
Evaluation of the Impact of the Scale-up of Malaria Control Interventions on All-Cause Mortality in Children under Five Years of Age in Mali, 2000-2012

Mali Malaria Impact Evaluation Group

Executive Summary



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Malaria is a public health problem of major significance in Mali, representing the primary cause of morbidity, mortality, and absenteeism at work and at school. In 2012, Mali recorded 2.2 million cases of malaria and approximately 1,900 deaths, according to Ministry of Health records. Between 2001 and 2012, the Government of Mali (GOM) and its international development partners invested heavily in malaria control, including insecticide-treated nets (ITN), intermittent preventive treatment in pregnancy (IPTp), indoor residual spraying (IRS) in selected zones, and prompt and effective diagnosis and treatment of cases. This report represents a synthesis of the impact of those investments in the morbidity and mortality of children under five from 2001-2012.

Concept

This evaluation is based on the premise that in high burden countries such as Mali, malaria constitutes a sizeable percentage of the child mortality envelope such that improvements in the coverage of malaria control interventions (ITN, IRS, IPTp, case management) should result in a subsequent decline in all-cause child mortality. This ‘plausibility argument’, as suggested by Rowe and colleagues (Rowe *et al.* 2007), and subsequently adopted by the Roll Back Malaria Monitoring and Evaluation Reference Group (RBM MERG) is the current standard for measuring the impact of the scale-up of malaria control over the past decade. Using all-cause child mortality (ACCM) as the primary outcome indicator ensures a robust measure that encompasses both direct and indirect malaria-related mortality. In addition to the mortality indicator, morbidity was assessed through measurement of severe anemia (<8 g/dl), and parasitemia in children 6-59 months old.

Data Sources

This evaluation primarily used data from four national population-based household surveys conducted by the National Institute of Statistics and the Ministry of Health, with technical assistance from ICF International (MEASURE DHS) and conducted in 2001, 2006, 2010, and 2012. As the northern regions of Mali were excluded from the 2012 DHS due to security issues, all survey data used in this evaluation have been similarly restricted for comparability. These data were supplemented by routine data from the *Système Local d’Information Sanitaire* (SLIS), small-area studies, and other survey data. Data sources are clearly cited throughout the report.

Implementation of Malaria Control Interventions

During the evaluation period, Mali experienced substantial changes in the coverage of malaria control interventions, including: the adoption of rapid diagnostic tests and ACTs as first-line treatment, increased access to ITNs, and introduction of IPTp.

In terms of prevention, household ownership of an ITN increased from 49% in 2006 to 84% in 2012. Similarly, the use of ITNs by children under the age of five increased from 26% (2006) to 69% (2012) and use by pregnant women increased from 28% (2006) to 73% (2012). In the general population, the percentage of people who slept under an ITN increased from 21% in 2006 to 61% in 2012.

IRS has been conducted in two districts (Koulikoro and Bla) since 2008 and was extended to a third district (Baroueli) in 2011. Pyrethroid insecticides were used until 2011, when the program switched to carbamates in response to high levels of pyrethroid resistance in the mosquito population. In 2012, the IRS program sprayed 206,295 structures achieving 98% coverage in the targeted districts and protecting 762,146 people. However, because the IRS program only covers approximately 4% of the Malian population, its impact on national-level morbidity and mortality statistics is not appreciable.

Mali has long been a leader in the implementation of interventions focused on prevention of malaria in pregnancy. ITNs are distributed at initial antenatal care (ANC) visits along with folate supplementation, and focused antenatal care (FANC) prioritizes effective case management of confirmed malaria illness and anemia. IPTp (two doses of sulfadoxine-pyrimethamine [SP] distributed via ANC visits), was piloted in 1998 and introduced into the national strategy in 2003. From the first survey measurement in 2006, IPTp coverage (2 doses) increased from 10% of pregnant women to 29% by 2012.

The Malian national policy for diagnosis and treatment of malaria has evolved dramatically during the timeframe of this evaluation. Malaria was initially treated with monotherapies (chloroquine and SP). Following the recommendation from WHO, Mali changed its treatment policy to artemisinin-based combination therapies in 2006. Artesunate-amodiaquine (AS-AQ) became the first-line treatment in 2006, followed by artemether-lumefantrine (AL) in 2010 (though AS-AQ remains an alternative first-line treatment). Before 2000, malaria diagnosis in Mali was primarily based on clinical diagnosis, with microscopy available in a limited number of national and regional hospitals. RDTs were formally introduced in 2009 with a policy of free case management for pregnant women and children under five; however official regulation of prices for diagnosis and treatment did not occur until 2011. Community case management to expand access to services began in 2005 and was adopted as national policy in 2010. As a result of these policy changes and new interventions, the availability of services and the standard of care for children with suspected malaria has evolved during the timeframe of this evaluation. However, according to survey data, the percentage of children under the age of five with a fever taken for treatment did not change significantly between 2001 and 2012, remaining consistently around 30%. Additionally, in 2012 (the only year for which these data are available), household survey data show that very few children received a finger or heel stick (the proxy indicator for a malaria diagnostic test); only 12% reported having been tested although the routine data indicated that 55% of children under five were tested. Among febrile children who reported receiving an antimalarial, very few received the recommended drug (ACT) in 2010 (23%) and 2012 (19%). Taken as a whole, the survey data show meager coverage of effective case management in children with fever. However, the case management indicators may not accurately reflect Mali's progress due to changes in policy and supply chain issues, as well as a political crisis in 2012.

Impact

Morbidity

A standard measure of malaria burden is parasite prevalence among children 6-59 months old. During the timeframe of this evaluation, malaria parasitemia was measured in two surveys in 2010 and 2012. These data indicate an increase in parasitemia prevalence from 39% (2010) to 52% (2012), with increases in most regions, though these increases are not statistically significant. The 2012 survey occurred during a time of political upheaval, when health services were disrupted and populations displaced, and thus it likely does not reflect longer term trends in prevalence. When the parasitemia data is disaggregated by province, the increase is only statistically significant in the Mopti Region where prevalence increased from 50% (2010) to 71% (2012).

Another indicator of malaria-associated morbidity is severe anemia, defined as <8g/dl. While not biologically specific to malaria, in most areas of high endemicity, prevalence of severe anemia is strongly correlated with the prevalence of *Plasmodium falciparum* infection in children under five. In Mali, there was a significant decrease in severe anemia in children under five from 24% in 2001 to 21% in 2012. This decrease was greater in young children (6-23 months) who are at greater risk of malaria than the older age groups.

The data from the routine information system show an increase in the cases of malaria and in the proportion of consultations linked to malaria since 2001, however these data must be interpreted with caution. During the evaluation period, the health sector expanded providing more health facilities and expanding community case management which may have contributed to an increased number of cases reported in the system. Towards the end of the evaluation period, RDTs were introduced and diagnostics were improved, also potentially contributing to an increase in reported cases. Weekly reporting on malaria cases was only functional in the epidemic-prone regions of the North until 2008 when it was extended to the entire country. From 2010 to 2012, the number of confirmed malaria cases in the weekly reporting system in Mali initially decreased from 1,199,893 (2010) to 1,073,071 (2011) only to increase again to 1,226,787 (2012).

Mortality

As explained earlier, ACCM is used as a standard indicator of malaria program impact in high endemicity countries of sub-Saharan Africa. In Mali, ACCM declined from 224.8 deaths per thousand live births for the period 1996-2001 to 192 (for 2001-2006) to 95.1 deaths for the period 2007-2012, a significant reduction of 58%. The greatest decline (76% reduction) was seen in children 6-23 months who are also at the highest risk for malaria-related morbidity and mortality. Although a decline was observed between 2001 and 2006, a much greater decline was observed between 2006 and 2012, the period corresponding to the rapid expansion of malaria control interventions.

These findings are also supported by the routine information system which shows that the inpatient case fatality rate for malaria decreased from 2.48 deaths per thousand in 2007 to 1.77 deaths per thousand in 2012 among children under five, following the change in drug policy to ACTs. A similar decline was seen among older children and adults. The total number of deaths in health facilities from all causes for both children under five and for older age groups was increasing between 2000 and 2010 before a decline through 2012, although access to health services and reporting also increased during this period. Between 2010 and 2012, when malaria diagnostics were more widely used in Mali (~50% of cases treated in a health center), the weekly surveillance data indicate a decline in deaths due to malaria.

Contextual factors

Even though the decline in ACCM coincides with an increase in the coverage of malaria control interventions between 2000 and 2010, it is important to note that other contextual factors also might have contributed to the observed declines in mortality. During the same timeframe, a number of other indicators of socio-economic conditions and coverage of other health interventions also improved. Gross domestic product (GDP) increased from \$2 billion in 2000 to \$10 billion in 2010. Certain indicators of living conditions and sanitation services improved from 2000 to 2012, such as access to potable water (44% to 66%) and access to improved toilets (7% to 18%). However, the benefits of economic growth are not equitably distributed across Mali (Gini coefficient = .33). An equity analysis of mortality shows that the proportion of deaths among children under five in the poorest quintiles increased over the study period, as economic benefits accrued in the wealthier groups. Several maternal and child health interventions also expanded coverage during this period including use of antenatal care, delivery with a skilled attendant, and vaccination coverage, however on a national scale, the percent of the population covered with these services remained quite low. Total vaccination coverage for children under five only increased from 30% in 2001 to 40% in 2012.

In terms of climate, national rainfall data indicate that the period between 2000 and 2006 was drier than the 15-year average, but the period corresponding to the expansion of malaria control interventions (2006-2012), was significantly wetter than average. Similarly, the annual temperature deviation from the 50-year

average was markedly hotter from 2006-2012 than for the earlier period. Taken together, these climate variations could have facilitated an increase in malaria transmission over the latter part of the evaluation period.

Finally, it is important to note that the 12 months or so immediately preceding the endpoint of this evaluation (2012) were a period of political upheaval and insecurity in Mali. The 2012 survey data were collected at a time of large-scale movements of malaria-naïve populations from the North to malaria-endemic regions of the South. The full impact of this situation is not investigated in this report; however, interpretation of the findings must be considered in this context.

Conclusion

In summary, the results of this evaluation show an important decline in ACCM corresponding to the timeframe of the rapid increase in coverage of malaria control interventions, including ITN distribution, IPTp expansion, and improvements in malaria case management. Increases in malaria control intervention coverage were largely scaled up after 2006 and correspond with the period of the most dramatic decline in ACCM. Declines in ACCM were more important in populations with high malaria risk (rural, younger children, high transmission areas). The expansion of other child survival interventions did not reach a significant proportion of the population during the timeframe of this review, and thus were less likely to contribute to the decline in mortality. Similarly, GDP grew at a relatively slow rate with the benefits spread inequitably across the population. It must be noted however, that markers of malaria morbidity, such as incidence rates and population-based parasitemia increased over the same time frame, indicating a continued high burden of malaria in Mali. The incidence rates are derived from routine data systems, which should be interpreted with caution as access to health services, diagnostic testing, and reporting also increased substantially over the same period. While national level parasitemia prevalence increased, that change was largely driven by an extreme increase in Mopti Region, the only region where a statistically significant change was observed over the timeframe. The endline period (2012) was a time of social, political and economic upheaval in Mali, with large numbers of displaced persons from the low malaria burden areas of the North, moving into high transmission zones of the South, especially the border region of Mopti. Thus parasitemia prevalence in 2012 is not an accurate reflection of longer term trends (indeed a subsequent survey in 2015 found 36% prevalence in children under five (lower than 2010 prevalence), as well as substantial declines in every region). Progress throughout the evaluation period appears to be inequitably focused among the wealthiest, meaning that the potential for continued impact is great provided interventions are distributed to those most at need. Taken as a whole, the evidence supports the conclusion that malaria control interventions substantially contributed to the observed decline in under-five mortality in Mali from 2000-2012, even in a context of continued high prevalence, and political instability. As Mali returns to a peaceful political status, the strong foundation of malaria control built over the past 15 years, provides a sense of optimism for future gains.