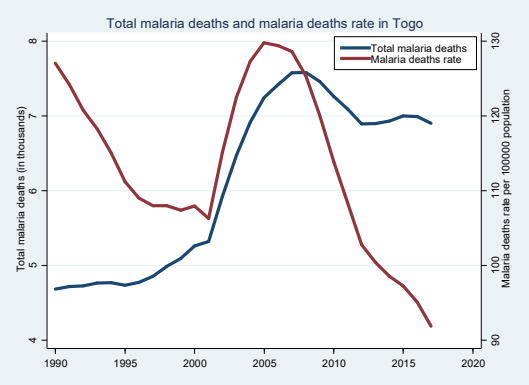


Fig.2: The Malaria Policy Index (MaPI) in Togo

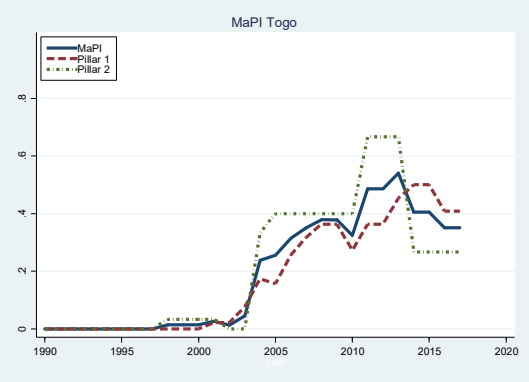


Fig.3: Malaria intervention strategies (Pillar 1) in Togo

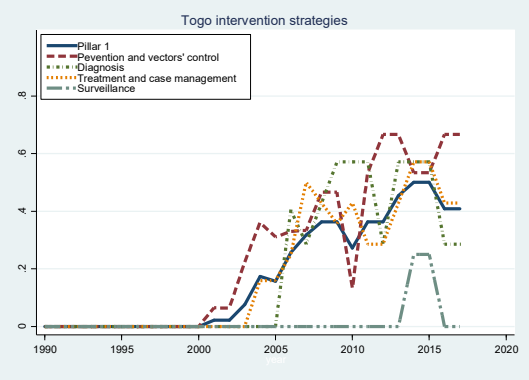
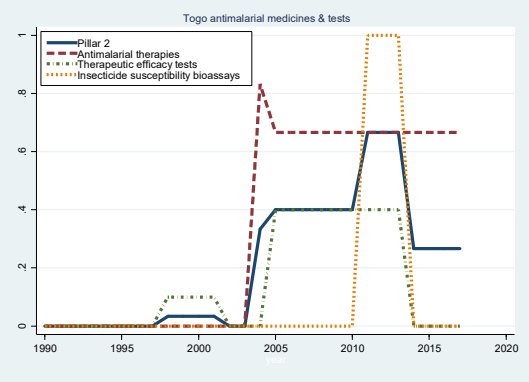


Fig.4: Antimalarial medicines and tests (Pillar 2) in Togo



Uganda

Uganda is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in most parts of the country, with potential epidemics during the rainy season (April to October). Uganda accounted for 4% of all estimated malaria cases worldwide in 2017. Between 2000 and 2017, Uganda reduced the incidence of malaria from 441.9 to 200.7 per 1,000 population at risk and the malaria deaths rate from 235.2 to 56.9 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Uganda occupies the 8th position (together with Nigeria) in our sample of 44 SSA countries, with a score of 0.53 (Fig.2), following Zambia and Botswana and preceding Angola, Somalia, Mali, Tanzania and Benin. In Pillar 1 (Malaria Intervention Strategies), the country ranks 17th over 44 (with Ethiopia and Gambia) with a score of 0.53, whereas it occupies the 7th place over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zimbabwe, Rwanda, Gabon, Cameroon, Burundi, Senegal, Zambia, Mozambique, Mali, Burkina Faso).

Since 1997, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of diagnosis policies, such as the implementation of parasitological confirmation for inpatient measures. From this year on, the country has gradually increased its policies implementation in this pillar, with some punctual impetuses in prevention measures in 1998, and treatment and case management interventions in 2002. The big push in this Pillar 1 occurs in this later year, motivated mainly by the increase in prevention and vector control measures. It is worth noting that the country has given very little and late (starting from 2016) interest in the implementation of surveillance measures (25%).

Regarding Pillar 2 (Fig.4), the interventions started in 1996 with the application of therapeutic efficacy tests. Before the relative stability of 2014, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. Thus, the country experienced its first large increase in Pillar 2 in 2004, due to the beginning and urgent implementation of antimalarial therapies. The second big improvement occurs in 2011 when the country involves in insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2009, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Uganda has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, 50% of treatment and 25% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 1990 and 2017.

Uganda: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	57.2	53.8	33.3	18.9	22.2
Malaria death ratio (per 100,000 population)	235.2	189.4	102.3	50.9	56.9
MaPI (Index 0-1)	0.13	0.35	0.38	0.53	0.53
Pillar 1: Intervention	0.07	0.32	0.41	0.53	0.53
Cat 1: Prevention	0.12	0.45	0.53	0.80	0.67
Cat 2: Diagnosis	0.23	0.42	0.29	0.57	0.57
Cat 3: Treatment	0.00	0.32	0.57	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.00	0.25
Pillar 2: Medicines & tests	0.20	0.39	0.33	0.53	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.60	0.19	0.00	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	1.00	1.00

Fig.1: Malaria mortality in Uganda

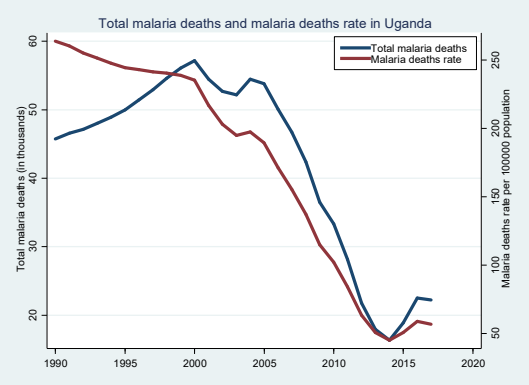


Fig.2: The Malaria Policy Index (MaPI) in Uganda

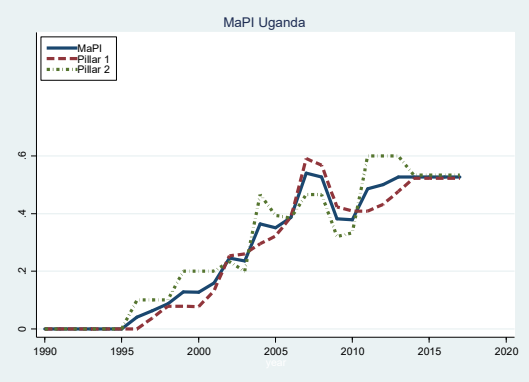


Fig.3: Malaria intervention strategies (Pillar 1) in Uganda

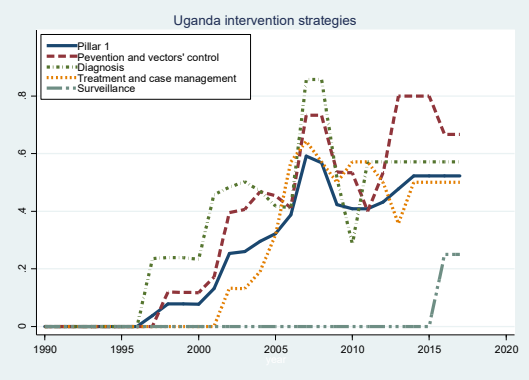
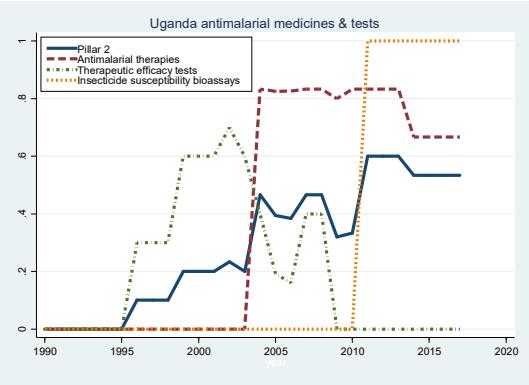


Fig.4: Antimalarial medicines and tests (Pillar 2) in Uganda



Zambia

Zambia is a country with high transmission of malaria. There are no free malaria areas in the country. Although transmission occurs all year-round, malaria is mainly seasonal in the country, with potential epidemics during the rainy season (November to May). Between 2000 and 2017, Zambia reduced the incidence of malaria from 265.1 to 203.3 per 1,000 population at risk and the malaria deaths rate from 65.6 to 26.9 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Zambia occupies the 6th position (together with Botswana) in our sample of 44 SSA countries, with a score of 0.54 (Fig.2), following Ethiopia and preceding Uganda and Nigeria. In Pillar 1 (Malaria Intervention Strategies), the country shares the 14th rank over 44 (with Eswatini and Somalia), with a score of 0.55, whereas it occupies the 7th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zimbabwe, Rwanda, Gabon, Cameroon, Burundi, Uganda, Senegal, Mozambique, Mali and Burkina Faso).

Since 1964, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics. This engagement remained relatively stable until 1998 when the country started increasing gradually its policies implementation in this pillar with some punctual impetuses in diagnosis and treatment and case management interventions. However, the big push in the implementation of Pillar 1 policies occurs between 2001 and 2005, motivated by a notable rise in all implemented policies. The country started the implementation of surveillance measures in 2013.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 1997. From this particular year, the country started implementing antimalarial therapies policies. Before the relative stability of 2010, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. The first big push in this pillar occurs in 2002, driven by the beginning and important implementation of these antimalarial therapies. Since 2010, the country has seen a second large improvement in Pillar 2 due to the introduction and full implementation of insecticide tests. These insecticide tests are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2017, the country had stopped carrying out therapeutic tests.

Summing up, as it is shown in the Table, in 2017 Zambia has implemented: first, regarding Pillar 1, the 67% of prevention policies, 57% of diagnosis, 50% of treatment and only 38% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2002 and 2017.

Zambia: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	6.5	5.5	3.8	5.0	4.7
Malaria death ratio (per 100,000 population)	65.6	48.0	28.1	30.7	26.9
MaPI (Index 0-1)	0.15	0.46	0.57	0.57	0.54
Pillar 1: Intervention	0.21	0.50	0.50	0.55	0.55
Cat 1: Prevention	0.32	0.70	0.67	0.80	0.67
Cat 2: Diagnosis	0.25	0.71	0.57	0.57	0.57
Cat 3: Treatment	0.18	0.47	0.57	0.50	0.50
Cat 4: Surveillance	0.00	0.00	0.00	0.13	0.38
Pillar 2: Medicines & tests	0.07	0.40	0.67	0.60	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.20	0.20	0.20	0.20	0.00
Cat 7: Insecticide bioassays	0.00	0.00	1.00	1.00	1.00

Fig.1: Malaria mortality in Zambia

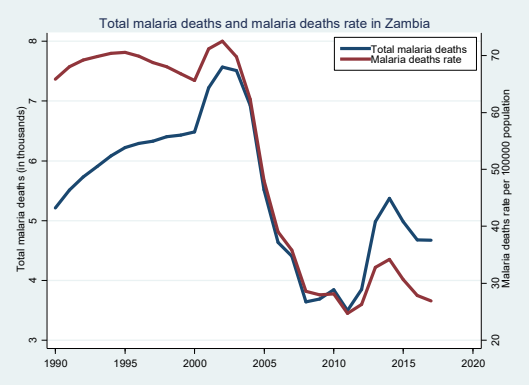


Fig.2: The Malaria Policy Index (MaPI) in Zambia

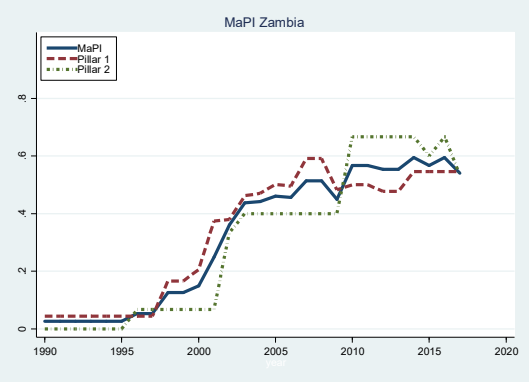


Fig.3: Malaria intervention strategies (Pillar 1) in Zambia

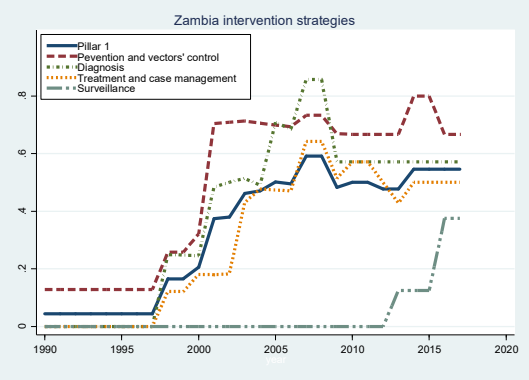
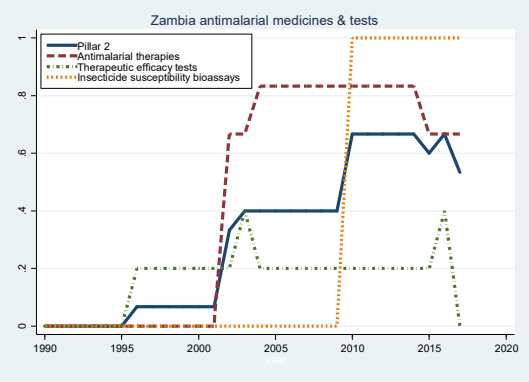


Fig.4: Antimalarial medicines and tests (Pillar 2) in Zambia



Zimbabwe

Zimbabwe is a country with low transmission of malaria. Free malaria areas represent 21% of the country. Although transmission occurs all year-round, malaria is mainly seasonal in the south of the country, with potential epidemics during the rainy season (October to March). Between 2000 and 2017, Zimbabwe reduced the incidence of malaria from 103.9 to 95.2 per 1,000 population at risk and the relatively low malaria deaths rate from 7.3 to 4.7 per 100,000 population (Fig.1).

In 2017, according to the MaPI, Zimbabwe occupies the 2nd position in our sample of 44 SSA countries, with a score of 0.65 (Fig.2), following Madagascar and preceding Senegal and Namibia. In Pillar 1 (Malaria Intervention Strategies), the country ranks 2nd over 44 (with Botswana), with a score of 0.73, whereas it occupies the 7th position over 44 in Pillar 2 (Antimalaria Medicines and Tests), with a score of 0.53. (as in Zambia, Rwanda, Gabon, Cameroon, Burundi, Uganda, Senegal, Mozambique, Mali and Burkina Faso).

Since 1947, the country has engaged in malaria intervention policies (Pillar 1 – Fig.3), beginning with the establishment of prevention and vector control policies, such as the use of IRS for prevention and control of epidemics. This engagement remained relatively stable until 1997 when the country started increasing gradually on the yearly base its policies implementation in this pillar with some punctual impetuses in treatment and case management interventions in 1998, diagnosis measures in 2008, and surveillance measures in 2012. However, the first big push in Pillar 1 occurs in 2008, motivated by the increase in prevention and vector control interventions and the beginning of diagnosis measures. The second big improvement occurs in 2012, a period in which all policies and measures rise notably.

Regarding Pillar 2 (Fig.4), no intervention was carried out before 1999. From this particular year, interventions started with the application of therapeutic efficacy tests. Before the stability that led to the decline of 2015, the country steadily increased this sort of policies implementation on the yearly base with some prompt pushes in the implementation of more antimalarial measures. However, since 2004, the country has seen a first large increase in Pillar 2 due to the implementation of antimalarial therapies. The second improvement occurs in 2001, with the application of insecticide susceptibility bioassays tests, which are needed to guarantee the efficacy of IRS measures (included in the preventive and vector control policies of Pillar 1). By 2015, the country had stopped carrying out therapeutic efficacy tests.

Summing up, as it is shown in the Table, in 2017 Zimbabwe has implemented: first, regarding Pillar 1, the 80% of prevention policies, 57% of diagnosis, 71% of treatment and 75% of surveillance policies; second, regarding Pillar 2, the 67% of antimalarial therapies and 100% of insecticide bioassays. Regarding mortality rate, there has been a continuous decrease between 2006 and 2017.

Zimbabwe: Malaria policies in a nutshell					
	2000	**2005**	**2010**	**2015**	**2017**
Malaria death (x1000)	0.87	0.99	0.84	0.75	0.69
Malaria death ratio (per 100,000 population)	7.3	8.0	6.4	5.3	4.7
MaPI (Index 0-1)	0.10	0.32	0.41	0.54	0.65
Pillar 1: Intervention	0.14	0.28	0.41	0.55	0.73
Cat 1: Prevention	0.30	0.65	0.67	0.80	0.80
Cat 2: Diagnosis	0.00	0.00	0.29	0.57	0.57
Cat 3: Treatment	0.13	0.19	0.43	0.50	0.71
Cat 4: Surveillance	0.00	0.00	0.00	0.13	0.75
Pillar 2: Medicines & tests	0.03	0.37	0.40	0.53	0.53
Cat 5: Medicines	0.00	0.83	0.83	0.67	0.67
Cat 6: Therapeutic tests	0.10	0.12	0.20	0.00	0.00
Cat 7: Insecticide bioassays	0.00	0.00	0.00	1.00	1.00

Fig.1: Malaria mortality in Zimbabwe

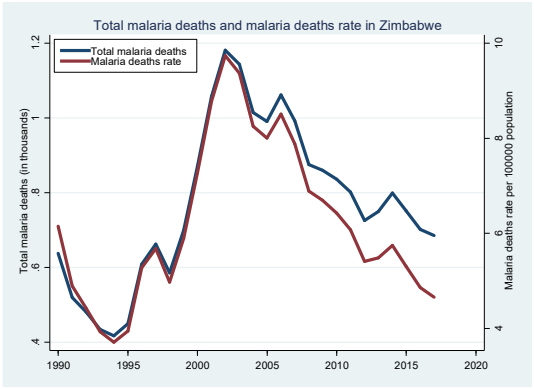


Fig.2: The Malaria Policy Index (MaPI) in Zimbabwe

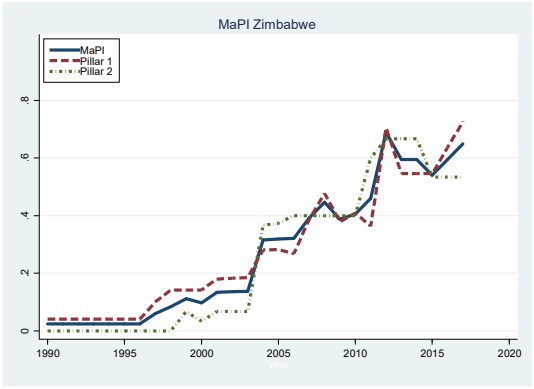


Fig.3: Malaria intervention strategies (Pillar 1) in Zimbabwe

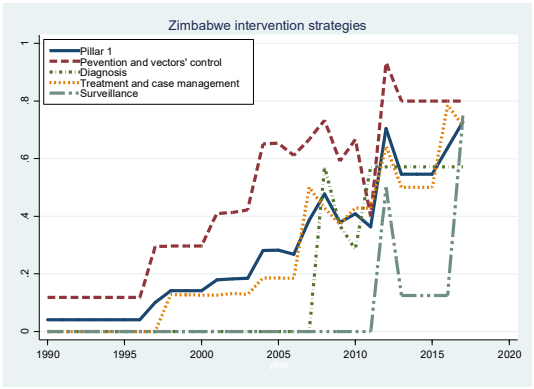


Fig.4: Antimalarial medicines and tests (Pillar 2) in Zimbabwe