RWANDA BIOMEDICAL CENTER

A Healthy People. A Wealthy Nation

ANNUAL REPORT

Malaria & Other Parasitic Diseases Division
Rwanda Biomedical Center

2015-2016

Acknowledgement

The Ministry of Health and Rwanda Biomedical Center (RBC) would like to express its appreciation to all who contributed to the finalization of the Rwanda Malaria annual report. This report under the lead of the MOPDD of RBC represents a collaborative effort in the fight against malaria involving all stakeholders engaged in controlling malaria in Rwanda during the fiscal year of 2015-2016.

This document provides a realistic picture of key malaria control interventions implemented in Rwanda as of 30th June 2016. The strength and reach of the invaluable collaboration have channeled the collective contributions of engaged, passionate and active partners into powerful network to contribute to a malaria-free Rwanda.

I would like to acknowledge the efforts of dedicated staff from the MOPDD who worked tirelessly to draft and complete the programmatic report on time. MPPD-RBC with support of SPIU-RBC has assisted with the PSM part. We remain entirely grateful to the inputs and support provided by our Partners. Special thanks to PMI-USAID, local and international Non-Governmental organizations, members of civil society, and Rwandan Government institutions who greatly participated in the review of this report.

I would also like to thank all members of the Malaria technical working group who reviewed and validated the content of this report. The Rwanda Country coordinating Mechanism also endorsed this report.

Reaching our 2018 Rwanda malaria control goals will not only save lives, it will reduce poverty and create a healthier, more equitable society. Ensuring the reduction and pre-elimination of malaria will generate benefits for entire economy, health systems and households.

We look forward to the re-shaping and improvements in the delivery of interventions as a result of the findings presented in this report.

I commend this document to all those concerned about our common future to entre malaria pre-elimination by 2018. Transforming our understanding of the powerful return on investment of ending malaria deaths into dynamic and effective action on the ground will be essential to realizing the future we want, a Rwanda free from Malaria.

31/8/2016

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List of Abbreviations

ACT	Artemisinin-based combination therapy
AL	Artemether Lumefantrine
ANC	Antenatal care
ASM	Maternal health community health workers (Animatrice de santé maternelle)
BCC	Behavior change communication
CDC	Center for Disease Control
CHAN	African Nations Championship
CHW	Community health worker
CPDS	Coordinated Procurement and Distribution System
DHA+PQ	Dihyroartemisinin-piperaquine
DHS	Demographic and Health Survey
DQA	Data quality audit
EPI	Expanded program on immunization
EQA	External Quality Assurance
FANC	Focused Antenatal Care
FY	Fiscal year
GF	Global Fund
GoR	Government of Rwanda
HBM	Home based management
HBMA	Home based management in adults
HMIS	Health Management Information System
HSSP III	Third Health Sector Strategic Plan
iCCM	Integrated community case management of malaria
IPTp	Intermittent preventive treatment
IRS	Indoor residual spraying
ISTp	Intermittent screening and treatment
ITN	Insecticide treated net
IVM	Integrated vector management
LAMP	Loop mediated isothermal amplification
LLINs	Long-lasting insecticide nets
MCHIP	Maternal and Child Health Integrated Program
MCP	Malaria Contingency Plan
MIP	Malaria in pregnancy
MIS	Malaria Indicator Survey
MoH	Ministry of Health
MOPDD	Malaria and Other Parasitic Diseases Division
MPPD	Medical Procurement and Provision Division
MSP	Malaria Strategic Plan
MTEF	Mid-Term Expenditure Framework
MTG	Malaria Treatment Guidelines
MVU	Mobile Video Unit

NRL	National Reference Laboratory
NSP	National Strategic Plan
NSPPSC	National Strategic Plan for Pharmaceutical Supply Chain
PCR	Polymerase chain reaction
PMI	Presidents Malaria Initiative
PSM	Procurement and supply chain management
PTF	Pharmacy Task Force
QC	Quality control
RBM	Roll Back Malaria
RDT	Rapid diagnostic test
RMTS	Rwanda Malaria Tracking and Surveillance
SBCC	Social behavior change communication
SOP	Standard Operating Procedure
SP	Sulfadoxine-pyrimethamine
TWG	Technical Working Group
UC	Universal coverage
WHO	World Health Organization

Executive Summary

Rwanda is targeting malaria pre-elimination defined as the reduction to near zero death due to malaria, by 2018 – an effort that requires robust evidence-based efforts and strong collaborations with neighboring countries. The Rwanda HMIS reveals that since the end of 2012 to today, Rwanda has experienced an increase of malaria morbidity. The 10 districts with the highest number of cases represent more than 62% of all total malaria cases, with these districts predominantly in the Eastern and Southern provinces.

Following deep analysis of malaria situation, main reasons contributing to malaria increase in Rwanda are: increase in reporting and health utilization, substandard coverage and use of mosquito nets, climatic data anomalies, increase of pyrethroid insecticide resistance, as well as increase of malaria in the region. In January 2016, the Malaria Contingency Plan was developed, approved and implemented to tackle the rising burden of malaria in Rwanda. From July 2015 to June 2016, the following key malaria control interventions were implemented:

1) LLINs distribution has been prioritized in ANC and EPI services and high malaria burden districts, however given delay in LLINs procurement and deliveries; universal coverage has not been achieved. A total of 97,984 LLINs have been distributed to primipares attending ANCs while 304,428 LLINs have been distributed to children under one attending EPI routine vaccination. A total of 1,279,511 LLINs were mass distributed across 16 high-risk districts. As a result, 81% of households own at least an ITN and respectively 80% of children under five and 88% of pregnant women leaving in household with LLINs have slept under an ITN the night preceding the survey;
2) IRS has been implemented in 6 high malaria districts reaching an average coverage rate of 98.7%. Since Rwanda has chosen carbamates insecticide, data has shown decline of malaria in those districts while malaria continues to increase in other districts. Rwanda has continued to monitor insecticide efficacy and resistance as well as entomological monitoring;
3) Improving early diagnostic and treatment through availability of malaria commodities, quality control, and strengthening and capacity building to help reducing malaria transmission at all levels of health care, resulting in 99.96% of confirmed malaria cases

tested prior to ACTs treatment. This has ensured early and prompt treatment, preventing increase of severe malaria cases, hence preventing malaria deaths;

4) Strengthening of community case management has resulted in the treatment of 96% of children under five within 24 hours of symptoms onset as well as 96% of children tested with RDTs prior to ACTs treatment. Community case management has been extended to children above 5 years of age and adults in 12 districts. More than 95% of adults treated are treated within 24 hours of onset of malaria signs and symptoms;
5) Malaria surveillance through reactive case detection in 6 pre-elimination districts. In these districts, 33.9% of malaria cases were notified due to an increase in malaria cases. Among those notified, 80.1% were investigated;
6) Strengthening of behavior change communication through community sensitization and mobilization using radio, TV, drama, and campaigns with strong involvement of local leaders;
7) The execution of Global Fund RBF Malaria budget was 43% while Government support was executed at 140% and PMI at 100%. The total funds used for malaria expenditures during this fiscal year were 36,776,909USD equivalent to 69,5% budget execution including the three sources of funding (Government, PMI, and Global Fund).

Rwanda has scaled up key malaria control interventions based on scientific evidence and supported by an exemplary organization and management of the health system. As a result, most of the key Rwanda MSP indicators targeted for this year have been achieved with exception of the malaria burden increase, which has resulted in the implementation of the Malaria Contingency Plan as a Government of Rwanda priority.

INTRODUCTION

Malaria is a major public health problem in Rwanda, among the leading causes of morbidity and mortality. Rwanda has made significant strides in controlling the epidemic through implementation of various control interventions including: mass distribution campaigns of long-lasting insecticide nets (LLINs), indoor residual spraying (IRS) in high-risk districts, adoption of mandatory laboratory confirmation, use of ACTs, and national scale up of community based management. Despite these successes, Rwanda has seen an increase in malaria morbidity since the end of 2012. This increase in cases is attributable to several factors, including vector density and resistance, climate anomalies (temperature and rainfall), environmental modification, human behavior, and non-universal coverage of effective interventions.

The Rwanda Malaria Strategic Plan (MSP) 2013-2018 builds on national policies and strategies that inform the Third Health Sector Strategic Plan (HSSP III) 2013-2017, as well as the Rwanda Vision 2020 which has the ambition of making Rwanda a lower-middle income country by 2020, and recognizes malaria as a major disease that constitutes a major health and economic problem. The vision of the current Rwanda MSP is a Rwanda free from malaria as a way to contribute to socioeconomic development. The MSP details an ambitious plan to achieve pre-elimination by 2018 and to achieve zero malaria-related deaths. This will be achieved by strengthening and implementing appropriate control interventions and quality health delivery services. Achievement of pre-elimination will require a concerted and collaborative effort the Government of Rwanda (GoR) and other partners. The specific objectives of the MSP are to achieve the following by 2018:

1) At least 85% of population at risk will be effectively protected with locally appropriate vector control interventions;
2) All malaria cases will be tested with a quality assured diagnostic method and promptly treated in line with the national guidelines;
3) Malaria morbidity measured by slide positivity rate will be less than 5% with six initial districts achieving this by 2016;
4) All health units will report timely, completely, and accurately on key malaria indicators;

5) Effective program management and coordination will be expanded to all levels including multi-sectoral and regional partnerships;
6) 95% of the population will have correct knowledge of malaria prevention and control.

As a result of the rise in cases, a Malaria Contingency Plan (MCP) has been developed and implemented since January 2016 with the aim of enhancing the implementation of current interventions to reduce the burden of malaria in the population. These malaria control interventions consist of the effective implementation of high impact interventions, including countrywide mass distribution of LLINs to reach universal coverage (1 net for 1.8 people), IRS using an efficacious insecticide in high-risk districts, early diagnosis and treatment at the health facility and community level, environmental management, and social behavior change communication (SBCC). These interventions need to be implemented simultaneously to decline the transmission of malaria and mitigate the severity of the disease.

The following report details the malaria control activities implemented over the 2015 to 2016 fiscal year (July 2015 to June 2016). These activities have been coordinated by the Malaria and Other Parasitic Diseases Division (MOPDD) of the Rwanda Biomedical Center (RBC), with support from other RBC and Ministry of Health (MoH) divisions, other GoR institutions, health facilities and community health workers (CHWs), and other partners.

PART I:

MALARIA PREVENTION

1. Introduction

Vector control is an essential component of malaria control and prevention. The two most important vector-control measures used in Rwanda are IRS and LLINs. IRS involves the spraying of an insecticide on indoor walls and ceiling where malaria vectors are likely to rest. In order to be effective, IRS needs to be implemented at a high level of coverage through malaria transmission seasons. In 2007, IRS was introduced in Rwanda targeting districts with high risk of malaria transmission. Initially, IRS was conducted across the three districts of Kigali City, and in 2009, it was expanded to include rural districts with a high burden of malaria.

LLINs are another malaria control tool that, when used by all or most members of the community, can reduce malaria transmission. LLINs are nets impregnated with synthetic pyrethroids, a fast-acting insecticide that will repel or kill mosquitoes, before or shortly after feeding. The current generation of LLINs lasts three to five years, after which point the net should be replaced. The GoR launched aggressive nationwide campaigns in 2006 and 2010 to scale up malaria control through the use of LLINs. The ultimate aim of LLIN distribution in Rwanda is to reach universal coverage (UC), defined as use by >80% of individuals in populations at risk of malaria by the Roll Back Malaria (RBM) initiative.[1] In order to achieve this, the WHO recommends supplying nets free of charge using a combination of periodic mass campaigns and routine delivery channels to deliver LLINs at scale.

Since 2008, these core vector-control interventions have been supplemented with other measures including larval source and environmental management. To ensure a successful and sustainable approach, MOPDD has embarked on the approach of integrated vector management (IVM).

In order to successfully implement optimal IVM strategies, a good understanding of the biology, behavior, and ecology of local vectors species is essential. This understanding includes: the types of breeding sites, the density of vectors, the species composition and their dynamics, and the biting and resting behavior of mosquitoes. Vector susceptibility to insecticides and entomological inoculation rates are other factors that determine the effectiveness of control measures. There is also a need for ongoing monitoring of the coverage, usage, quality, and durability of vector-control interventions following their deployment.

[1] Global strategic plan: roll back malaria 2005-2015. Geneva. Roll Back Malaria Partnership; 2005

2. Indoor Residual Spraying

2.1. IRS campaigns

Prior to implementation of the MCP, 5 districts were planned and targeted for IRS. According to the new recommendations in the MCP, 8 districts were planned to be sprayed in a second round of IRS; the total estimated need for this activity was USD 9.4 million. Due to budget constraints, of these 8 districts, 5 were sprayed. There was overlap between the districts sprayed in the two rounds meaning a total of 6 districts were sprayed over the FY2015-2016. These districts were: Bugesera, Gisagara, Nyanza, Nyagatare, Kirehe, and Gatsibo.

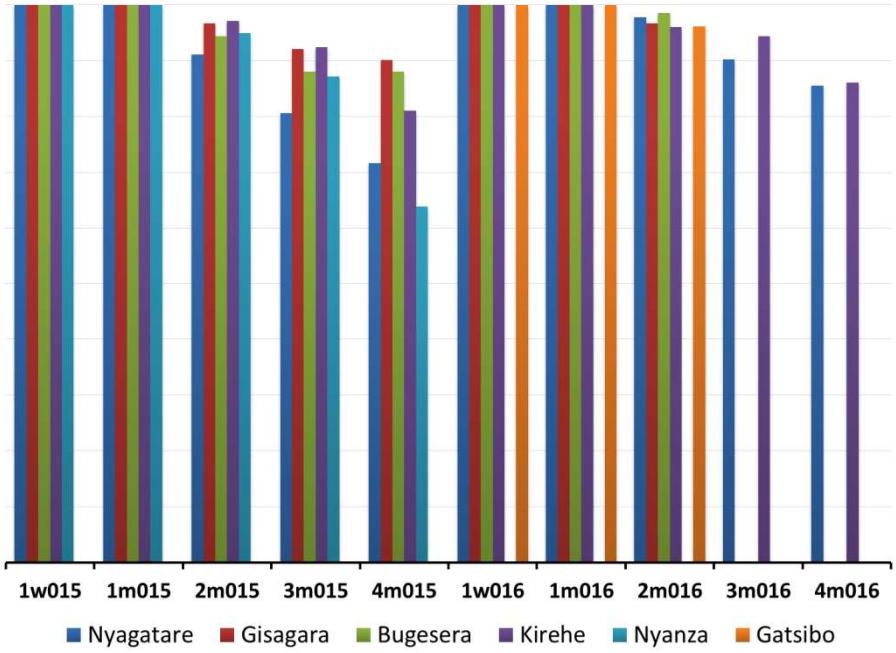
Over the September-November 2015 spray period, five districts were sprayed, with targeted spraying conducted in three districts and blanket spraying in the remaining two. The targeted IRS campaign was performed in Gisagara (4 out of 13 sectors), Nyagatare (4 out of 14 sectors), and Nyanza (5 out of 10 sectors). Bugesera and Kirehe districts were blanket sprayed. A total of 260,060 structures were sprayed out of 263,961 structures identified by spray operators in the targeted areas, for a coverage rate of 98.5%. The insecticide used belongs to the class of Carbamates, “Bendiocarb 80 WP”, and a total of 213,205 sachets were used in a ratio of one sachet per 1.2 houses. Overall, 1,040,794 residents were protected including 16,394 (1.6%) pregnant women and 154,410 (14.8%) children under five years.

In the second IRS round of February-May 2016 implemented in line with the MCP, blanket spraying was carried out across five districts: Nyagatare, Kirehe, Bugesera, Gisagara, and Gatsibo. The total structures sprayed were 453,457 out of 458,672 targeted in 65 sectors. The average coverage achieved was 98.85%, with a usage of 384,671 sachets of Bendiocarb 80 WP at a ratio of one sachet per 1.17 structures. In these districts that received IRS, the total population protected was estimated to 1,804,121 people; 266,791 (14.8%) were children below age five and 30,322 (1.7%) were pregnant women. In addition, during the FY, MOPPD was called upon to target additional special populations with IRS, including schools and hotels across further districts.

2.2. IRS monitoring

Wall bioassays were performed on a monthly basis to determine the longevity of the insecticide used in the six districts targeted with IRS (Nyagatare, Bugesera, Gisagara, Kirehe, Nyanza and Gatsibo); the activity covered the two rounds of IRS campaign using Bendiocarb 80 WP as described above (Section 2.1). The activity was performed in 2 sectors per district with 6 houses per sector (2 plastered non-painted, 2 plastered painted, and 2 mud). The susceptible Kisumu strains of *Anopheles gambiae s.s.* reared at the MOPDD insectary based at national entomology laboratory were used for the tests. Mosquitoes 3-5 days old were exposed in each wall house at the top, middle and bottom level of the walls. Two replicates for each type of house were applied (plastered non-painted, plastered painted, and mud). The mortality after 24 hours exposure was calculated for both exposed and control samples.

Figure 1 Post IRS Wall Bioassays in FY2015-2016



The results of the IRS durability monitoring are shown in Figure 1. Following the IRS campaign conducted in September-November 2015, Bendiocarb 80 WP displayed a decline of residual efficacy at the forth month post spraying in two districts: Nyagatare and Nyanza. The same trend was found after the next IRS round conducted in February 2016 in Nyagatare and Kirehe. As of

June 2016, the results of the wall bioassay in Bugesera, Gisagara, and Gatsibo were available up to 2 months post spraying; the insecticide was still effective at this time. The results confirm a residual efficacy of Bendiocarb 80WP from three to four months in the context of Rwanda and two cycles per year will be needed in order to cover the two annual peaks of malaria transmission.

3. Long Lasting Insecticidal Bed Nets (LLINs)

3.1. Total LLIN procurement and distribution

In order to aim for UC of LLINs, routine distribution is organized through antenatal care (ANC) and expanded program on immunization (EPI) services to target pregnant women and children. In addition to routine distribution, mass household distribution campaigns are organized.

For the reporting period, there was a need of 7,412,937 LLINs to be distributed in order to reach UC. Due to delays in procurement, of this need, 1,279,511 LLINs were distributed (904,511 procured with Global Fund support and 375,000 procured with PMI support). A total of 6,201,501 additional LLINs are under procurement for distribution through FY2016-2017 (5,201,501 funded by Global Fund and 1,000,000 by PMI) using the budget allocated for FY2015-2016.

3.2. LLIN distribution to pregnant women and children under one year

Rwanda had committed to maintain LLINs universal coverage using a WHO/RBM strategy to distribute nets free of charge to pregnant women and children under one year through the ANC and EPI services respectively at health center level.

On a monthly basis, distribution of LLINs was reported through the national health management information system (HMIS). Over this FY, 97,984 LLINs were distributed to pregnant women through ANC services. A further 304,428 LLINs were distributed to children under one year through EPI services.

3.3. LLIN distribution to households through the mass campaign

In addition to the routine system of providing LLINs through ANC and EPI services, nets have been distributed to all households through mass distribution campaign. The mass distribution campaign was used to increase the chance of UC of LLINs as per the recommendation of RBM. Implementation of universal access campaigns started in March-April 2015 and continued in November 2015 and in February 2016. Table 1 below shows the number of LLINs distributed per district during the mass campaign distribution conducted in this FY; a total of 1,279,511 LLINs were distributed across 16 high-risk districts.

Table 1 Number of LLINs distributed to households across 16 districts in Nov 2015 and Feb 2016

Hospital	LLINs distributed
Remera-Rukoma	115,787
Gakoma	47,050
Kibilizi	42,950
Rwamagana	99,594
Nyagatare	145,221
Ngarama	83,877
Kabgayi	182,500
Gitwe	80,262
Ruhango	107,270
Gahini	28450
Kabutare	74650
Kibungo	28150
Kirehe	48,600
Nyamata	100,350
Nyanza	77,300
Rwinkwavu	17,500
Grand Total	**1,279,511**

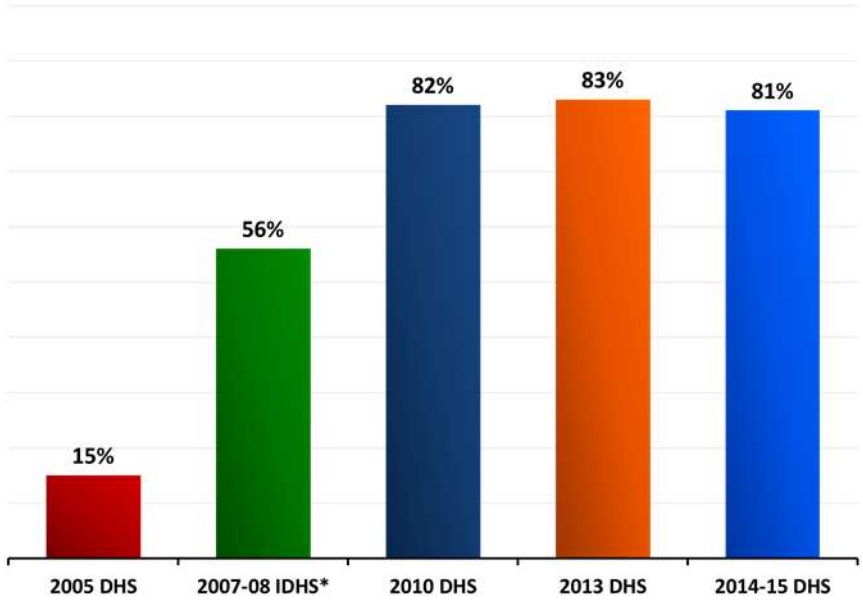
3.4. LLIN ownership and use

Malaria outcome indicators are evaluated every 2 years through the Malaria Indicator Survey (MIS) and every 5 years through the Demographic and Health Survey (DHS). From November 2014 to February 2015, the MoH, in collaboration with the National Institute of Statistics and MOPDD, conducted the DHS 2015 in order to evaluate key impact/outcome health indicators including malaria indicators. The final DHS 2014-2015 report was published in March 2016.

3.4.1. LLINs ownership and use by the general population

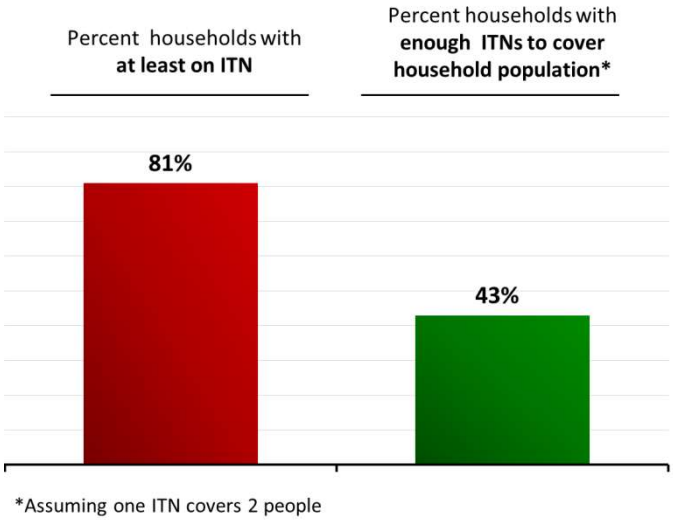
As shown in Figure 2, LLIN ownership has increased since 2005, when only 15% of households owned at least one LLIN. Since 2010, LLIN ownership has stagnated (81-83% between 2010 and 2015). Since the distribution of LLINs has been a rolling distribution, covering only targeted districts, Rwanda has not been able to reach UC.

Figure 2 Percent of households with at least one LLIN



*2007-08 IDHS categorized ITNs as long-lasting insecticidal nets (LLINs)

Figure 3 Ownership of LLINs, DHS 2014-2015

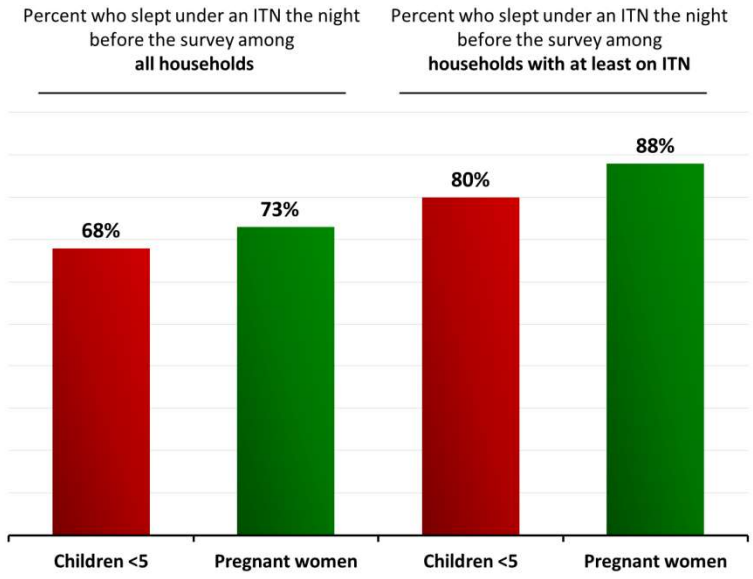


According to the 2014-2015 DHS, while 81% of households own at least one LLIN, only 43% of households have enough LLINs to cover each household member, assuming one LLIN is used by two people (Figure 3).

3.4.2. LLINs ownership and use by children under five years and pregnant women

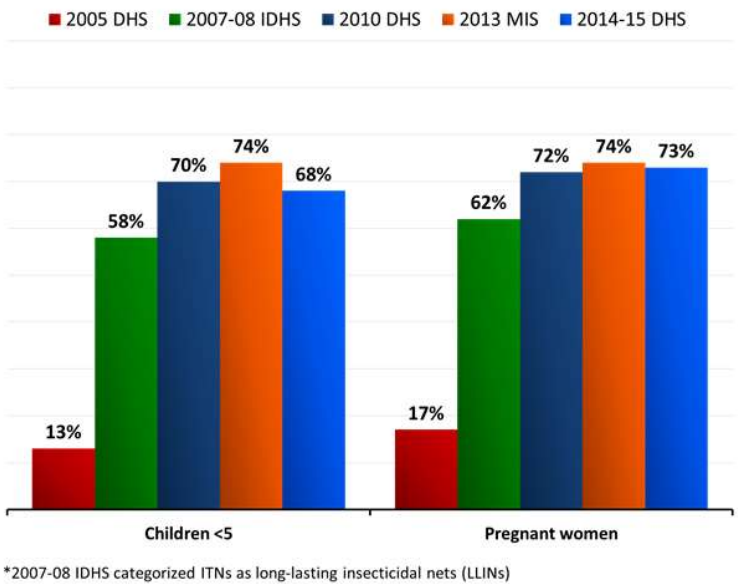
The DHS 2014-2015 reports data by risk group. As shown in Figure 4, more than two-thirds of children under 5 and 73% of pregnant women slept under an LLIN the night before the survey. When considering those households that own at least one LLIN only, 80% of children under 5 and 88% of pregnant women slept under an LLIN the night before the survey; this data indicates that owning a net does not imply that all individuals within the household are protected, including high-risk groups.

Figure 4 Use of LLINs in children under 5 and pregnant women, DHS2014-2015



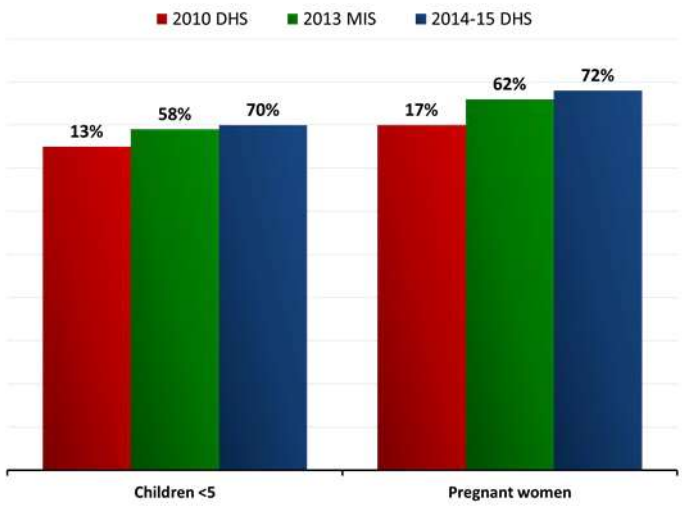
As shown in Figure 5, the use of LLINs among children under 5 and pregnant women has increased since 2005. Net usage has been stable since 2010 in both populations, even in households with at least one net (Figure 6).

Figure 5 The use of LLIN among all households



Percent who slept under a LLIN the night before the study among all households

Figure 6 The use of LLIN among households with at least one LLIN



Percent who slept under a LLIN the night before the study among households with at least one LLIN

3.5. Re-distribution of LLINs to balance LLIN stock at health centers

During this FY the program has observed that some health centers did not have adequate stocks of LLINs for routine distribution. To address this issue, the program adopted an approach to redistribute LLINs from health facilities with sufficient stock. In total 115,220 LLINs were re-distributed as follows: 100,870 LLINs rectangular for EPI and 14,350 LLINs conical for ANC to 217 HCs. This redistribution was done on basis of the authorization letter addressed to DHs for accountability.

3.6. Monitoring of LLINs data management at health centers level

An assessment of LLINs management by distribution channel at health centers was conducted. The main aim of the assessment was to verify the availability of management tools for each channel, and to give corrective recommendations to any problems identified. Specific objectives were as follows:

- Ensure the existence of guidelines for the LLINs distribution;
- Ensure the appropriate storage of delivery notes accompanying LLINs from the central level;

- Ensure the existence of stock card by distribution channel;
- Ensure the registration of LLINs beneficiaries using the latest version of distribution registers provided to health centers;
- Verify the consistency between the number of LLINs issued on the stock card and the number of registered beneficiaries for mass campaign and routine ANC and EPI;
- Physical inventory of LLINs in storage by distribution channels.

The LLINs management assessment was conducted in 94 health centers of Kirehe, Kabutare, Nyamata, Kiziguro, Ngarama, Gahini, Nyanza, Rwinkwavu, Mugonero, Munini, Gakoma, and Nemba district hospitals.

Discrepancies between LLINs issued on the stock card and LLINs distributed to registered beneficiaries was observed at all health centers for mass campaign, and routine ANC and EPI. In some health centers, one or more management tools were missing. It was recommended that facilities ensure that all management tools were completely filed and available at all times. MOPPD will ensure this is conducted through supportive supervision. All health centers with issues in LLINs management signed the supervision form with recommendations and commit to correct and improve LLINs management.

3.7. LLIN durability monitoring

LLIN durability monitoring was carried out between October and November 2015. LLIN collection was carried out from households under 13 district hospitals that distributed nets in the month of April 2015. The district hospitals were as follows: Kiziguro, Nyagatare, Kibungo, Kirehe, Rwinkwavu, Gahini, Gakoma, Kibilizi, Nyamata , Rwamagana, Nyanza , Remera-Rukoma, and Kabutare.

The monitoring consisted of physical integrity/deterioration assessment and bio-efficacy testing after 6 months of use. The households for sampling LLINs were randomly selected. Random selection was achieved using the LLIN distribution register stored at health facilities to ensure that the nets sampled were distributed 6 months prior to the assessment. Included nets were to have been found hanging in the households, regularly used by owners, and with the label

showing the date of manufacture and branding name of the net. After confirmation that the net was received as part of the April 2015 campaign, the net was eligible for evaluation if it fulfilled the criteria. The net was taken for use in the assessment; each collected net was replaced by a new one of the same type. This activity was conducted in partnership with the CHWs responsible for the distribution of LLINs to specific households.

Ten nets were collected from each district hospital catchment area making a total of 130 LLINs collected from different sites. The LLINs physical aspect and deterioration were evaluated by visual assessment and counting of holes. Table 2 below shows the LLIN physical deterioration index scores recommended by the World Health Organization (WHO) and utilized in the current assessment[2]:

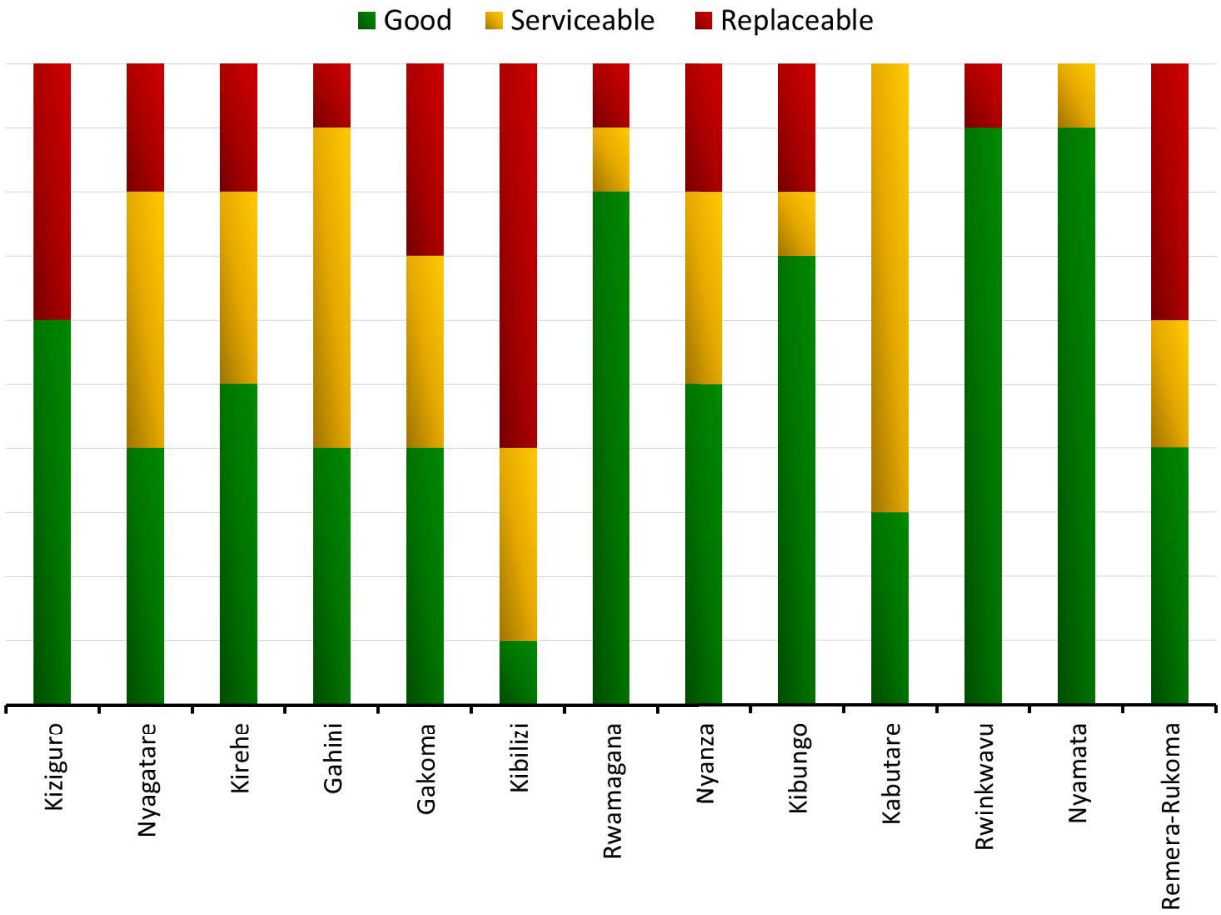
Table 2 WHO LLIN physical deterioration index

Hole size category	Score value
I – smaller than a thumb (0.5-2cm)	1
II – larger than a thumb but smaller than a fist (2-10cm)	23
III – larger than a fist but smaller than a head (10-25cm)	196
IV – larger than a head	578

The proportionate holes index (pHI) was calculated by multiplying the number of holes in a given category by the score value (above) and summing the results. Using the pHI, LLINs were categorized as 'in good condition' (pHI<64), 'in serviceable condition' (64≤pHI≤768), or as 'in need of replacement' (pHI>768). Figure 7 shows the results of the durability tests by district hospital.

[2] WHO (2011). Guidelines for monitoring the durability of long-lasting insecticidal mosquito nets under operational condictions.

Figure 7 Percent of LLINs deemed good, serviceable, or replaceable by district hospital



Overall results after 6 months of usage, 53% of the nets have been categorized as in good condition, 25% as serviceable nets, and 22% as replaceable nets. Kibilizi, Kiziguro and Remera-Rukoma district hospitals showed the highest deterioration level, with a large proportion of nets deemed unsuitable for use.

MOPDD conducts bio-efficacy studies in line with WHO guidelines to test insecticidal bio-efficacy. This bio-efficacy activity is conducted using 30% of the nets evaluated in the durability assessment. MOPDD is continuing the work of bio-efficacy testing.

4. Entomological Surveillance

4.1. Monitoring of bionomics of malaria vectors

Entomology surveillance was carried out over twelve sentinel sites (Bungwe, Rukara, Bukora, Kicukiro, Busoro, Karambi, Mashesha, Kivumu, Rwaza, Mubuga, Mareba, and Mimuli). Between July 2015 and June 2016, mosquitoes were collected from indoor and outdoor sites on a monthly basis for assessment of the following parameters: vector bionomics using human landing catching method, indoor resting behavior of mosquitoes using Pyrethrum Spraying catching method, and monitoring of larval density and occupancy using dipping method.

As shown in Table 3, during the activity a total of 184,339 mosquito vectors were collected: 39,688 (21.5%) were *Anopheles gambiae s.l.* and 974 (0.5%) were *Anopheles funestus.* Over the period, 54% *Anopheles gambiae s.l.* were found outside (exophilic); this varied from 45% to 92% by site. Overall, 46% of *Anopheles funestus* were found outside, varying from 31% to 100% across the sites.

The biting rate by *Anopheles gambiae s.l.* varied from 0 to 60 bites per person per night, with an average of 8 bites per person per night. The average biting rate of mosquitoes in general (*Culicidae*) was 36 bites per person per night (8 to 98 bites per person per night).

This information, particularly the site level data, can be used to inform the control methods used in specific regions.

Table 3 Distribution of malaria vectors

Site name	*Anopheles gambiae s.l.*			*Anopheles funestus*			Total *An.*	Total *Culicidae*	Biting behavior, %				Biting rate, /person/night		
	Inside	Out-side	Total	Inside	Out-side	Tota			Ag. Endo	Ag. Exo	Af. Endo	Af. Exo	Ag	Af	Culicidae
Mimuli	2,339	2,268	4,607	-	-	-	4,638	11,999	51	49	na	na	11	0	28
Mashesha	12,433	13,526	25,959	-	-	-	26,029	42,322	48	52	na	na	60	0	98
Mareba	1,415	2,240	3,655	-	-	-	3,925	35,127	39	61	na	na	8	0	81
Kicukiro	1,078	1,312	2,390	-	-	-	2,474	23,299	45	55	na	na	6	0	54
Karambi	51	117	168	-	-	-	180	3,505	30	70	na	na	0	0	8
Busoro	57	683	740	3	2	5	1,315	27,087	8	92	60	40	2	0	63
Bungwe	3	4	7	64	130	194	619	6,279	43	57	33	67	0	0	15
Bukora	84	199	283	-	4	4	290	12,801	30	70	0	100	1	0	30
Rwaza	17	67	84	-	4	4	98	5,613	20	80	0	100	0	0	13
Kivumu	51	47	98	99	44	143	450	8,829	52	48	69	31	0	0	20
Rukara	699	695	1,394	6	9	15	1,852	4,047	50	50	40	60	3	0	9
Mubuga	166	137	303	353	256	609	1,012	3,431	55	45	58	42	1	1	8
Total	**18,393**	**21,295**	**39,688**	**525**	**449**	**974**	**42,882**	**184,339**	**46**	**54**	**54**	**46**	**8**	**0**	**36**

Abbreviations: An. *Anopheles*; Ag. *Anopheles gambiae s.l.*; Af. *Anopheles funestus*; endo, endophilic; exo, exophilic

4.2. Insecticide resistance tests

The WHO mosquito susceptibility test (tube method)[3] was performed to determine resistance to the following seven insecticides belonging to the four classes: Carbamates: Bendiocarb 0.1%; Organophosphates: Fenitrothion 1%, and Pirimiphos methyl 0.25%; Organochlorines: DDT 4%; and Pyrethroids: Permethrin 0.75%, Deltamethrin 0.05%, Lambdacyalothrin 0.05%.

Larvae collection from the *Anopheles* genus was conducted using the dipping method as described by the WHO[4]; larvae were subsequently reared in the MOPDD insectary following the standard conditions of temperature (26-28°C) and relative humidity (70-80%). The susceptibility test was conducted on *Anopheles gambiae s.l* aged 2 to 3 days, and fed with sweet juice.

The mosquitoes were exposed to the insecticide for one hour (knock down test) and observed for 24 hours post-exposure for mortality assessment; exposure mortality was calculated as number of dead mosquitoes over total number. A mortality rate between 98% and 100% is considered to indicate susceptibility; 90-97% mortality suggests the possibility of resistance that needs to be confirmed. Mortality <90% indicates resistance. For testing, a minimum of 100 mosquitoes were used in 4 replicates with 20-25 females per tube for each insecticide. Each test had a control replicate and exposure mortality was corrected should the control mortality outside of WHO thresholds.

In total, the resistance tests were carried out in 32 different sites between July 2015 and June 2016 (Figure 8). As per WHO recommendations and funding available, resistance testing was repeated in 10 sites, making a total of 42 assessments. The following results consider the results from the 32 different sites; in the case where 2 assessments had been carried and the results differed, the assessment with the highest level of resistance was included in the calculations.

[3] WHO (2013). Test procedures for insecticide resistance monitoring in malaria vector mosquitoes
[4] WHO (2003) Malaria entomology and vector control – Learner's Guide

Figure 8 Map showing the sites for insecticide resistance monitoring

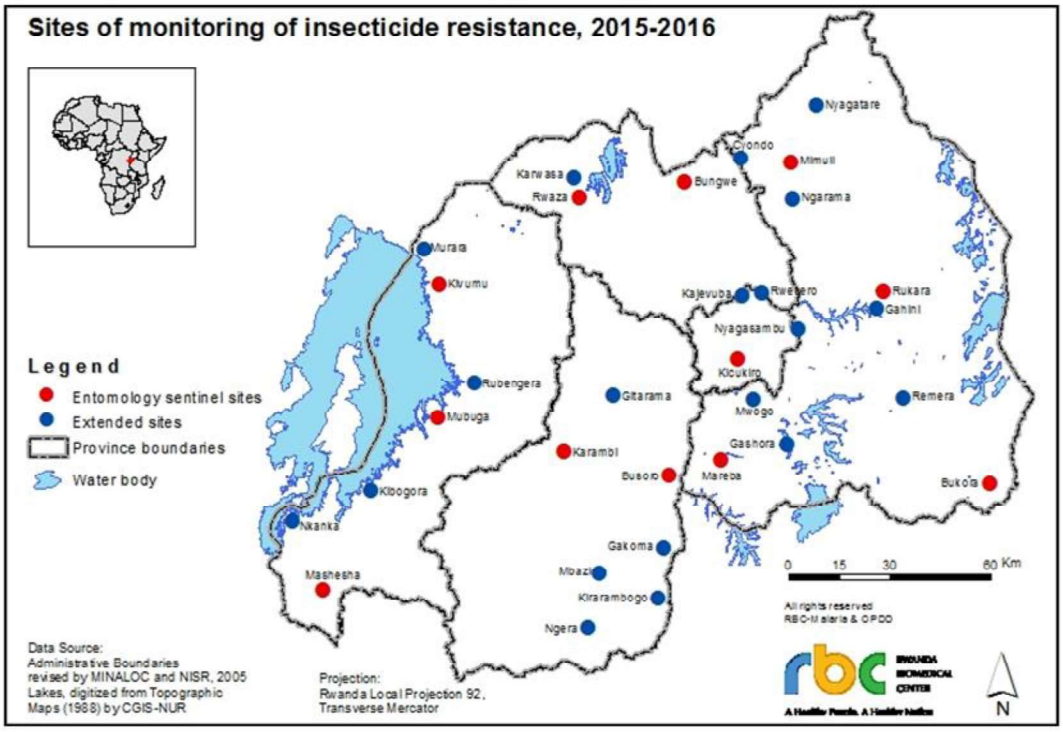


Table 4 shows the results of the resistance testing. The highest level of resistance was observed against the pyrethroid insecticides where 27 (84%) of sites surveyed had confirmed resistance to at least one insecticide in this class. Specifically, resistance to Permethrin was confirmed in 75% (24 sites), and to Lambdacyalothrin and Deltamethrin in 69% (22 sites). A high level of resistance was also observed to DDT (53%, 17/32 sites).

No resistance was observed to Fenitrothion (Organophosphates) in any site. No resistance was observed to Pirimiphos Methyl in 31/32 sites; in one site (Rubengera) there was suspicion of resistance (mortality rate: 92%). Resistance to Bendiocarb 0.1% was identified in two sites: Nyagasambu (mortality rate: 75%) in Rwamagana district and Karwasa (mortality rate: 81%) in Musanze district. No resistance to any of the insecticides tested was observed in seven sites: Bungwe, Cyondo, Kiyumu, Rwaza, Gakoma, Mareba, and Busoro.

In four of the sites with confirmed resistance to pyrethroids, the use of synergists to boost the toxicity of certain insecticides was evaluated. In 3 of the 4 sites with confirmed resistance to

Pirimiphos Methyl, resistance was no longer found when applied with a synergist. In the 2 sites with confirmed resistance to Deltamethrin, when the insecticide was applied with a synergist, resistance was no longer detected in one site; suspected resistance remained in the other site. These results suggest a significant role of metabolic mechanisms in mediating pyrethroid resistance in malaria vectors.

Table 4 Results of resistance tests for 7 insecticides performed 2015-2016

No	Sites surveyed	Month/ year	*Delta.* 0.05%	*Perm.* 0.75%	*Λ-cyhal* 0.05%	*Pirim.* 0.25%	*Bend.* 0.10%	*Fen.* 1%	DDT 4%
1	Bukora	Dec-15	SS	RR	RR	SS	SS	SS	SS
	Bukora	Jun-16	RR	RR	RR	SS	SS	SS	SS
2	Bungwe	Aug-15	SS	SS	SS	SS	SS	SS	SS
	Bungwe	May-16	RS	RR	RS	SS	RS	SS	SS
3	Busoro	Mar-16	RS	SS	RS	SS	SS	SS	SS
4	Cyondo	Aug-15	RS	RS	RS	SS	SS	SS	RS
5	Gahini	Oct-15	RR	RR	RR	SS	RS	SS	RR
6	Gakoma	Sep-15	RS	RS	RR	SS	SS	SS	SS
	Gakoma	Mar-16	SS	RS	RS	SS	SS	SS	SS
7	Gashora	Jan-16	RR	RR	RR	SS	RS	SS	RR
8	Gitarama	Oct-15	RR	RR	RR	SS	RS	SS	RR
9	Kajevuba	Nov-15	RR	RR	RR	SS	RS	SS	RR
10	Karambi	Feb-16	RS	SS	RR	SS	RS	SS	RS
11	Karwasa	Apr-16	SS	RR	RS	SS	RR	SS	RS
12	Kibogora	Feb-16	RR	RR	RR	SS	RS	SS	RR
13	Kicukiro	Jul-15	RS	RR	RS	SS	SS	SS	SS
	Kicukiro+syn	Jul-15		SS					
14	Kirarambogo	Nov-15	RR	RR	RR	SS	RS	SS	RR
15	Kivumu	Mar-16	SS	RS	RS	SS	SS	SS	SS
16	Mareba	Dec-15	SS	RS	RS	SS	SS	SS	SS
	Mareba	Jun-16	SS	RS	SS	SS	SS	SS	SS
17	Mashesha	Feb-16	RR	RR	RR	SS	RS	SS	RR
18	Mbazi	Sep-15	RR	RR	RR	SS	SS	SS	RR
	Mbazi+syn	Oct-15		SS					
19	Mimuli	Sep-15	RR	RR	RR	SS	RS	SS	RR
	Mimuli	May-16	RR	RR	RR	SS	RS	SS	RR
	Mimuli+syn	Sep-15	RS	RR					
20	Mubuga	Jul-15	RS	RR	RR	SS	SS	SS	RR
	Mubuga	Apr-16	RR	RR	RR	SS	SS	SS	RR
21	Murara	Mar-16	RR	RR	RR	SS	SS	SS	RR

No	Sites surveyed	Month/ year	*Delta.* 0.05%	*Perm.* 0.75%	*Λ-cyhal* 0.05%	*Pirim.* 0.25%	*Bend.* 0.10%	*Fen.* 1%	DDT 4%
22	Mwogo	Oct-15	RR	RR	RR	SS	RS	SS	RR
23	Ngarama	Sep-15	RR	RR	RR	SS	SS	SS	RS
	Ngarama+syn	Sep-15	SS	SS					
24	Ngera	Nov-15	RR	RR	RR	SS	RS	SS	RS
25	Nkanka	Feb-16	RR	RS	RR	SS	SS	SS	RR
26	Nyagasambu	Nov-15	RR	RR	RR	SS	RR	SS	RR
	Nyagasambu	Jun-16	RR	RR	RR	SS	SS	SS	RS
27	Nyagatare	Sep-15	SS	RR	RS	SS	SS	SS	SS
	Nyagatare	May-16	RR	RR	RR	SS	SS	SS	RR
28	Remera	Oct-15	RR	RR	RR	SS	RS	SS	RR
	Remera	Jun-16	RR	RR	RR	SS	SS	SS	RR
29	Rubengera	Apr-16	RR	RR	RR	RS	RS	SS	RR
30	Rukara	Jan-16	RR	RR	RR	SS	RS	SS	RS
31	Rwaza	Apr-16	RS	SS	RS	SS	SS	SS	SS
32	Rwesero	Sep-15	RS	RR	RR	SS	SS	SS	SS
	Rwesero	May-16	RR	RR	RR	SS	SS	SS	RR

SS: Susceptible, RS: Resistance Suspicion, RR: Confirmed Resistance.
Syn; synergist; *Λ-cyhal*, Lambdacyhalothrin; *Perm.*, Permethrin; *Delta.*, Deltamethrin.; *Bend.*, Bendiocarb.; *Fen.*, Fenitrothion; Pirim. *Meth,*. Pirimiphos methyl or Actellic.

4.3. Entomology capacity building

Within the framework of entomology capacity building, the following activities were achieved:

- An entomology surveillance workshop on planning activities was held in Nyagatare in December 2015. In total, 44 participants attended the workshop: 5 representatives of MOPDD, 1 from Abt associates, 2 from national referral laboratory (NRL); Titulaires; Accountants; and 12 entomology technicians from health centers hosting entomology sentinel sites;
- Entomology refresher training held in Nyagatare in December 2015. The primary objective of the training was the capacity building of the entomology technicians in mosquito identification and basic data analysis. Thirty one people attended the training: 23 entomology technicians from the 12 sentinel sites, 6 from MOPDD, and 2 from NRL;
- In collaboration with CDC Atlanta, a training in September 2015, and refresher training in May 2016 were organized on PCR and Lamp for malaria parasites and vectors

identification; both trainings were conducted at the Entomology laboratory established at Kicukiro/the School of Public Health, University of Rwanda. Participants were staff from MOPDD vector control unit and NRL;

- In collaboration with Biozeq Kenya Ltd, refresher training was conducted in June 2016 for 3 vector control officers for identification of acetylcholinesterase (ace-1R) in *Anopheles gambiae*;
- Training of student interns and visit of students from the University of Rwanda.

5. Prevention of Malaria in Pregnancy

Interventions to prevent pregnant women from malaria are few, though effective. First, a pregnant woman should sleep under an LLIN every night from the beginning of pregnancy. Secondly, in high and stable transmission areas, intermittent preventive treatment (IPTp) with sulfadoxine-pyrimethamine (SP) should be given as early as possible.[5] Thirdly, mechanisms should be in place to quickly detect and treat malaria in pregnancy.

In Rwanda, the use of IPTp with SP has been deemed inappropriate because of widespread SP resistance and low malaria incidence rates in some districts. At first ANC attendance, all pregnant women are given an LLIN and iron-folic acid supplements to prevent anemia. Malaria testing is not yet systematic for pregnant women and requires a health worker to suspect that an ANC client might have malaria based on her symptoms, complaints and/or vital signs.

Recent studies on malaria in pregnancy (MIP) have focused on intermittent screening and treatment (ISTp) of malaria in pregnancy and also alternatives to SP due to increased resistance in many African countries. ISTp, wherein a pregnant woman is tested with a rapid diagnostic test (RDT) at each ANC visit, has been proposed as an additional control measure; women with a positive result are appropriately treated.

A 2011-2012 study of malaria prevalence in pregnancy in Rwanda in 6 districts, jointly conducted by MOPDD and the Maternal and Child Health Integrated Program (MCHIP), found

[5] WHO (2012). WHO Evidence Review Group: IPTp with sulfadoxine-pyrimethamine

that malaria persists in certain districts. In particular, 9.6% of new ANC clients in Nyagatare and 4.0% in Gisagara had malaria parasites as determined by RDT.

5.1. Implementation strategies

In the districts that receive facility-based care, pregnant women will be tested for malaria at the health center during all ANC visits using RDT and a blood smear, which is the common practice in Rwanda. If lab facilities are not available, then facilities will use RDT only. If the test is positive, women will be offered treatment as per Rwanda malaria treatment guidelines with artemisinin-based combination therapy (ACT), or quinine for those in the first trimester. These women will be followed by maternal health community health workers (ASMs) to make sure that they attend scheduled ANC visits in line with the Focused Antenatal Care (FANC) guidelines.

In the district that ISTp will be implemented at community level, the activity will be integrated in the ASM's routine ANC work. Pregnant women will be tested at health centers at the first ANC visit using RDT and blood smear. Subsequently, ASMs and binomes will conduct malaria testing at the community level, using an RDT and blood smear (prepare slide to be sent to health center for staining and reading). The ASMs and binom.es will be expected to test women a total of three times during pregnancy aligned with the usual schedule for the ANC to the women. All women positive for malaria during the second or third trimester will be treated by ASMs or binomes using the regimen described above; all women positive for malaria in the first trimester will be referred to the nearest health center or district hospital for treatment with quinine.

PART II:

MALARIA CASE MANAGEMENT

1. Introduction

The 2015 updated WHO Guidelines for the Treatment of Malaria stipulate that early diagnosis and prompt effective treatment remain a key component of malaria control and elimination strategies. In line with this and Rwanda's 2013-2018 MSP, Rwanda is striving to improve access to early diagnosis and appropriate case management to reduce the malaria burden. To achieve this it is important to ensure use of standard treatment guidelines, availability and delivery of effective diagnostics and antimalarial medicines, and training and supervision of health care workers at all levels of health care delivery.

In 2009, MOPDD adopted WHO recommendation to require diagnostic confirmation of all fever cases. As such, MOPDD in collaboration with partners are supporting the strengthening of diagnostic testing to ensure that all patients with malaria are properly identified and can receive timely and appropriate treatment. All individuals parasitologically confirmed are categorized as having either uncomplicated or severe malaria for the purpose of prescribing treatment. According to WHO guidelines, Rwanda has adopted the use of Artemether Lumefantrine (AL) for the treatment of simple malaria. The use of intravenous artesunate monotherapy is implemented countrywide for treatment of severe malaria cases. MOPDD works closely with the Medical Procurement and Provision Division (MPPD) to ensure availability of these commodities across the country.

In order to facilitate access to care and reduce time to effective treatment, home-based management of fever (HBM) was introduced in 2004 and scaled-up to all districts in 2008. HBM utilizes volunteer CHWs elected by the population to identify and treatment cases of malaria in children less than 5 years old and to refer severe cases to health facilities for appropriate management. CHWs are appropriately trained to recognize malaria using RDTs and administer packaged ACTs (AL) according to age-specific treatment protocol. Malaria HBM is incorporated in the integrated community case management of childhood illnesses (C-IMCI) strategy to ensure comprehensive and continuous care to children less than 5 years at the village level. HBM has led to an increase in healthcare access and utilization, reducing malaria-related morbidity and mortality in children. As of 2013, 96% of children under 5 with malaria are tested and treated with ACTs within 24 hours of symptom onset, compared to 62% in 2008.

Following the increase in malaria cases and the severe malaria audit findings which showed that the majority of deaths occurred in adults and children above 5, HBMA was piloted in three districts in August 2015 This was scaled-up to 12 districts in May 2016 and the decision to scale further to the remaining 18 districts was agreed upon during the MCP approval process. The goal of the expanded HBM program is to provide timely treatment in the community for all cases of uncomplicated malaria, regardless of age. With HBMA, patients can be identified and treated early after symptoms emerge, preventing severe malaria and death, and limiting transmission.

In order to ensure quality of services, both at the facility and community level, a multi-level supervision plan has been implemented. Here, the national level is responsible for supervision of district hospitals, who subsequently supervise health centers. CHWs are supervised by staff at the health center and monthly CHW meets are held to cover data quality audit, drug management, and cooperative activities.

2. Update of Malaria Treatment Guidelines

In collaboration with district hospitals, district pharmacies, and partners, MOPDD reviewed the National Malaria Treatment Guidelines (MTG) 3rd Version following the release of the updated WHO MTG (3rd Version) in July 2015. Revision of the Rwanda National MTG started in October 2015and the first draft is now available. The Rwanda Malaria Technical Working Group (TWG) will review the document and provide inputs, with approval expected during the next FY. Once approved by the TWG, the updated MTG will be submitted to the Honorable Minister for publishing and authorization to be used by the end user at the decentralized level.

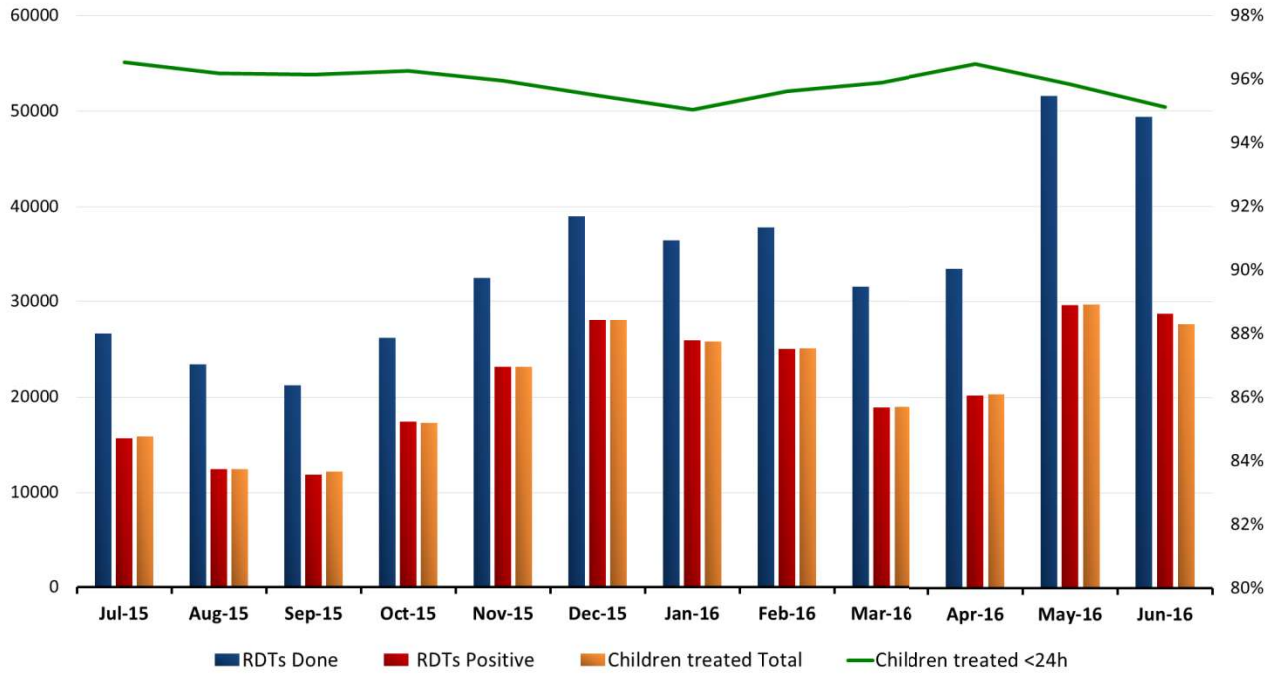
The next steps will be to print and distribute the MTG 4th Version, and provide refresher training of health providers and clinical mentors on the updated guidelines. Clinical mentors will be responsible for continued mentorship of health providers; for this to be successful, clinical mentor capacity should be further strengthened.

3. Case Management at the Community Level

3.1. Children under five years old

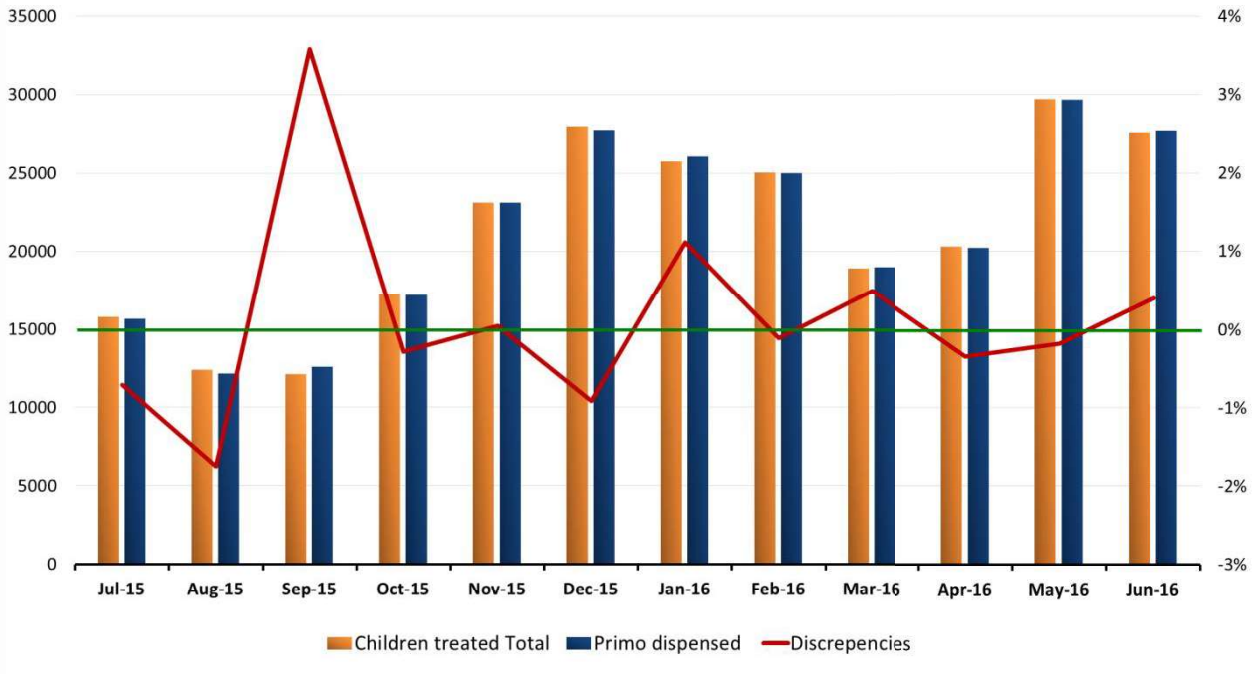
HBM for children less than 5 years old is implemented in all 30 districts of Rwanda. Figure 9 shows that more than 99% of children treated for malaria by CHWs are treated after a positive malaria biological test (malaria RDT). Above 96% of children treated by CHWs for malaria are treated within 24 hours of onset of malaria signs (fever). Management of malaria at the community level shows the seasonality pattern of malaria. There is a steady increase of cases from October with a high peak in December and there is a second peak starting in May; this normally correlates with the annual rainfall pattern.

Figure 9 Community Malaria Case Management in <5 YO, FY2015-2016



There are some discrepancies in key indicators between number of RDTs positive and cases treated reported by CHWs and actually number of drugs dispensed. Figure 10 shows these trends; there appears to be a slight improvement in reporting after September 2015.

Figure 10 Discrepancies between drugs dispensed and cases treated in HBM, FY2015-2016



3.2. Children above five years old and adults

HBMA was piloted in three districts in August 2015 and scaled-up to a further 9 districts in May 2016 (12 districts in total). These districts are as follows: Nyanza, Huye, Kamonyi, Nyagatare, Gatsibo, Kayonza, Kirehe, Ngoma, Rwamagana, Nyamata, Ruhango, and Gisagara. Data on the implementation of HBMA will be available in the next annual report.

In the MCP approval process it was agreed that HBMA would be scaled-up to the remaining 18 districts. These districts are now being prepared in terms of logistics, commodities, and monitoring. This will play a big role in malaria control, especially in interrupting the malaria transmission cycle, and will help to prevent the development of severe malaria cases and death.

4. Procurement and distribution of malaria commodities

4.1. Quantification of malaria commodities

The objective of good procurement and supply chain management (PSM) is to ensure that malaria commodities are available at all levels of the supply chain and the stock level is always between the minimum and maximum levels. MOPDD have managed to keep available stock within the desired stock levels using a new approach of weekly updates of status level from all facilities and the use of appropriate quantification tools, such as the pipeline software. Several quantification reviews took place over the reporting period with the following recommendations:

- **September-October 2015**: Urgent action required for 4 products: procurement of AL 6x3, AL 6x4, and quinine tablets in January 2016 to avoid stock out and procurement of quinine injection to be split in to 2 installments to avoid expiration;
- **December 2015**: Immediate procurement of artesunate given the long lead time of procurement, and procurement of additional AL 6x4 by the end of quarter two 2016;
- **January 2016**: All stock levels reviewed given urgent need to implement the home-based management in adults (HBMA);
- **February-March 2016**: Procurement and delivery of ACT products planned for June-September 2016 should brought forward to April 2016 to ensure sufficient stock levels.

Forecast accuracy of 2015 was found to be good in general with a variance of forecasted and actual consumption between 10 and 20%, except for quinine injection which had a variance of 30%.

4.2. Procurement of malaria commodities

Table 5 below summarizes the commodities procured in the fiscal year 2015-2016 by funder. Among the commodities submitted for procurement during the FY2015-2016, some will be received in 2016-2017 including 5,596,813 ACT blisters, 342,636 artesunate vials, and 46,617 Quinine injection vials.

Table 5 Malaria commodities distributed in FY2015-2016

Product	Quantity distributed	Quantity
Arte 20mg + Lume 120mg Tab (1X18) B/30	800,790	4,217,070
Arte 20mg + Lume 120mg Tab (1X24) B/30	2,322,210	
Arte 20mg + Lume 120mg Disp Tab (1X6) B/30	437,490	
Arte 20mg + Lume 120mg Disp Tab (2X6) B/30	656,580	
Artesunate 60mg Powder Inj with Solvent	165,203	165,203
Quinine 300mg Tablet B/100	763,100	763,100
Malaria Rapid Diagnostics Ag P.f/Pan 30T	2,911,440	2,911,440
Safety Boxes 25 Pieces for RDTs	393,850	393,850
Slides	643,200	643,200
Giemsa Stain 500ml	2,249	2,249
Glucose Isotonic 5% 500ml	29,352	58,102
Glucose Isotonic 10% 250ml	28,750	
Catheter Short IV UU 18G	2,200	5,700
Catheter Short IV UU 22G	3,000	
Catheter IV 20G	500	

Table 6 Quantification of commodities submitted for procurement in FY2015-2016

Products	GoR		GF	PMI		Total
	Jan-16	Mar-16	Oct-15	Apr-16	May-16	
AL 6X1	193,294	-	-	182,854	250,000	626,148
AL 6X2	593,201	454,028	-	376,239	300,000	1,723,468
AL 6X3	56,284	1,024,240	357,280	-	151,000	1,588,804
AL 6X4	536,400	2,481,452	819,540	-	377,000	4,214,392
Total ACTs submitted in 2015- 2016	**1,379,179**	**3,959,720**	**1,176,820**	**559,093**	**1,078,000**	**8,152,812**
Total ACTs procured to be received in 2016-2017						**5,596,813**
Artesunate injection	148,354	242,636			100,000	490,990
Quinine tablets	930,360	-	379,300			1,309,660
Quinine injection	18,287	46,617				64,904
Malaria RDTs	3,482,830	-				3,482,830

4.3. Distribution of malaria commodities

4.3.1. Routine distribution

Routine active distribution of malaria commodities is conducted by MPPD after validation of data by the malaria logistics officer. Table 6 shows the quantity of commodities routinely distributed over the FY.

4.3.2. Special distribution of drugs and commodities

In addition to active distribution, MOPDD sometimes conducts special distribution of malaria commodities. For example, in 2015 MOPDD distributed some commodities with a short expiration date (see Table 7 below).

Table 6 Special distribution of malaria commodities, FY2015-2016

Period	Product	Quantity distributed	Health Facility
Jul-15	Glucose 10%	2,720 bottles	LA CROIX DU SUD
	Catheter G18	1,600 pieces	
	Catheters G22	2,500 pieces	
	Giemsa solution	31 bottles	
	Immersion oil	26 bottles	
	Slides	24,200 pieces	
Sep-15	Glucose 5%.	1,140 bottles	POLICE
Nov-15	Glucose 5%	1,200 bottles	POLYFARM
	Glucose 10%	600 bottles	
	Giemsa	10 bottles	
	Immersion oil	25 bottles	
Nov-15	Glucose 10%	1,000 bottles	LA MEDICALE
	Giemsa	20 bottles	
	Immersion oil	20 bottles	
	Slides	5,000 pieces	

4.3.3. Distribution of drugs and commodities to pre-elimination districts

From July 2015 to June 2016, MOPDD distributed additional RDTs and ACTs to 11 district hospitals implementing active detection activities. These district hospitals were Gakoma, Kibirizi, Gisenyi, Muhororo, Kabaya, Shyira, Musanze, Ruli, Nemba, Butaro, and Nyagatare. Total commodities distributed are shown in Table 8.

Table 7 Total additional commodities distributed to pre-elimination districts

Commodity	Total quantity
Primo yellow	8,850
Primo red	6,042
AL 6x3	5,502
AL 6x4	12,611
RDTs	232,311
Gloves	65,520

4.3.4. Distribution of drugs and commodities for HBM

A malaria commodities distribution plan was produced and submitted to MPPD for active distribution of HBM/HBMA activities. For the treatment of children under five, AL 6x1 and AL 6x2 were packaged as Primo Red and Yellow, respectively, where Primo Red is for children aged 6 months to 3 years, and Primo Yellow is for children between 3 and 5 years (Figure 11). This package ensures that children receive the correct doses and full regimen of treatment. The quantity of Primo packaged in the FY is shown in Table 9.

Table 8 Quantity of Primo Red and Yellow packaged for distribution in FY2015-2016

Commodity	Q4	Q1	Q2	Q3	Total
Primo Red		192,250		194,489	386,739
Primo Yellow		167,750			167,750

Figure 11 Packaging of AL in to Primo packaging for children less than 5 years old

Malaria commodities for the treatment of children over 5 and adults have been distributed to 3 districts in order to initiate HBMA: Nyanza, Kamonyi, and Huye. The commodities distributed were the following: AL6x1: 6,750 blisters, AL6x2: 9,965 blisters, AL6x3: 8,507 blisters, AL 6x4: 16,688 blisters, malaria RDTs: 38,520 tests, and 2,500 safety boxes. In April 2016, MOPDD submitted to MPPD a distribution plan of commodities to avail HBMA commodities across all 12 implementing districts. Distribution quantities are shown in Table 10.

Table 9 Distribution plan for HBMA commodities, submitted April 2016

Product	Quantity (in unit of measures)
Artemether Lumefantrine 6x2	74,388 blisters
Artemether Lumefantrine 6x3	128,780 blisters
Artemether Lumefantrine 6x4	326,382 blisters
Malaria RDTs	355,382 tests

5. Monitoring of Malaria Commodities

5.1. Monitoring of stock, procurement, and distribution at MPPD

Monitoring of malaria commodities at MPPD was conducted throughout the FY. This was particularly important to ensure evaluation of the progress of the MCP. The following key findings were identified:

- Initial monitoring in the FY showed that AL6x2 and AL6x3 had less than 6 month of stock remaining. Planned shipments would return the stock to the maximum level;
- In September, an analysis of commodities at risk of expiry in 2015-2016 was conducted. Bendiocarb stock at risk of expiry was subsequently distributed. The remaining stock at risk of expiry was to be closely monitored and distributed to district pharmacies, district hospitals, and other potential clients to reduce the risk of expiration (e.g. referral hospitals and private clinics);
- In October, a meeting was held to monitor commodity procurement. Adjustments were made to the frequency of AL6x4 procurement, splitting the shipment to avoid expiry;
- A technical meeting held in January recommended to bring ahead the delivery of AL6x3 and AL6x4 from September 2016 to April 2016 to prevent stock-out;
- A technical meeting in April recommended to postpone the shipment of AL6x2 and to split the shipment of AL6x3 and AL6x4 to minimize the risk of expiration.

5.2. Monitoring of stock at district pharmacy and health facility level

A new online reporting tool was developed and implemented countrywide to monitor stock level for 10 key products at the facility level. District pharmacies are responsible for entering stock data to the database on a weekly basis for the pharmacy and respective health facilities; data is subsequently accessible by MOPDD and the MoH Pharmacy Task Force (PTF). The tool is used to help identify pharmacies with low stock and allow stock replenishment, either through redistribution of stock from high stock sites or through urgent distribution requests. The findings are shared with districts in order to assist with stock planning.

5.2.1. Validation of requests by district pharmacies

Due to the increase of malaria cases, some district pharmacies expressed the need to replenish their stock outside of routine distribution. MOPDD validated those requests with some modifications after analysis of data. In addition, MOPDD have validated requests from district hospitals for commodities with risk of stock out.

5.2.2. Supervision of malaria commodity management at district pharmacies

In October 2015, supervision relating to pre-elimination commodity management was conducted in 3 districts: Burera, Nyabihu, and Musanze. The findings showed that these districts managed very few products due to low endemicity of the region. There was no stock outs identified at Burera. In Musanze, there was stock out of Primo yellow; the request had already been made and delivery in process at MPPD. In Nyabihu stock out of Primo yellow was also observed: MOPDD recommended borrowing them from neighboring district while waiting for replenishment from central level.

5.3. Development of SOPs for health products quantification

In July 2015, Standard Operating Procedures (SOPs) were developed for the quantification of health products in order to integrate quantification in one single system (Coordinated Procurement and Distribution System; CPDS). The final drafts have been submitted to MoH authorities for approval.

6. Quality Control of Malaria Commodities

6.1. Quality control of RDTs

In order to ensure quality testing and diagnosis, MOPDD conducts quality control (QC) of RDTs stored at different levels of point of care. This activity is important to ensure that commodities have retained the principle ingredients, irrespective of storage conditions and temperature.

In February-March 2016, MOPDD collected 300 RDTs from 8 districts to be sent to an international laboratory for QC. They were collected from Gisagara, Nyaruguru, Musanze, Gakenke, Nyanza, Ruhango, Kicukiro, and Bugesera. The sample collection was conducted

according to WHO guidelines with the quantity of samples limited to 150 tests per lot. Samples collected were analyzed according to the TDR/FIND standards procedure and at a WHO recognized laboratory.

The RDT lot tested passed the QC test detecting antigen at a threshold sufficient for use in the field. 100% of tests were positive on the first test (200 and 2000 parasites/microliters); all tests were positive on repeat testing.

In October 2015, there were global concerns about the quality of Malaria Ag. (PLDH/HRP2) Combo Rapid Diagnostic Test in one of the lots procured. Those RDTs failed the 18-month stability study, and were therefore requested to organize a batch recall. In collaboration with MPPD, there was a recall of these RDTs. This entailed working with district pharmacies to identify which health facilities with the stock and organize recall. Approximately 93,000 of these tests were returned from health facilities to MPPD to be destroyed. This exercise helped to ensure that available malaria products for use by patients are of good quality.

6.2. Quality control of blood smears at district hospitals

The NRL has established the Laboratory Malaria Diagnosis External Quality Assurance (EQA) program to ensure the quality of malaria diagnosis in the national laboratory network. Besides the laboratory routine testing, this includes slides blind retesting, proficiency testing scheme, and on site supervision.

Quarterly evaluation of the quality of thick and thin smear practices, Giemsa staining, and microscopy results are enforced in health facilities in Rwanda. Health center practices are supervised by the district hospital; district hospitals are supervised by the NRL. Sample collection is done every 3 months; the total quantity of blood smears collected is variable depending on those available on site during the period of QC. For each quarter and per health facility 15 blood smears were collected for QC during the FY2015-2016.

Among the 42 district hospitals in which EQA/QC of blood smear was conducted during the FY, 39 presented at least one discordance. The overall discordance was 3.7%, with the highest

discordance of 9% found in Kigeme hospital. Table 11 shows the district hospitals with discrepancies about 5%, the threshold for acceptability.

Table 10 Quality control of blood smears, sites with discordance greater than 5%

District Hospital	Discordance rate
Kigeme	9%
Rwamagana	8%
Rwinkwavu	7%
Shyira	7%
Kirehe	7%
Kibuye	7%
Mibilizi	7%

6.3. Quality control of ACTs

To ensure all drugs are meeting the international pharmacopeia with adequate active ingredients, MOPDD conducted ACT QC in FY2015-2016. In February 2016, MOPDD collected ACTs from 41 sites (district pharmacies, district hospitals, health centers, and MPPD). The ACTs collected were: 528 blisters of AL 6x1; 292 blisters of 6x2; 259 blisters of AL 6x3; 174 blisters of AL 6x4; and 330 vials of Artesunate 60mg. These samples were sent to University of Rwanda for analysis. The results showed that all ACTs collected were of good quality.

7. Capacity Building and Case Management Strengthening

7.1.Supervision

During the FY2015-2016 onsite formative supervisions were conducted at different levels of the health structure from the district hospital level to the community level. More supervision sessions were conducted in close collaboration under the community health platform and with MOPDD partners.

7.2. Laboratory training

Light microscopy remains the gold standard for laboratory diagnosis of malaria, therefore, capacity building of microscopists is essential for making the correct diagnosis of malaria in Rwanda. A training to strengthen laboratory technicians' capacity using a microscope, especially to differentiate malaria species, was conducted in October 2015. The training took place in Huye district where facilitators from the NRL and district hospitals trained 82 participants from the health centers of Nyanza, Kayonza, Huye, Gatsido, Kirehe, and Ngoma districts. In order to improve diagnosis at all levels, a cascade training of at least two laboratory technicians is planned. The technicians will be responsible for training laboratory technicians at the health center level.

In order to strengthen the local capacity in polymerase chain reaction (PCR) analysis, MOPDD in collaboration with malaria experts from CDC Atlanta conducted training on PCR malaria diagnosis in May 2016 to 9 staff from the NRL and MOPDD in Kigali, Rwanda. The outcome objective of the training was that the trained staff will be able to independently perform molecular detection of malaria parasites, specifically using PCR and loop mediated isothermal amplification (LAMP).

7.3. Strengthening of community case management

Training is a key tool used by MOPDD in order to ensure that CHWs are delivering community health care according to the national guidelines. In line with this, a refresher course on integrated community care management took place for 19 national trainers. Additionally, during the FY, 1,806 new Binomes were trained on malaria case management at the community level (HBM and HBMA). These Binomes were from the following districts: Gasabo, Kicukiro, Nyarugenge, Kayonza, Ngoma, Kirehe, and Ruhango. The training had a special focus on the use of malaria RDTs, dispensing anti-malarial drugs, and management of commodities, including waste management.

A countrywide orientation meeting was held in January 2016 on the HBMA package with attendees including CHWs in charge of C-IMCI, health center titulaires, and district hospital directors. The HBMA roadmap was discussed and agreed upon based on real settings and the

stock available. During the orientation meeting, over 94% of CHWs were trained on the integration of malaria case management for all ages at the community level; training on the electronic reporting tools was also provided.

7.3.1. Monitoring and distribution tools for HBM

Reporting tools HBM were developed and 33,000 copies of each of the five tools (e.g. algorithm, case register, transfer note, etc.) were printed in collaboration with the RBC Planning Unit. Distribution of the tools is ongoing in districts.

For better data management, C-IMCI standardized data forms have been deployed at all levels, including forms for reporting consumption of medicines, number of treated cases, number of referrals, and funds collected. Each month, reports are compiled by the Binomes and contribute to the health center monthly report (SIS Com report). This data is used to inform the supply chain of medicines through a "pull" system, whereby CHWs are supplied on a monthly basis based on the consumption report.

8. Monitoring and Evaluation of Case Management

8.1. Quality of malaria diagnosis and healthcare

Once a year, MOPDD conducts an assessment of malaria deaths to evaluate the quality of malaria diagnosis and healthcare. The purpose of this activity was to: 1) characterize the patient population presenting at district hospitals with severe malaria, and 2) describe the diagnosis and treatment process for patients with severe malaria in Rwanda. Through chart reviews, the goal was to highlight areas within the malaria case-management process that could benefit from additional development in order to promote timely, accessible, and appropriate clinical care.

Preliminary findings showed that there is a need to set recommendations and orient health provider for the improvement of the management of severe cases and reinforcement of behavior change communication (BCC) in terms of seeking treatment as early as possible. Specific preliminary findings were as follows:

- Among 383 deceased patients, 32% were children under 5 years old and 45% were over the age of 15 years;
- 60% of adults who died from severe malaria were over the age of 50;
- Mortality rates for severe malaria were highest among patient in the Eastern and Western provinces;
- Rates of coma were particularly high among deceased adults at 71%;
- Blood smear microscopy was used to diagnose malaria in 89% of cases reviewed (9% used RDTs to confirm malaria infection);
- As per the guidelines, artesunate was the most commonly administered antimalarial drug among severe malaria cases.

Based on these key findings, the following recommendations were set:

- To identify the specific *Plasmodium* species associated with severe malaria;
- Decentralization of diagnostic and treatment services to the community-level;
- Additional mentorship training on appropriate documentation of treatment and monitoring;
- Clear guidelines on antibiotic use should be developed for use in the healthcare system.

8.2. Malaria health facility survey

This survey has the following main objectives:

- Description of the capacity of health facilities to provide quality health care services in the context of malaria;
- Identification of gaps in support services and resources in providing quality antimalarial drugs and quality of care;
- Evaluation of the management of simple and severe malaria;
- Highlight principal barriers and challenges in malaria case management at health facility level.

This survey is interpreted using a standardized tool to determine the functionality of health facilities and the quality of care with key indicators showing availability of commodities and expiry/rupture rate and assessment of health worker performance regarding malaria case

managed at the health center level correctly as output indicator. Through observation of clinical cases of health provider and exit interview of care giver, the treatment and counseling of patient or care giver shows that proportion of patients with simple malaria cases (clinical observation) who received correct treatment at the health center are at 98.4%.

8.3. Data Quality Audit

With the aim of developing an evidence-based system as a key strategy for better delivery of services, MOPDD entered into a cycle of review and validation of reported data through routine data quality audits (DQA). During this FY DQA were conducted twice in August 2015 and July 2016, with the main objectives:

- Verify the quality of reported data for key indicators at selected sites;
- Assess the ability of data management systems to collect and report quality data;
- Strengthen data management and reporting systems of audited sites.

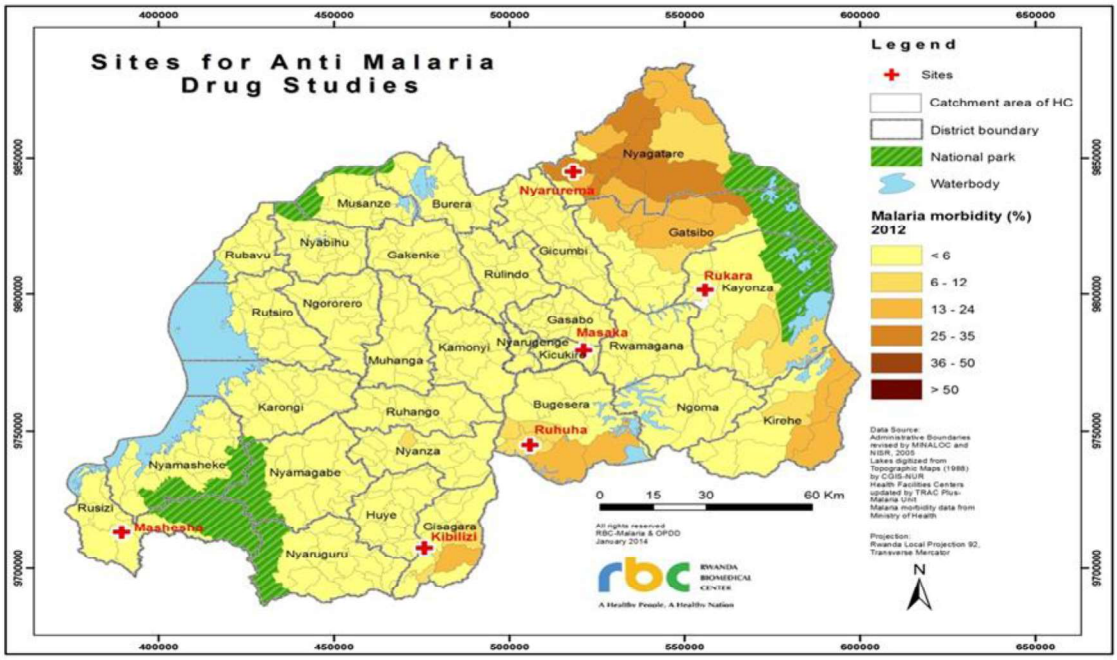
In August 2015 DQA data collection was conducted in 137 health facilities of 34 district hospitals while the July 2016 DQA round was conducted in 162 health facilities of 13 district hospitals. The report is currently being finalized and will be disseminated once complete.

8.4. Anti-malaria drug efficacy

Since 2001, antimalarial efficacy studies have been conducted routinely in Rwanda at 3 main sites: Rukara, Mashesha and Kicukiro health centers. In 2012 and 2013, 4 new sites were added to surveillance: Nyarurema in Nyagatare, Kibirizi in Gisagara, Masaka in Kicukiro, and Ruhuha in Bugesera counting six sites in total (Figure 12). Study protocols are developed according to WHO standard antimalarial drug efficacy protocol and are approved by the Rwanda Ethics committee.[6]

[6] WHO (2009). Methods for surveillance of antimalarial drug efficacy

Figure 12 Sentinel sites for antimalarial drug studies and malaria morbidity across districts



From 2012 to December 2015, MOPDD conducted an efficacy study of AL among children from 6 to 59 months. The study included 4 sites and the sample was 445 participants, with follow up visits at days 7, 14, 21, 28, 35, and 42. A second study to compare efficacy of AL and dihyroartemisinin-piperaquine (DHA+PQ) was conducted from 2013 to December 2015. This took place at 2 sites and recruited 576 individuals. These studies were conducted mainly with the support of the Global Fund and PMI. The results of these studies are shown in Table 12.

In April 2016, with the support of the WHO, samples for all participants were sent to Geneva/WHO for analysis. A qualified laboratory will receive samples and different analysis will be performed for PCR determination of parasitic genotype in the event of treatment failure; genotyping of the recurrent infection will be done by characterizing MSP1, MSP2, and GLURP respectively.

Table 11 Preliminary findings of ACT efficacy studies

Site	Screened	Recruited	Number of individuals (% of those recruited)				
			Success	ETF	LTF	Lost to follow-up	Excluded
STUDY TITLE: ETUDE ARTEMETHER - LUMEFANTRINE AU RWANDA							
RUKARA	1620	138	111	1	2	1	0
NYARUREMA	2290	82	52	1	25	2	2
KIBIRIZI	579	106	81	1	22	2	0
MUGANZA	981	119	86	1	29	3	0
Total	**5470**	**445**	**330**	**4**	**101**	**8**	**2**
STUDY TITLE: EVALUATION OF THE EFFICACY OF ARTEMISININ COMBINATION THERAPY COMPARING AL AND DUOCOTEXIN							
RUHUHA	1220	268	230	2	33	3	0
MASAKA	700	268	184	3	80	1	0
Total	**1920**	**536**	**414**	**5**	**113**	**4**	**0**

NB: PCR analysis has not yet been performed

PART III:

MALARIA SURVEILLANCE, EPIDEMIOLOGY, AND PREELIMINATION

1. Introduction

While scale up of control activities have led to an overall decline in malaria morbidity and mortality over the past 15 years, malaria remains a major public health challenge in Rwanda, with the entire Rwandese population considered at risk.

Morbidity and mortality data are collected routinely from all public health facilities through the Rwanda Health Management Information System (HMIS). The HMIS platform is also home to SIScom, the community health worker information system reporting information from HBM/HBMA. A separate database has been set up to capture data enhanced surveillance from pre-elimination districts (pre-elimination database). These data show that infection is seasonal and epidemic patterns vary geographically across the country. While there are general trends in risk, malaria transmission is unstable, correlated with variable rainfall periods and with the scale up of malaria control interventions deployed across the country. Since 2012 up to today, Rwanda has experienced an increase in malaria morbidity particularly in districts known to have a high malaria burden. Probable identified factors for this increase in factors include climate change (increased temperatures and rainfall), substandard LLINs, and insecticide resistance. This increase in cases not only compromises the health of the population, but also negatively impacts the nation's economic development.

2. Key Malaria Indictors

2.1. Malaria prevalence

From the DHS 2014-2015, the malaria prevalence was estimated at 0.6% for women aged 15-49 and 2.2% for children less than 5 years of age. Based on the current epidemiological profile in country, it would be beneficial to determine the prevalence in the general population in order to have an overall picture; using HMIS data, children under 5 represent only 9% of national malaria cases and may not be used to generalize across the population.

2.2. Malaria Incidence

Malaria incidence has been calculated from the general population. The current incidence rate in Rwanda is 308 cases per 1,000 people for FY2015-2016. The incidence for 2014-2015 was estimated at 179 cases per 1,000. This data reveals a significant increase in cases in FY2015-2016 which is likely due to a myriad of reasons.

2.3. Malaria morbidity

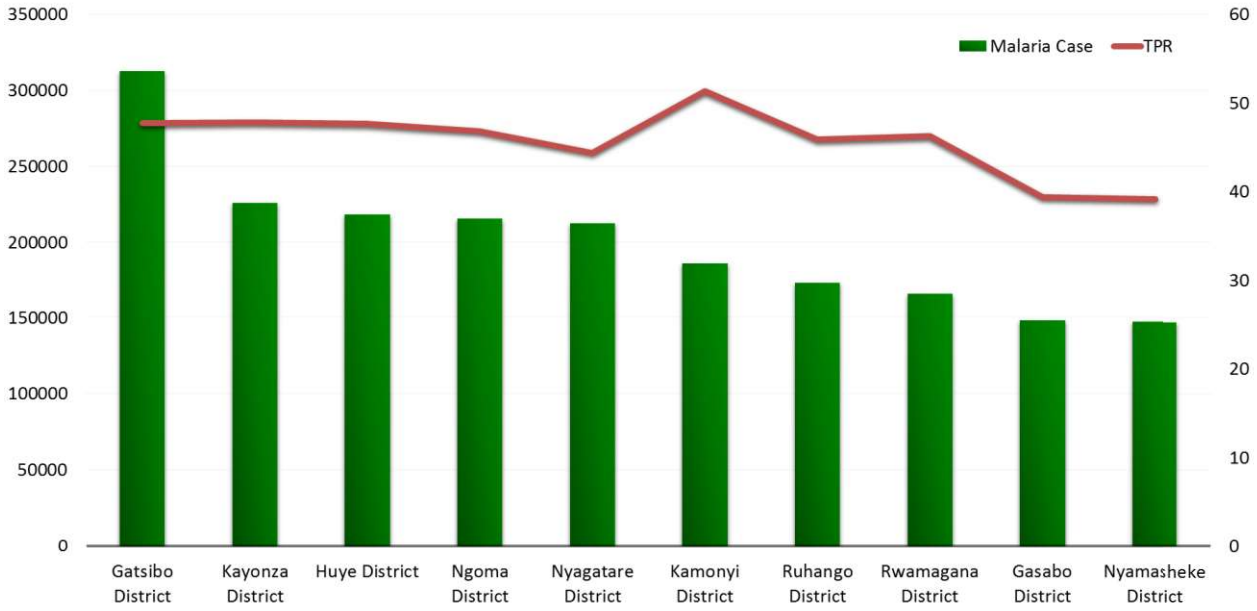
Of all individuals attending health facilities, 23.7% presented with malaria. This figure has increased from 2014-2015, where 16.4% of individuals presenting at health facilities presented with malaria.

2.3.1. Malaria test positivity rate

Countrywide, a total of 7,532,637 fever cases were screened during the FY with either a RDT or blood smear test at health facilities. Of those with suspected malaria, 99.96% were parasitologicaly screened (7,532,637/7,535,537). A further 387,719 individuals with fever received at the community level through HBM, among them 381,121 were tested with RDTs (99%).

This led to a countrywide malaria test positivity rate (TPR) estimated at 41.5% during the FY2015-2016. Higher TPRs were identified in districts with more malaria cases (Figure 13). This compares with a TPR of 37% during the FY2014-2015. The TPR may reflect changes in factors associated with malaria rather than true changes in malaria morbidity.

Figure 13 Malaria test positivity rate in top 10 districts with highest number of cases, FY2015-2016



2.3.2. Uncomplicated cases

From July 2015 to June 2016, a total of 3,921,835 uncomplicated malaria cases were reported and treated. The figures include all cases identified at the facility level and in the community (HBM/HBMA) recorded on HMIS, SISCOM, and the pre-elimination database. This data is shown by district in Table 13. Of these cases, 99.9% had confirmed malaria by either RDT or blood smear; 2,900 individuals were treated presumptively.

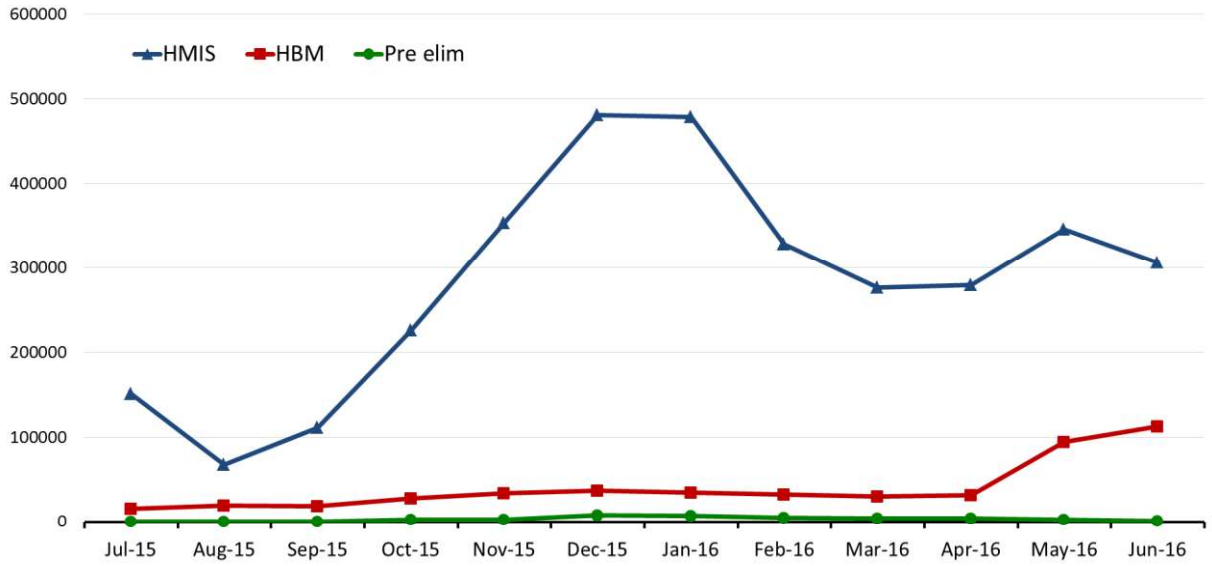
The majority of cases were identified at the health facility level (3,405,739, 86.8%); 474,155 (12.1%) were identified in the community (HBM/HBMA), and 41,941 (1.1%) were identified in pre-elimination districts through further investigation (Figure 14).

Of the databases, only the facility level (HMIS) disaggregated cases by age. Using this facility level data, 323,560/3,405,739 (9.5%) cases were in children under five; 90.5% of malaria cases identified at the facility level occurred in individuals 5 years and above. In the FY2014-2015, 2,044,431 cases of uncomplicated malaria were identified at the health facility level indicating an increase of 66.6% health facility identifications in the current fiscal year.

Table 12 Distribution of uncomplicated malaria cases by district (facility and community level), FY2015-2016

District	Province	Malaria Cases	Percentage
Gatsibo District	Eastern	340,151	8.70%
Ngoma District	Eastern	299,397	7.60%
Huye District	Southern	293,016	7.50%
Kayonza District	Eastern	264,528	6.80%
Nyagatare District	Eastern	259,367	6.60%
Kamonyi District	Southern	209,426	5.30%
Rwamagana District	Eastern	204,090	5.20%
Ruhango District	Southern	199,583	5.10%
Nyanza District	Southern	191,743	4.90%
Gasabo District	Kigali	159,378	4.10%
Gisagara District	Southern	154,965	3.90%
Nyamasheke District	Western	151,664	3.90%
Muhanga District	Southern	147,809	3.80%
Rusizi District	Western	111,397	2.80%
Karongi District	Western	110,229	2.80%
Kirehe District	Eastern	103,421	2.60%
Nyaruguru District	Southern	90,868	2.30%
Bugesera District	Eastern	89,133	2.30%
Nyamagabe District	Southern	87,160	2.20%
Rulindo District	Northern	68,408	1.70%
Gicumbi District	Northern	63,851	1.60%
Rubavu District	Western	60,112	1.50%
Ngororero District	Western	58,824	1.50%
Nyarugenge District	Kigali	49,140	1.30%
Kicukiro District	Kigali	47,580	1.20%
Rutsiro District	Western	41,397	1.10%
Gakenke District	Northern	40,371	1.00%
Burera District	Northern	9,430	0.20%
Musanze District	Northern	8,864	0.20%
Nyabihu District	Western	6,533	0.20%
Total		**3,921,835**	**100%**

Figure 14 Malaria cases by level of identification (facility & community level)



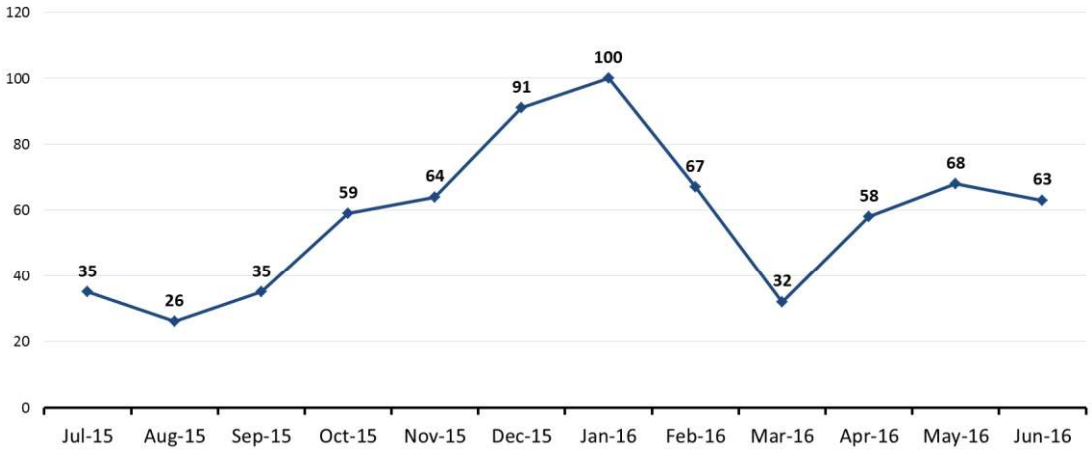
2.3.3. Severe cases

Over the reporting period, 18,030 cases of severe malaria were reported at the facility level. This is a 58.7% increase compared with the raw number of severe malaria cases reported from July 2014-June 2015 (11,362 severe cases). Of the total malaria cases reported, 0.5% of cases were severe malaria. This ratio of severe cases to total cases has not increased from FY2014-2015. This indicates that interventions such as early diagnosis and treatment have been successful in preventing an increase in the proportion of severe cases, despite the increased volume of cases and consequent burden on the health system.

2.4. Malaria mortality

Over the FY2015-2016, a total of 698 deaths were recorded as a result of hospitalization due to severe malaria. The number of deaths varied significantly by month and was highest between December 2015 and January 2016 (191 deaths; 28%). Figure 15 shows the total malaria-related deaths by month. Table 14 below shows the number of deaths due to malaria by district during this. Over the reporting period, malaria-related deaths accounted for 6.64% of all reported deaths. Of all severe malaria cases, 3.9% of individuals died as a result of infection (<0.02% of all malaria cases).

Figure 15 Malaria related deaths, FY2015-2016



The FY2015-2016 saw a 46% increase in the raw number of deaths compared with the same period from the FY2014-2015. The ratio of deaths to serious cases this FY was similar to that of FY2014-2015 (3.9% vs. 4.1% for FY2015-2016 and FY2014-2015, respectively). Trends in malaria related deaths are shown in Figure 16. Note that data from July 2015 up to January 2016 was audited and findings showed that the number of malaria death cases reported through HMIS was higher than when assessed during death audit exercise. The death audit to cover the period from February 2016 to June 2016 is planned to confirm the accuracy of data reported.

Figure 16 Trends in malaria deaths, 2013-2016

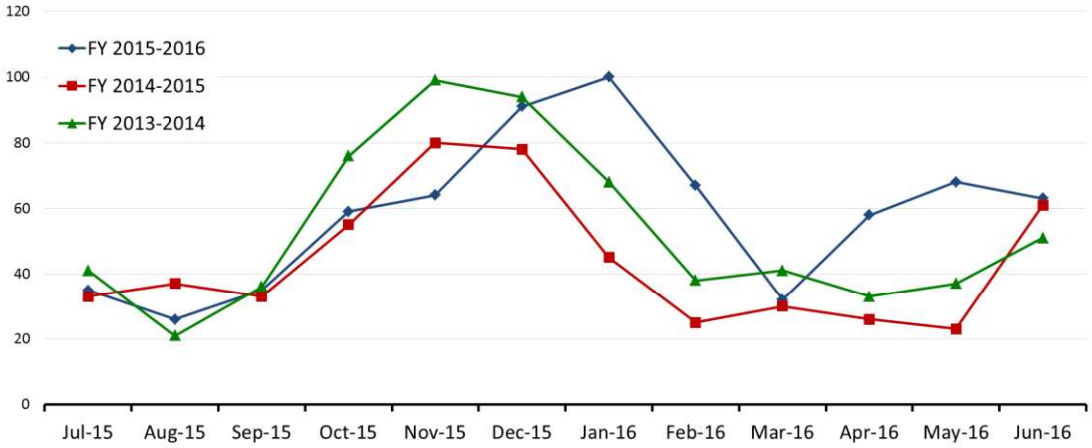


Table 13 Distribution of malaria deaths due to malaria by district, FY2015-2016

District	Province	No. deaths	% of deaths
Rusizi District	Western	62	8.9%
Karongi District	Western	51	7.3%
Gasabo District	Kigali	50	7.2%
Huye District	Southern	45	6.4%
Muhanga District	Southern	38	5.4%
Kayonza District	Eastern	34	4.9%
Rubavu District	Western	34	4.9%
Nyanza District	Southern	33	4.7%
Gatsibo District	Eastern	30	4.3%
Ruhango District	Southern	29	4.2%
Kamonyi District	Southern	28	4.0%
Nyaruguru District	Southern	28	4.0%
Nyamasheke District	Western	23	3.3%
Gicumbi District	Northern	21	3.0%
Rwamagana District	Eastern	21	3.0%
Ngororero District	Western	20	2.9%
Rutsiro District	Western	20	2.9%
Gisagara District	Southern	18	2.6%
Kicukiro District	Kigali	18	2.6%
Nyamagabe District	Southern	16	2.3%
Nyarugenge District	Kigali	16	2.3%
Gakenke District	Northern	13	1.9%
Nyagatare District	Eastern	10	1.4%
Musanze District	Northern	8	1.1%
Kirehe District	Eastern	7	1.0%
Rulindo District	Northern	7	1.0%
Bugesera District	Eastern	5	0.7%
Ngoma District	Eastern	5	0.7%
Nyabihu District	Western	5	0.7%
Burera District	Northern	3	0.4%
Grand Total		**698**	**100%**

3. Pre-Elimination

The aim of the pre-elimination phase is to reduce local transmission of malaria, in contrast to the control phase, in which the objective is to reduce the number of cases to low levels but not necessarily interrupt local transmission. The objective of a malaria surveillance system in the pre-elimination phase is to detect all malaria infections, whether symptomatic or not, and ensure that they are radically cured so early that they do not generate secondary cases.

Passive case detection should therefore lead to the detection of most malaria infections. The continuous presence of a health worker is required for good passive case detection in active transmission foci and is preferable to periodic visits by mobile teams. Passive case detection also serves as the trigger for reactive case detection. Active case detection is a complementary strategy that involves the detection by health workers of malaria infections at community and household level in population groups that are considered to be at high risk.

Active case detection is always used in epidemiological investigations of new cases and foci, among family members, neighbors, the population of the focus, people at the workplace of an index case, fellow exchange students etc. Active case detection can be fever screening followed by parasitological examination of all febrile patients or parasitological examination of a target population without fever screening. Blood sampling of non-febrile persons by common methods (microscopy, rapid diagnostic tests) may still not result in detection of low-level asymptomatic infections or infections in the liver stage of development. Generally, mass parasitological screening could be considered for newly detected foci or for well-defined high-risk populations, especially semi-immune migrants from endemic areas, but should not be a routine measure due to the intensity of resources required. Although malaria may be focal in the elimination phase, surveillance systems must cover the entire country, with additional attention to areas with ongoing or a recent history of transmission.

Surveillance in the pre-elimination phase must be of a high standard. All suspected cases of malaria should receive a parasitological test and results should be carefully and systematically recorded at the testing site. All cases and foci should be fully investigated. Records should be

kept of all tests and investigations, to guide program implementation, for future reference and to build the evidence base for eventual certification of the malaria-free status.

In 2014, Rwanda implemented malaria the pre-elimination strategy in the following 6 districts: Nyagatare, Burera, Ngororero, Musanze, Nyabihu, and Gisagara. Two districts (Rubavu and Gakenke) were added in mid-2015. The purpose of this strategy is as follows:

- Passively and actively detect all malaria case;
- Notify malaria cases within 24 hours;
- Investigate all cases and infections within 48 hours;
- Follow-up of malaria cases on day 3, 14 and 28th days;
- Line listing and mapping all cases, to identify hotspots or malaria foci;
- To detect changes in trends or distribution in malaria and other vector borne diseases in order to initiate investigative or control measures.

3.1. Case based surveillance in 8 pre-elimination district hospitals (6 districts)

3.1.1. Case notification

During this FY, across the 8 district hospitals (6 districts) the total number of cases received was 405,925 of which 137,655 were notified (33.9%). The average notification rate for district hospitals was 58.8% (non-weighted). The low notification rate is due to the fact that the country faced an increase in malaria cases resulting in an overwhelmed system. This impaired the implementation of the case notification. This information is detailed in Table 15.

Table 14 Case notification in pre-elimination districts

District	Hospital	Total received cases at HC	Total number cases notified at HC	Notification case rate (%)
Burera	Butaro	8,834	6,310	71.4
Gisagara	Gakoma	29,845	12,070	40.4
Ngororero	Kabaya	8,800	7,802	88.7
Gisagara	Kibilizi	73,501	53,220	72.4
Ngororero	Muhororo	29,917	13,851	46.3
Nyagatare	Nyagatare	240,655	34,436	14.3
Musanze	Ruhengeri	8,043	6,087	75.7
Nyabihu	Shyira	6,330	3,879	61.3
Total		**405,925**	**137,655**	**33.9**

3.1.2. Active detection and case investigation

Of the 137,655 cases that were notified across the 8 district hospitals (6 districts), 110,240 (80.1%) were investigated. The non-weighted average across district hospitals was 85.8%. The highest case investigation rates were observed in Gakoma, Shyira, and Ruhengeri district hospitals (>95% case investigation). The district hospitals with the lowest investigation rates were Kabaya (61.5%) and Nyagatare (69.1%). This information is shown in Table 16 below.

Table 15 Case investigation in pre-elimination districts

District	Hospital	Total number of notified cases at HC	Total of cases investigated	Investigation rate
Burera	Butaro	6,310	5,834	92.5
Gisagara	Gakoma	12,070	12,008	99.5
Ngororero	Kabaya	7,802	4,799	61.5
Gisagara	Kibilizi	53,220	41,477	77.9
Ngororero	Muhororo	13,851	12,627	91.2
Nyagatare	Nyagatare	34,436	23,809	69.1
Musanze	Ruhengeri	6,087	5,851	96.1
Nyabihu	Shyira	3,879	3,835	98.9
Total		**137,655**	**110,240**	**80.1**

3.2. Capacity building and system strengthening for pre-elimination districts

During this FY, the following capacity building and system strengthening activities were conducted across the eight pre-elimination districts:

- Formative and regular supervisions carried out monthly at health center level;
- Production and distribution of malaria pre-elimination registers;
- Regular distribution of communication fees (airtime) to facilitate communication between the central level, district hospitals, health centers, and CHWs;
- Malaria case mapping collected regularly in all districts;
- Rwanda Malaria Tracking and Surveillance System (RMTS System) database developed and upgraded to record case notification data for index cases and case investigation data for each secondary cases;
- RMTS system installed on 147 mobile phones with GPS and distributed across all health centers, district hospitals, and MOPDD supervisors for tracking and reporting;
- Capacity building training for 87 health care providers;
- Training of 64 data manager on malaria case surveillance using the new RMTS system;
- Coordination meeting to develop key recommendation to address identified challenges, especially the low investigate rate.

PART IV:

SOCIAL BEHAVIOR CHANGE COMMUNICATION

1. Introduction

In this FY malaria social behavior change communication (SBCC) was conducted with the main objective of providing to the Rwandan population the correct knowledge, behaviors, and practices towards malaria prevention and control**.**

It is in this regard that malaria messages have been developed and widely disseminated through multiple channels of communication including: radio programs, radio spots, community drama, community outreaches, churches, community works (Umuganda), and TV programs through the African Nations Championship football tournament (CHAN) held in Rwanda in January-February 2016. Messages disseminated were oriented to focus on malaria control in Rwanda by changing behavior and social norms including, sleeping under LLINs, environmental hygiene to destroy the breeding sites of anopheles mosquitoes, and early and correct diagnosis and treatment of malaria.

2. Implemented Activities

2.1. Production and airing of radio spots

Ten radio spots were produced and diffused through Radio Rwanda, community radio stations, and private radio (Izuba radio). These radio spots educated the population and create awareness on control and prevent of malaria in the general population. Among these radio spots produced and aired, 5 of them were disseminated through specific campaign of IRS. The main messages of these spots were instructions for IRS, information on environmental hygiene to destroy anopheles breeding sites, and the proper use of LLINs. Among the radio spots, one was an integrated malaria prevention message provided during the Mother and Child Health Week campaign. These radio spots were aired a total of 255 times across the radio stations.

2.2. Production and airing of TV spots

One television spot was produced which was aired through Rwanda television using the voice and image of Rwandan Stars musicians. This was aired during CHAN in parallel with radio messages, and provided community sensitization through Rwanda television and radio Rwanda

29 times. A second TV spot on malaria, use of LLINs, treatment, environmental hygiene, and closing window and doors in the evening, was produced and aired over 5 days, twice per day equal to 10 diffusions.

2.3. Production and airing of weekly malaria talk shows and dramas (radio)

A weekly radio talk show is produced and aired every Wednesday. During this fiscal year, 31 talks show programs have been aired. Radio programs have had an emphasis on community sensitization to fight against malaria through integrated vector control management, combination of malaria preventions measures and early and correct treatment of malaria. Radio stations used for the radio program were radio Rwanda, all community radio working under radio Rwanda, Radio flash FM, and Salus Radio. Each talk show lasted one hour and consisted of MOPDD staff providing necessary messages. The talk show included participation from the public that allowed the population to ask questions and get feedback through calling, sms, whatsapp, and facebook during the show. Following the radio show, the Rwanda Health Communication Division call center and facebook page was utilized so that the population was able to follow and ask questions and get clarification. In addition, Urunana development Communication disseminated messages on weekly basis through the popular Ururnana drama.

2.4. Dissemination of malaria prevention message in newspapers and social media

Around World Malaria Day, key messages for the fight against malaria were disseminated using imvaho newspaper, new times, igihe, and a press release to all media companies working in Rwanda. A web banner with the World Malaria Day theme was disseminated through igihe.com. All campaigns were disseminated using the RBC and MoH websites and twitter.

2.5. Community sensitization using different forums

The community work at the end of February 2016 was dedicated to sensitize all Rwandans population to fight against malaria in families. During this umuganda, messages on malaria prevention and control were provided at all villages during the community meeting at end of umuganda. All religious institutions participated and provided malaria prevention messages.

In partnership with Rwanda Health Communication Center Division, MOPDD conducted community sensitization activities for the fight against malaria in May-June 2016 across 24 districts (one sector per district). These community outreach activities sensitized the population on malaria prevention and control.

These outreach activities were strengthened by messages transmitted as follows:

- Audio and Video Songs with malaria messages;
- Projection of TV drama containing malaria prevention messages titled “Ibuye ryagaragaye ntiriba rikishe isuka” (loosely translated as “If you are aware there is a problem, you will find a way around it”);
- Projection of TV spot with key messages on malaria prevention and control;
- Comedy also was used to disseminated messages on malaria;
- Modern and traditional dances were also used to attract people. At each site the audience was between 3000 and 4500 persons including men, women, youth and children;
- Question and answers were also used to evaluate and disseminate assimilation of information. To motivate people prizes were provided to people offering correct answers, including paying Mutuelle de Santé subscription fees, and providing t-shirts and umbrellas.

Participants provided feedback after each session and also the lessons learnt. Overall, the community was grateful for the messages provided and committed themselves in the control and prevention of malaria.

In addition, 10 sessions of community outreaches using Urunana development communication institution. These live drama performances were conducted in nine top districts with high malaria burden during the MCH week. These districts were: Rwamagana, Kayonza, Ngoma, Kirehe, Gatsibo, Kamonyi, Huye, Gicumbi, Gisagara and Muhanga. The approach used was the community drama with malaria preventions messages and the consequences of malaria. Urunana is a very popular drama group and as a result each session attracted between 6,000 and 10,000 people (see Figure 17). Other malaria drama presentations were conducted by community based organizations in Nyanza, Huye, Gatsibo, and Kirehe, during which malaria prevention messages were disseminated through theatre performances.

Figure 17 Community sensitization in Ngoma district using the performance of Urunana

Community sensitization was strengthened during the launching ceremony of IRS which was done in Districts where IRS was operated (Bugesera, Gisagara, Gatsibo, Kirehe,Nyagatare and Nyanza; Figure 18). Vice Mayor Social Affaire of Gatsibo District, Executive Secretary and Representative of RBC, Representative of Military and Police Representative attended the launching site and provided message for malaria control to the population at each launching sites and requested all participant in the event to disseminate malaria prevention messages and to facilitate the IRS operations. IRS banners were placed at all Sectors' Offices of Bugesera, Nyagatare, Kirehe, Gatsibo, Nyanza and Gisagara where IRS was operated.

Door to mobilization was conducted in all households where the IRS was operated. Messages with instructions of IRS and malaria prevention were developed and disseminated using following channels: the placement at public places in district such us district hospitals, health centers, markets, sectors and cells offices, schools and religious institutions.

Figure 18 Launching of IRS Campaign in Gatsibo district, Ngarama Sector

2.6. Mobile Video Units

Mobile video units (MVUs) were used in targeted locations and hotspots to disseminate promotional and educational messages on malaria prevention. MVUs were used in Nyanza, Huye, Ngoma, Gatsido, and Kirehe, and were found to be an effect way of attracting and entertaining large number of the population. In addition, supervision visits were carried out in areas where MVUs were conducted to assess the update of malaria interventions. A total of 17,845 individuals were reach through this delivery mechanism.

2.7. Meeting with Local Leaders for Malaria Control

In June 2016, a meeting was conducted in Rubavu district and gathered those in charge of Social Affairs from all sectors under Rubavu District, Director of DH, Director of Health and RBC Staffs. The meeting conducted by RBC staff and DH, discussed the findings from the recent increase in malaria in the district. Prevention and control messages were agreed upon and submitted to local authority for their dissemination at the community level.

In Rubavu health centers, individuals were sensitized and screened, and those identified as positive for malaria were treated.

PART V:

KEY CHALLENGES

1. Overall

A significant increase in malaria cases due to a variety of factors has impacted all malaria control interventions over the FY. The increase in malaria cases was as a result of a myriad of factors, many extraneous to the malaria program, including an increase in temperature, increased rainfall, increase in water bodies (due to rainfall and agriculture practices), and resistance to insecticide. These issues are not isolated to Rwanda with the impact being felt across East Africa and other regions.[7]

These factors combined have led to an increase in the number of vectors increasing opportunities for malaria transmission and consequently an increase in the number of cases and deaths. This has resulted in a greater burden on all interventions, from scaling up prevention activities to ensuring early diagnosis and treatment for greater numbers.

2. Key Challenges in Prevention

The following key challenges were identified in the implementation of prevention activities including IRS and LLIN distribution and usage:

- Financial and resource gap leading to a reduction in the planned IRS of endemic districts (6/8 district sprayed);
- Change to more expensive insecticides to combat and prevent further resistance adding to funding need;
- Delay in the delivery of expected LLINs leading to a delay in mass distribution and fewer districts reached (16/30 districts reached);
- LLINs not meeting technical specifications with low durability and quality (22% loss within 6 months) meaning reduction in efficacy of prevention method;
- Difficulties in quantification of LLIN need;
- Lack of resources to deliver BCC messages to entire population resulting in misconceptions around the quality and usage of LLINs;

[7] Caminade et al. 2014 & Stern et al. 2011

- Change in vector species and behavior with new trend of outdoor biting behavior affecting current prevention strategies;
- Low involvement of other sectors such as agriculture, environment, and infrastructure, to assist in malaria control.

3. Key Challenges in Case Management

The following key challenges were identified that impacted case management and early diagnosis and treatment:

- Delays in commodity procurement and delivery and problems with malaria commodity quantification as a result of increase in cases leading to stock-outs at some facilities;
- Overworking and lack of remuneration of CHWs affecting the quality and expansion of HBM services;
- Limited resources for effective active surveillance and detection.

PART VI:

FINANCING THE MALARIA STRATEGIC PLAN

1. Introduction

The financing of the National Malaria Strategic Plan becomes increasingly a high priority for the GoR as a simple reduction of the budget may result in recrudescence of malaria cases with important consequences on public health. The MSP 2013-2018 is funded by GoR and donor support as follows:

- Government revenues which include revenues generated from taxation, loans, grants, donations – reported as Government contribution;
- Development Partners contributions through General and Sector Budget Support. These include the Global Fund for HIV & AIDS, TB and Malaria Results Based Financing (GF), and contribution from Presidential Malaria Initiative (PMI);
- Health insurance pooled funds (Mutuelle de Santé or Community based health insurance) from household expenditures. This is not captured in this report;
- Income generated funds from health facilities not captured in this report.

The data collection for the contribution of all these sources is not conducted on a regular basis, therefore the report will focus on funding sources where data were are available as explained. Although the system is currently operating, data of the actual financial report were generated through SMART FMIS given that HRTT captured so far budget and expenditures of 2014/2015. To facilitate the collection of financial information for this year's report, a separate data collection process was adopted using SMART FMIS (Integrated Financial Management Information System) for Global Fund grant and Government contribution; and directly from in country office for PMI.

2. Public and External Funding Sources for Malaria Program 2013-2018

Table 17 shows the funding allocated to malaria by funding source over the FY2015-2016.

Table 16 Malaria funding sources, FY2015-2016

Funding Sources	Budget planned (USD)	Share as % of budget (USD)
Global Fund	30,951,588	58%
PMI	18,000,000	34%
GoR	3,982,301*	8%
Grand Total	**52,933,889**	**100%**

*Revised to USD 5,707,439

2.1. Global Fund to fight HIV/AIDS, Tuberculosis and Malaria

The GF has committed an estimated amount of USD 49,340,552 (13% of total budget) to contribute to MSP operational plan of January 2015 to December 2017. Over this FY2015-2016, USD 30,951,588 funding was planned through the new results based financing (RBF) model for the following interventions:

The GF intervention areas include:

- Malaria prevention by procuring and distribution of LLINs;
- Malaria prevention by procuring and distribution of other health products;
- Malaria Contingency Plan activities as approved by the CCM;
- Malaria case management focused on the procurement of malaria commodities;
- Surveillance, monitoring, and evaluation and reporting.

2.2. Presidential Malaria Initiative

PMI has committed an estimated USD 58 million (48%) to support planned interventions of the MSP 2013-2018. The budget planned for this FY was USD 18 million based on an operational plan.

- Malaria prevention by procuring and distribution of LLINs and Net durability monitoring
- Indoor Residual Spraying (IRS) in targeted districts, entomological monitoring and IRS technical assistance

- Malaria in Pregnancy with one activity of early detection and treatment of malaria in pregnancy Social Behaviour Change communication (BCC) through:
  - BCC for LLINs, MIP, and CCM
  - Strengthening capacity building for SBCC
  - Repackage ACTs

- Health System Strengthening/Capacity Building through:
  - Support data manager for malaria pre elimination
  - Support capacity building of the NMCP for M&E, DQA, and dissemination of country success stories
  - Support for FELTP trainees in malaria

2.3. Government of Rwanda

The GoR has committed a total of USD 12.26 million to contribute to MSP operational plan of January 2015 to December 2017. The GoR contribution for FY2015-2016 amounts to USD 3,982,301 and is mainly allocated to the costs related to human resources, infrastructure, quality and demand for services, sensitization, health-insurance coverage for the poorest, and specialized health services in line with Rwanda Health Policy. For this FY2015-2016, the GoR subsequently revised its contribution from USD 3,982,301 up to USD 5,707,439.

2.3.1. Methodology used to estimate the GoR allocations to various health programs

GoR funds are allocated to different health programs during the annual planning and budgeting process, which entails prioritization process by the Ministry, RBC and decentralized levels with HSSPIII gaps and different disease program strategic plans serve as guiding documents.

The planning phase also uses the disease burden and services utilization data from HMIS to inform an effective resource allocation. The output from this process is reflected in the Mid-Term Expenditure Framework (MTEF) that becomes part of the budget law voted by the Parliament.

Aside from program specific financing, the estimation of counterpart financing takes into consideration all other health related programs costs, categorized as health systems strengthening costs in the categories of: (i) Human resources (salaries), (ii) Infrastructures (including constructions, renovation and equipment), (iii) Quality of services (including performance based

financing and accreditation programs), (iv) Specialized health services, (v) Health commodities (drugs, consumables, etc.), and (vi) Health insurance for indigents.

3. Financial report for the FY2015-16

The opening balance from FY2014-2015 was USD 913,231; this was not used in FY2015-2016 and has been carried over to the next FY2016-2017. The current total expenditures is amounting to USD 36,776,909 as in Table 18.

Table 17 Malaria expenditures, FY2015-2016

Funding Sources	Budget planned, USD	Revised budget	Share as % of budget	Amount spent, USD	Budget execution rate	Comments
GLOBAL FUND RBF MALARIA	30,951,588	30,951,588	58%	13,193,788	43%	The unspent budget represents 57% which will be carried over to FY16-17 and is mainly due to amount of USD 17.4 million committed for procuring LLINs. The tender is in process and payment will be done after delivery in FY 16-17.
PMI	18,000,000	18,000,000	34%	18,000,000	100%	The budget execution estimated at 100% during the FY15-16
GoR	3,982,301	5,707,439	10%	5,583,121	98%	The contribution for GoR to the MSP FY 2015-2016 has increased by USD 1,725,135 compare to the initial budget of USD 3,982,301.
Average	**52,933,889**	**54,659,027**	**100%**	**36,776,909**	**67%**	

3.1. MSP budget and expenditures by source of fund for FY2015-2016

3.1.1. Government contribution to Malaria Expenditures, FY2015-2016

The total GoR contribution to malaria expenditures is USD 5,583,121 which represents 15% of the total budget execution of USD 36,776,909. As shown in Table 19, 33% of the total expenditure was allocated to the human resource budget category; this category was executed 100%. The next biggest expenditures were procurement and supply chain management costs (19%) and living support to clients/target populations (19%).

Table 18 Government expenditure by MSP cost category

NSP Cost Category (USD)	Malaria Budget	Malaria Expenditures	Expenditures Share %	Budget execution
01. Human Resources	1,863,809	1,859,046	33%	100%
02. Technical Assistance	187,847	187,581	3%	100%
03. Training	490	482	0%	98%
04. Health Products and Health Equipment	524,136	529,453	9%	101%
05. Medicines and Pharmaceutical Products	166,844	97,107	2%	58%
06. Procurement and Supply Management Costs	1,085,027	1,040,431	19%	96%
07. Infrastructure and Other Equipment	364,288	357,444	6%	98%
08. Communication Materials	9,861	9,605	0%	97%
09. Monitoring & Evaluation	40,065	39,002	1%	97%
10. Living Support to Clients/Target Populations	1,077,233	1,077,233	19%	100%
11. Planning and Administration	295,950	295,840	5%	100%
12. Overheads	91,987	89,897	2%	98%
Grand Total	**5,707,439**	**5,583,121**	**100%**	**98%**

Table 20 shows the GoR expenditures by implementer. The MoH (Central level) and Rwanda Biomedical Center (RBC) consumed 69% of total costs (USD 3,857,153); the majority of these expenditures are related to staff salaries. District hospitals and health centers consumed approximately 25% of the expenditure while the remaining hospitals consumed the final 6%.

Table 19 Government expenditure by type of budget entity

Budget entity (USD)	Malaria Budget	Malaria Expenditure	Expenditure share, %	Budget execution
Central University Hospital of Kigali (CHUK)	171,298	171,298	3%	100%
Central University Hospital of Butare (CHUB)	114,710	114,710	2%	100%
Ndera Neuropsychiatric hospital (HNN)	31,954	31,954	1%	100%
MoH/Central Level	1,601,341	1,591,590	29%	99%
Kacyiru Police Hospital (KPH)	35,142	37,085	1%	106%
Rwanda Biomedical Center (RBC)	2,377,031	2,265,563	41%	95%
District hospitals & Health Centers	1,375,960	1,370,920	25%	100%
Grand Total	**5,707,439**	**5,583,121**	**100%**	**98%**

3.1.2. Global Fund contribution to Malaria Program

The Global Fund contribution this FY2015–2016 was USD 30,951,588 which represents 58% of the total contribution to the MSP. From this budget, a total amount of USD 13,193,788 was spent by the sub-recipients (Tables 21 and 22). The remaining balance of USD 17,757,800 has been carried over to this FY2016-2017 and is committed under contracts whose payments will progressively be carried out during the FY2016-2017; a significant portion of these costs of committed to the procurement of LLINs.

The remaining FY2014-2015 the balance not spent for the implementation of case management activities (USD 913,231) will be carried over to FY2016-2017. Thus, the total amount carried over will be USD 18,671,032.

Table 20 Global Fund Contribution to RBF Malaria, FY2015-2016

NSP Cost Category (USD)	Malaria Budget (Including Reallocation)	Malaria Expenditure	Expenditure share, %	Budget Execution, %
01. Human Resources	843,006	452,700	3%	54%
04. Health Products and Health Equipment	22,030,973	6,927,126	53%	31%
05. Medicines and Pharmaceutical Products	3,386,486	3,276,487	25%	97%
06. Procurement and Supply Management Costs	1,382,867	380,382	3%	28%
09. Monitoring & Evaluation	3,141,163	2,081,036	16%	66%
12. Overheads	166,809	76,056	1%	46%
Grand Total	**30,951,305**	**13,193,788**	**100%**	**43%**

Table 21 Global Fund contribution to RBF Malaria Expenditures by budget entity FY2015-2016

Budget entity (USD)	Malaria Budget	Malaria Expenditure	Expenditure share, %	Budget Execution, %
Administrative & support services	240,059	210,253	2%	88%
RBC MOPDD	1,590,901	1,503,005	11%	94%
RBC procurement & distribution	26,714,879	9,397,321	71%	35%
DHs-HCs	2,405,748	2,083,209	16%	87%
Grand Total	**30,951,588**	**13,193,788**	**100%**	**43%**

During the grant implementation, further savings amounting to USD 6,676,341 from different budget categories was identified and reallocated to the MCP planned activities after the CCM approval. This is shown in Table 23.

Table 22 Reallocated funding for MCP planned activities

Proposed activities	Total budget, USD
Procurement of additional anti malaria drugs an RDTs	2,048,673
IRS insecticide and related health products	3,275,625
IRS Operational Costs	1,352,043
Total	**6,676,341**

3.1.3. PMI Contribution to Malaria Expenditures for this FY2015-16

The PMI contribution for malaria expenditures went specifically to malaria preventive intervention (69%) and to malaria case management interventions (18%). The budget for preventive interventions was spent mainly on the procurement of LLINs and IRS. The total budget execution is assumed to be 100%, however the reporting period for PMI differs (October-September) and so this will require confirmation.[8]

Regarding staffing, locally-hired staff to support PMI activities either in Ministries or in USAID will be approved by the USAID Mission Director. Because of the need to adhere to specific country policies and USAID accounting regulations, any transfer of PMI funds directly to Ministries or host governments will need to be approved by the USAID Mission Director and Controller, in addition to the USG Global Malaria Coordinator.

Table 23 President's Malaria Initiative Contribution to Malaria FY2015-2016

President's Malaria Initiative – Rwanda	Total Budget USD	Expenditures USD	Expenditures share %	Budget execution
Malaria Preventive	12,330,360	12,330,360	68.5%	100%
Malaria Case management	3,189,640	3,189,640	17.7%	100%
Monitoring and Evaluation	850,000	850,000	4.7%	100%
BCC/IEC	250,000	250,000	1.4%	100%
Health System Strengthening/Capacity Building	480,000	480,000	2.6%	100%
In-country Staffing and Administration	900,000	900,000	5%	100%
Grand Total	**18,000,000**	18,000,000*	100%	**100%**

*18,000,000 total expenditures to be confirmed in the PMI annual expenditures report

4. Conclusion

The overall Malaria Budged execution for FY15-16 is 67%. Following unexpected increase of malaria cases, the country developed and implemented MCP which required additional funds. RBF Malaria contributed up to 6.6 million USD (savings from mainly LLINs budget) after CCM

[8] Actual reported PMI expenditures are subject for final confirmation with expected annual (FY2015-2016) expenditures report

approval in Feb 2016. However, budget constraints for funding the gap related to MCP 2016-2017 is still a big issue.

GENERAL CONCLUSION

Following the malaria NSP 2013-2018 and approval of the MCP, MOPDD in collaboration with other partners have implemented various malaria prevention and control activities throughout the FY. The key achievements of this FY include:

- IRS implementation in 6 high risk malaria districts;
- LLIN distribution through routine ANC and EPI services and mass distribution in 16 districts;
- Improved case management such that almost 100% of cases receive confirmatory testing prior to treatment;
- Improved early diagnosis and treatment by increasing access at the community level through the expansion of HBM services to include adults in 12 districts;
- Strengthening of BCC through a number of community sensitization and mobilization activities.

In order to achieve these accomplishments, a number of other activities have been implemented, such as strengthening supply chain management, improving entomological knowledge to inform prevention strategies, monitoring of activities, and capacity building of personnel at all levels.

Despite these key achievements, an increase in malaria cases has had an impact on all interventions and indicators. The increase in cases has demanded more of the health system, augmenting the volume of individuals needing screening and treatment, and requiring enhanced preventive measures, such as additional IRS spraying of endemic regions. Despite the negative impact this has had on certain indicators, such as a rise in raw number of severe cases and deaths, the ratio of severe cases and deaths to the number of cases remains unchanged since the previous FY; this has decreased since 2012. This demonstrates the success of interventions, maintaining early access to diagnosis and appropriate treatment despite the increased burden.

The increase in malaria cases necessitates additional investments in direct and indirect treatment and prevention intervention costs. Persistent and growing funding gaps jeopardise Rwanda's ability to successfully identify and treat these new cases and to curb the number of new infections. In addition, malaria is placing increased burden on the health system, such as supply chain management and human resources for health. This risks reduced availability and quality of

malaria prevention and treatment services across the country. This resource gap remains an issue in implementation of the malaria NSP and MCP and without additional funding, could result in the further spread of malaria.

Annex. Malaria RBF Indicator Performance

1. Impact Indicators

Impact indicator	Baseline			July 15-June2016		
	Value	Year	Source	Target	Results	Achievements, %
Malaria test positivity rate	34%	Jul 2013 - Jun 2014	HMIS	28%	41.5%	67%
Number of deaths associated with malaria	458	Jul 2013 - Jun 2014	HMIS	382	698	55%

1.1. Comments

During the reporting period, the country faced unexpected increase of malaria cases and malaria test positivity rate increased from 34% (2014/15) to 41.5% (2015/16). The top 10 ten districts with high malaria test positivity rate are Gatsibo, Kayonza, Huye, Ngoma, Nyagatare, Kamonyi, Rwamagana, Gasabo and Nyamasheke with 5 out 10 are in Eastern Province.

This under achievement is correlated with many probable factors such as increase in temperature, rainfalls, delay in replacing LLINs and low coverage of LLINs, resistance to insecticides and increase in water bodies. In fact:

Temperature affects the life cycle of the malaria parasite. The time required for the parasite to complete its development in the gut of the mosquito is about 10 days, but it can be shorter or longer than that depending on the temperature. As the temperature *decreases*, the number of days necessary to complete the development *increases* for a given *Plasmodium* species. *P. vivax* and *P. falciparum*. While it has been shown that an increase **of 1 degree Celsius** is resulting to shortening the duration of mosquito's development and hence increasing the proliferation of mosquitoes and malaria transmission if infected. The time needed for the parasite to complete its development in the mosquito, decreases to less than 10 days as temperature increases from 21°C to 27°C, with 27°C being the optimum.

The anophele mosquitoes breed in water. So the right amount of rainfall is often important for them to breed. Different anopheles mosquitoes prefer different types of water bodies in which to breed. Generally, water collections that support vector breeding appear mainly after the rains, and therefore malaria transmission is highest following the rainy season. Increase of rainfall volume has been correlated with increase of malaria cases.

In 2010-2011 Rwanda conducted a countrywide massive distribution of Long Lasting Insecticides Treated Mosquito nets (LLINs), and reached a population level coverage of 83% effective LLINs. This achievement had a significant impact on the number of malaria cases, inpatient and deaths. Since then Rwanda has not been able to maintain that level of population coverage of effective LLINs because there has not been a countrywide LLINs distribution given that replacement were done in targeted districts based on LLINs distribution. LLINs replacement were not done based on LLINs needs and LLINs efficacy duration of 2 years as seen in the monitoring of LLINs durability and efficacy. The following distribution of LLINs that followed (2012-2015) has been targeting only few districts. Due to significant delay in procurement there has been no timely replacement of LLINs after their 2years shelf life and maintenance of universal coverage as seen in the DHS 2014-15 where only 43% of the population had one LLIN per 2 people.

Much of the success in controlling malaria is due to vector control. Vector control is highly dependent on the use of pyrethroids, which are the only class of insecticides currently recommended for ITNs or LLINs. In most of the sentinel site monitoring insecticide resistance, resistance to insecticides of pyrethroid family used for public health has been detected. Fortunately, this resistance has only rarely been associated with decreased efficacy of LLINs, which continue to provide a substantial level of protection in most settings. Rwanda has made the monitoring and prevention of the spread of insecticide resistance a priority.

Increase in water bodies (environmental factors, Riziculture, Road): Agriculture is the main sources of income in Rwanda. In the recent years, the development of agriculture in Rwanda has led to an important transformation of the ecological landscape, creating suitable habitats for malaria vectors. The evidence shows that the introduction of intensive irrigation agriculture increases the malaria transmission. Evidence has shown that districts affected by malaria have important rice cultivation areas compared to districts less affected by malaria.

Ongoing interventions to tackle the increase of malaria

In December 2015, the Government of Rwanda and its partners developed the Malaria Contingency Plan 2015-2017 which consists of enhancing the implementation of the current interventions by involving government and partners' institutions and synergy of interventions recommended by WHO. The following key proposed interventions are to be implemented:

1. Urgent increase of effective LLINs coverage

In order to ensure availability of LLINs in Rwanda, an urgent procurement was put in place though IDA/GF in order to reduce delay in delivery and distribution. This is currently under reception. However, the country continues to distribute LLINs to children under one year and pregnant women through EPI and ANC services.

2. Indoor Residual Spray (IRS)

The proposed vector control measures proposed consist of IRS in eight high malaria burden districts. Of these, six districts have been sprayed throughout FY2015-2016 using GF Malaria NSP savings (interesting financial offer from IDA foundation with GF support) after CCM approval in February 2016.

3. Introduction of HBM for adults

Following the 2011 reduction in malaria morbidity, there was a change in epidemiology whereby adults are vulnerable to malaria, constituting the majority of malaria cases (over 91% of all simple malaria cases). The Malaria Contingency Plan (presented and approved by CCM) initiated the scaling up of HBM in adults in order to reduce malaria transmission and gametocyte carriage in blood by treating earlier most of malaria cases at the onset of symptoms and signs not exceeding 24hours.

4. Social Behavior Change Communication

The SBCC is cross cutting intervention and each intervention requires strong engagement of everyone from central level to community level. Media and social mobilization campaigns focusing on increasing awareness on malaria prevention and control.

Conclusion

Although reported result shows underachievement, this required high attention from all stakeholders in order to reduce the malaria burden. This situation implies an increase in malaria commodity procurement and consumption which is impacted by fund availability through budget reallocation within the malaria budget.

During the reporting period 2015/16, the country faced unexpected increase of malaria cases leading to increased deaths from 458 (2014/15) to 698 (2015/16). This under achievement is correlated with all factors related to the increase of malaria in general at national and regional level.

The increase of severe malaria cases probably due to recent reduction of Immunity following a sharp decrease of malaria morbidity observed between 2007 and 2012, Over the reporting period 18,030 cases of severe malaria were reported at the facility level. This is a 58.7% increase compared with severe malaria cases reported last Fiscal year (11,362). However, a slight improvement of severe malaria case management at health facility was noted where the case fatality rate decrease from 4,03% to 3,87% in 2014-2015 and 2015-2016 respectively. Specific measures to address this situation was the introduction of HBM in adult current being implemented in 12 high malaria burden districts counting over 65% of overall malaria cases countywide. There is a plan to scale up the HBM in adult in 18 districts to cover the national coverage. Real Time notification of on the onset of severe malaria diagnosed from health center to central level for close monitoring and better service delivery including accurate case management. Note that the malaria death data reported through HMIS are regularly being audited and preliminary findings from malaria death audit conducted for the period of January 2015 to January 2016 show that in some cases, the number of deaths reported is bigger than the real cases. Regular death audit is planned on quarterly basis.

2. Outcome and Output Indicators

OUTCOME Indicator	Baseline				July2015-June 2016			Indicator performance
					Target	Achievements		
	N# / D#	%	Year	Source	%	N # / D #	%	
VC-5: Proportion of structures in targeted areas that received Indoor Residual Spraying during the reporting period	123,919 / 127,096	97.5 %	Jan – Jun 2014	Administrative records	98%	713517 / 722633	98.7%.	101%
OUTPUT INDICATOR								
CM-1a: Proportion of suspected malaria cases that receive a parasitological test at public sector health facilities	3,394,387 / 3,395,921	99.95 %	Jul 2013 - Jun 2014	HMIS	99%	7,532,637 / 7,535,537	**99.9%**	101%
CM-1b: Proportion of suspected malaria cases that receive a parasitological test in the community in children under 5 years	367,953 / 367,973	99.99 %	Jul 2013 - Jun 2014	HMIS		387,121 / 387,719	**99%**	100%
CM-2a: Proportion of confirmed malaria cases that received first-line antimalarial treatment according to national policy at public sector health facilities	NA	96.1 %	2013	Health Facility survey	96%	NA	**98.4%**	102%
CM-5: Percentage of confirmed cases investigated (malaria elimination phase)	81,353 / 95,709	85.0 %	Jan - Jun 2014	Surveillance systems	85%	110,240 / 137,655	**80.1%**	94%