Republic of Rwanda
Ministry of Health

Rwanda Biomedical Centre
Healthy People, Wealthy Nation

Rwanda Malaria and Neglected Tropical Diseases

Annual Report 2019-2020

Foreword

The Ministry of Health and Rwanda Biomedical Centre (RBC) would like to take this occasion to express their deep gratitude and sincere thanks to everyone including all partners and stakeholders who contributed to the compilation of this annual report of the Malaria and Other Parasitic Diseases Division (MOPDD) in Rwanda.

This Malaria and Neglected Tropical Diseases Report 2019-2020 was developed based on data generated from the HMIS and Program data from RBC/MOH Rwanda. It presents a comprehensive picture of the prevention, control and management of malaria and NTDs in Rwanda and is structured based on the Extended 2013-2020 Rwanda Malaria National Strategic Plan, the Revised Malaria Contingency Plan 2016-2020 as well as the NTDs Strategic Plan.

Actions needed to control Malaria and NTDs burden in Rwanda require partnership and close collaboration between stakeholders in environmental control programs, as well the strengthening of surveillance systems across all sectors at both national and decentralized levels. These programs must be conducted using an evidence-based intervention for prevention, treatment and support for patients, community health workers, and the communities where these strategies are implemented.

I would like to acknowledge the efforts of the dedicated staff in the various institutions of the Government of Rwanda who worked tirelessly to complete this report. We remain entirely grateful to the inputs and support provided by our partners.

Special thanks to the members of the Civil Society Organizations, Local and International Non-Governmental, Bilateral Organizations as well as the Rwandan Government institutions who were heavily involved in the implementation of Malaria and NTDs control activities.

I would also like to thank all members of the Technical Working Group that reviewed and validated the content of this report. We thank you all for your support in the fight against Malaria and NTDs in Rwanda.

Dr. NGAMIJE M. Daniel
Minister of Health

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List of Abbreviations

ACT	Artemisinin-based Combination Therapy
AL	Artemether Lumefantrine
ANC	Ante-Natal Care
CDC	Center for Disease Control
CHW	Community Health Worker
CPDS	Coordinated Procurement and Distribution System
DQA	Data Quality Audit
EPI	Expanded Program on Immunization
EQA	External Quality Assurance
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 IV	Third Health Sector Strategic Plan IV
iCCM	Integrated Community Case Management of Malaria
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
IVM	Integrated Vector Management
LLINs	Long-Lasting Insecticide Nets
MCP	Malaria Contingency Plan
MDA	Mass Drug Administration
MIP	Malaria In Pregnancy
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
NRL	National Reference Laboratory
NSP	National Strategic Plan
NTD	Neglected Tropical Diseases
PCR	Polymerase Chain Reaction
PMI	President's Malaria Initiative
PSM	Procurement and Supply chain Management
QC	Quality Control
QMIA	Quality Management Improvement Approach
RBM	Roll Back Malaria
RDT	Rapid diagnostic test
SBCC	Social Behavior Change Communication
SCH	Schistosomiasis
SOP	Standard Operating Procedure
STH	Soil Transmitted Helminthiasis
TWG	Technical Working Group
UC	Universal Coverage
WHO	World Health Organization

Executive Summary

Today, Rwanda has a strong vision for a country free from malaria and NTDs as a way of contributing to the well-being of the Rwandan population including reduction of the impact of malaria and NTDs-related burden of diseases. To achieve this requires robust evidence-based efforts and strong collaboration with all relevant stakeholders especially in implementation of appropriate interventions and quality health delivery services.

Following the recent malaria upsurge, the Government of Rwanda and its Partners have been combining efforts in the fight against malaria through different malaria control interventions.
In line with the National Malaria Strategic Plan 2013-2020 goals, all malaria control interventions aim at achieving the following objectives:

Objective 1: By 2020, at least 90 % of population at risk will be effectively protected with locally appropriate preventive and vector control interventions.
Objective 2: By 2020, all malaria cases will be promptly treated in line with the national guidelines
Objective 3: By 2020, all health facilities provide complete reporting to strengthen surveillance, monitoring and evaluation and inform operational research.
Objective 4: By 2020, strengthen coordination, collaboration and effective program management at all levels.
Objective 5: By 2020, 75% of the population will have correct practices and behavior towards malaria control.

Despite the continued malaria burden increase since 2012 in almost all 30 districts of Rwanda, significant results were registered in the reporting period July 2019-June 2020. These included:

- Reduction in the incidence of malaria from 321 per 1,000 person per year in FY2018-2019 to 198 per 1,000 in 2019/2020. In addition, the National Slide Positivity Rate (SPR) dropped from 44.4% in FY2018/2019 to 34.5% in FY2019/2020
- Decline in uncomplicated malaria cases from 3.9million cases in FY2018/2029 to 2.5millioncases in FY2019/2020 (37% reduction) with currently 58% of these cases managed at community level.
- Reduction in severe malaria cases from 7,054 cases in FY2018-2019 to 4,358 severe cases in FY2019/2020 representing 38% decrease in all severe malaria cases.
- Significant decrease in the number of deaths due to malaria from 372 in FY2018-2019 to 167 deaths in FY2019-2020.

Regarding malaria prevention, the following results were achieved during the FY 2019-2020:

- A total of 5,566,006 Rectangular LLINs (including 769,150 LLINs IG2 Nets, 1,399,528 PBO Nets, and 3,397,328 Standard LLINs) were distributed to the general population through mass campaign (Households Distribution) in 23 districts while seven districts were not covered because of COVID-19 constraints.

    - The number of districts covered with Indoor Residual Spraying (IRS) increased from 10 in FY2018/2020 to 12 districts (Nyagatare, Kirehe, Bugesera, Gatsibo, Ngoma, Kayonza, and Rwamagana in Eastern Province; and Huye, Nyanza, Gisagara, Ruhango and Kamonyi in Southern Province) fully sprayed in FY2019/2020 with seven high burden sectors of Rusizi Districts sprayed as outbreak control strategy. In these IRS Districts, a 99,3% coverage (1,231,070 out of 1,239,880 structures were sprayed) was achieved with a total population of 4,867,811 out of 4,899,459 protected (99,4%) from malaria in IRS targeted districts.

Regarding Neglected Tropical Diseases (NTDs) control, two rounds of Mass Drug Administration (MDA) targeting Soil Transmitted Helminthiasis (STH) in Pre-School and School Age Children countrywide were conducted in the FY2019-2020 with >95% coverage of targeted children.

Malaria and NTDs Programs budget available in FY2019/2020 was **68,161,328 USD** of which 65,505,929 USD was executed (96%) with Global Fund at 90%, PMI at 100%, GoR at 98%, and END FUND Old Grant at 94% and END FUND New Grant at 8%.
It is important to note that during this COVID-19 pandemic period, some Malaria and NTDs Programs activities were affected including delays in LLINs procurement, quality control and distribution, low implementation of SBCC related activities involving people gatherings, etc.
Furthermore, COVID-19 pandemic also affected the Malaria and NTDs Programs including additional budget needs to implement LLINs inspection, distribution and IRS implementation that may even affect the GoR commitments for the next FY2020/2021.

Introduction

Malaria and NTDs represent major public health problem in Rwanda and are considered among the leading causes of morbidity and mortality. Rwanda has made significant strides in controlling these disease through implementation of various control interventions including: mass and routine distribution of Long-Lasting Insecticide Nets (LLINs), Indoor Residual Spraying (IRS) in high endemic districts, adoption of mandatory laboratory confirmation prior to the treatment, use of ACTs in the treatment of uncomplicated malaria cases, national scale up of community based management and improvement in routine surveillance, monitoring and evaluation platforms, Mass Drug Administration (MDA) targeting Soil Transmitted Helminthiasis (STH) and Schistosomiasis (SCH) .
Despite combined efforts, Malaria and NTDs still represent a public health concern in Rwanda with millions of people affected every year.

The Rwanda Malaria and NTDs Strategic Plans build on national policies and strategies such as the Health Sector Strategic Plan IV (HSSP IV) which recognizes malaria and NTDs as major diseases that contribute to health and economic related burden. The vision of the Malaria and NTDs Strategic Plans is for Rwanda to become free from malaria and NTDs to contribute to the socioeconomic development. Reduction of malaria and NTDs burden will be achieved by strengthening and implementing appropriate control interventions and delivering quality health services. Achievement of Rwanda Malaria and NTDs Free will require a concerted and collaborative effort between the Government of Rwanda (GoR) and other partners.

Today, Malaria and NTDs Control efforts are being implemented at all levels through evidence-based interventions to reduce the disease burden in the population. This consists of effective implementation of high impact interventions, including countrywide MDA for NTDs Chemoprophylaxis, LLINs Mass and Routine Distribution, IRS using an effective insecticide in targeted high malaria endemic districts, early diagnosis and treatment at the health facility and community level, environmental management, surveillance/Monitoring and Evaluation and social behavior change communication (SBCC).

The following report details malaria and NTDs control activities implemented over the FY2019-2020. These activities have been coordinated by the Malaria and Other Parasitic Diseases Division (MOPDD) of the Rwanda Biomedical Centre (RBC) with support from other GoR institutions, Health Facilities and Community Health Workers (CHWs) and implementing partners under the leadership of Rwanda Biomedical Centre and the Ministry of Health (MoH)

Malaria Program Results per Strategic Plan Framework

The results and achievements presented in this annual report are in line with the following program objectives:

Objective 1: By 2020, at least 90 % of population at risk will be effectively protected with locally appropriate preventive and vector control interventions

Objective 2: By 2020, all malaria cases will be promptly treated in line with the national guidelines

Objective 3: By 2020, all health facilities provide complete reporting to strengthen surveillance, monitoring and evaluation and inform operational research

Objective 4: By 2020, strengthen coordination, collaboration and effective program management at all levels.

Objective 5: By 2020, 75% of the population will have correct practices and behaviors towards malaria control.

PART I: MALARIA PREVENTION

***Objective 1:* By 2020, 90% of the Population at Risk Will Be Effectively Protected with Locally Appropriate Preventive and Vector Control Interventions Based on Evidence**

A. Long Lasting Insecticidal Bed Nets

Objective 1: By 2020, 90% of the population at risk will be effectively protected with locally appropriate preventive and vector control interventions based on evidence
As recommended by WHO, since 2009 Rwanda embarked to achieve universal coverage through the LLIN mass distribution of households and routine distribution to the most vulnerable groups: children of under five years old and pregnant women in order to reduce maternal and perinatal morbidity and mortality associated to malaria. LLINs household mass distribution campaigns are organized every 2 to 3 years according to the availability of funds.

1. LLIN Procurement and Distribution per Channel of Distribution

In the Fiscal Year 2018-2019, RBC/MOPDD had procured a total of 7,527,448 rectangular LLINs on Global Funds budget through RBC/MPPD and on USAID/PMI budget through GHSC-PSM.
In this reporting period, a total of 6,181,867 LLINs were delivered with 5,955,916 of them (96%) accepted after going through the RBC internal normal process of Quality Control.

Table 1: LLINs Procurement and Distribution per Source of Funds

Source of Fund	LLINs Type	Procured	Delivered	Accepted	Distributed			Total
					HH	EPI	ANC	
Global Fund	Standard	3,627,453	2,281,872	2,281,872	1,884,150	191,850	194,650	2,270,650
Global Fund	IG2 Nets	1,200,000	1,200,000	1,129,431	769,150	-	-	769,150
USAID/PMI	Standard	1,176,922	1,176,922	1,142,441	968,650	79,028	79,000	1,126,678
USAID/PMI	PBO Nets	1,523,073	1,523,073	1,402,172	996,850	199,240	203,438	1,399,528
Totals		**7,527,448**	**6,181,867**	**5,955,916**	**4,618,800**	**470,118**	**477,088**	**5,566,006**

Note:

- The variance between Procured and Delivered is due to COVID-19 Impact on the procurement
- The variance between Delivered and accepted is due to LLINs defects during QC Checks

- Noting that some quantities received were not ready for distribution, the Program prioritized Households Distribution to protect the maximum of people staring with high burden and non-IRS districts

Table 2: LLINs Distribution per Zone per Type

Donor	Type of LLINs	District	Distribution Period	LLINs Distributed			Total
				HHs	ANC	EPI	
PMI	PBO Nets	Kicukiro	Feb-20	168,550	43,398	42,750	254,698
		Gasabo	Feb-20	302,050	59,250	55,700	417,000
		Nyarugenge	Feb-20	152,400	-	-	152,400
		Rulindo	Feb-20	161,350	42,440	42,440	246,230
		Gicumbi	Feb-20	212,500	58,350	58,350	329,200
	S/Total			**996,850**	**203,438**	**199,240**	**1,399,528**
	Standard LLINs	Nyagatare	Mar-20	281,500	10,650	10,678	302,828
		Ngoma	Mar-20	198,550	14,400	14,400	227,350
		Kirehe	Mar-20	180,650	10,650	10,650	201,950
		Butaro	Mar-20	182,100	35,400	35,400	252,900
		Gakenke/Nemba	Jun-20	125,850	7,900	7,900	141,650
	S/Total			**968,650**	**79,000**	**79,028**	**1,126,678**
GF	IG2 Nets	Karongi	May-20	171,050	-	-	171,050
		Nyamasheke	May-20	198,400	-	-	198,400
		Muhanga	May-20	173,800	-	-	173,800
		Rusizi	May-20	225,900	-	-	225,900
	S/Total			**769,150**	**-**	**-**	**769,150**
	Standard LLINs	Ruhango	Feb-20	174,750	39,800	39,800	254,350
		Nyamagabe	Feb-20	196,050	21,600	21,600	239,250
		Nyaruguru	Feb-20	156,850	14,500	14,550	185,900
		Nyanza	Feb-20	166,500	13,100	13,100	192,700
		Kamonyi	Feb-20	208,200	23,500	23,500	255,200
		Rubavu	Feb-20	218,450	16,800	16,800	252,050
		Rutsiro	Jun-20	166,150	11,800	11,800	189,750
		Ngororero	Jun-20	180,900	13,900	13,900	208,700
		Nyabihu	Jun-20	143,850	16,650	16,650	177,150
		Musanze	Jun-20	214,850	16,450	16,450	247,750
		Gakenke/Ruli	Feb-20	57,600	6,550	3,700	67,850
	S/Total			**1,884,150**	**194,650**	**191,850**	**2,270,650**
	Totals			**4,618,800**	**477,088**	**470,118**	**5,566,006**

COVID-19 pandemic has impacted on the procurement, inspection and distribution of LLINs leading to non-coverage of seven (7) districts (Rusizi, Gisagara, Huye, Bugesera, Rwamagana, Kayonza and Gatsibo) in LLINs mass Campaign as well as non-coverage in routine LLINs for 10 districts (Rusizi, Gisagara, Huye, Bugesera, Rwamagana, Kayonza, Gatsibo, Nyamasheke, Muhanga and Karongi) . These districts are earmarked to receive LLINs in FY2020/2021.

1. LLINs in the Private Sector

On February 26th, 2018 the Ministry of health published the instruction No 20/0002 regulating the distribution of LLINs for free of charges to the population in ubudehe1&2 and the selling of LLINs to the population in Ubudehe 3&4 in public and private institutions to all who are able to buy the LLINs for protection. During this fiscal year two partners Society for Family Health (SFH) Rwanda and Rwanda Development Organization (RDO) were involved in the social marketing of LLINs in different areas of the country through: community based distribution (CBD) by CHWs and pharmacies, and 76,202 LLINs were distributed by SFH (19400 LLINs and RDO (56,772 LLINs).

Strategy 2: Conduct IRS and other Vector Control Interventions in Targeted Districts

1. Introduction

Vector control interventions are primary component of malaria control and prevention. The two -core important vector-control interventions used in Rwanda are of Indoor Residual Spraying (IRS) and Long-Lasting Insecticidal Nets (LLINs). The IRS intervention consist of the spraying of interior surfaces of dwellings with a residual insecticide to kill or repel endophilic mosquitoes[1]. In order to be effective, IRS needs to be implemented at a high level of coverage before the peak of malaria transmission seasons. In 2007, IRS was introduced in Rwanda targeting districts with high risk of malaria transmission in urban district of Kigali and then from 2011 extended in the rural districts.

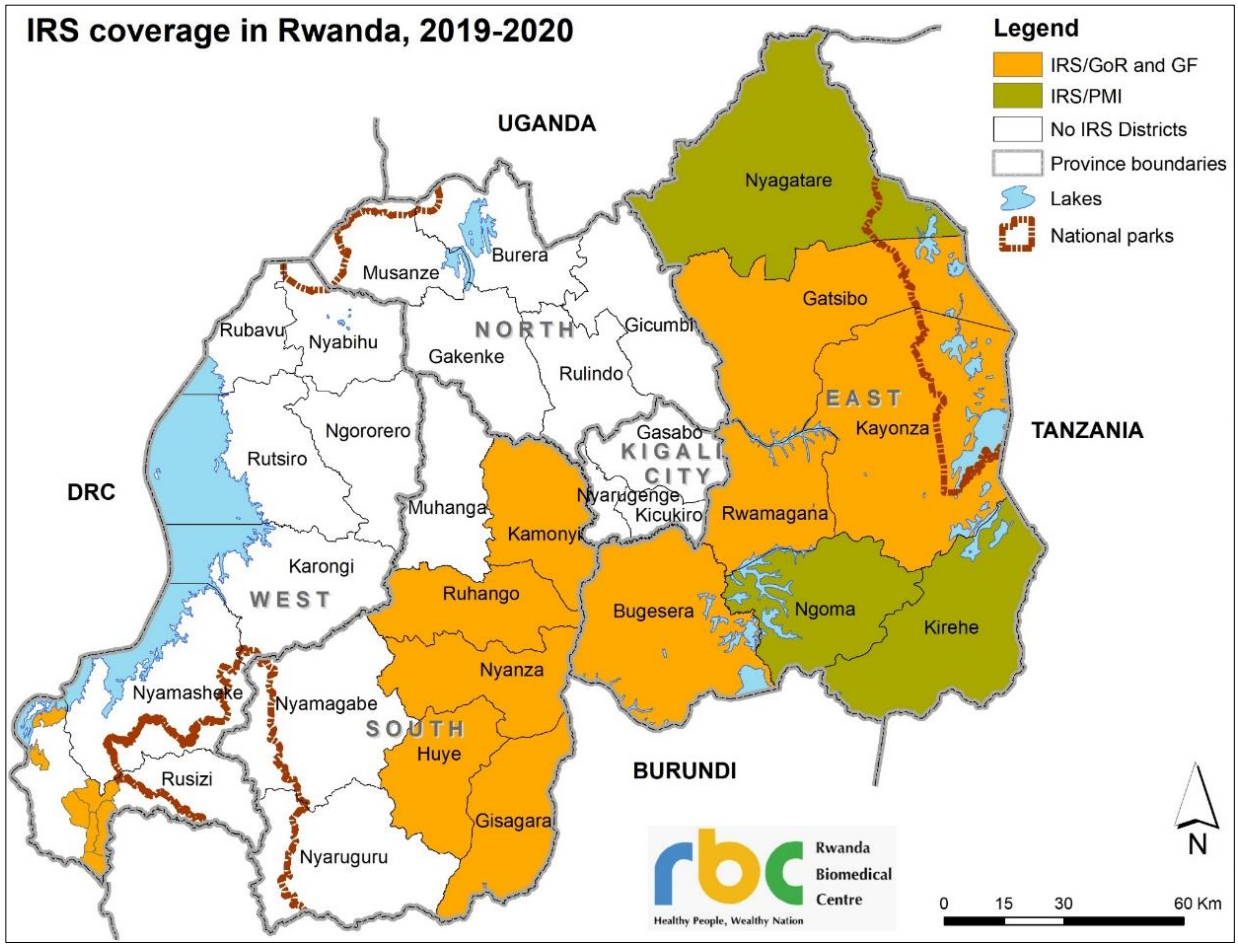
Since 2008, the above core vector-control interventions have been supplemented with other measures including larval source management using bio-larvicides and environmental management, mosquito repellents, fish farming in fish ponds and water dams. To ensure a successful and sustainable approach, Rwanda introduced the approach of Integrated Vector Management approach (IVM) by implementing its five pillars (i) Advocacy and social mobilization, ii) collaboration, iii) capacity building, iv) integrated approach and v) evidence-based decision-making. In order to successfully implement and optimize IVM strategies, the bionomics, behavior and transmission of local malaria vectors species are annually assessed. This information includes the monitoring of the species composition and density, the biting and resting behavior of mosquitoes, susceptibility to insecticides and the infection rate of mosquitoes with *Plasmodium* parasite and the entomological inoculation rate is calculated per species and per study site. The coverage, usage, quality, and durability of vector-control products and interventions are also annually monitored following their setting deployment.

[1] WHO 2018, Malaria terminology, Global Malaria Programme, **Geneva-Switzerland. 38 pp**

2. Indoor Residual Spraying

During FY 2019-2020, 13 districts were sprayed out of 15 targeted districts for Indoor Residual Spraying (IRS). Three out of the above districts (Nyagatare, Kirehe, and Ngoma) were supported PMI/VectorLink project implemented by Abt Associates. The remaining 10 districts received the support from Global Fund and Rwanda Government (GF/GoR): Bugesera, Gatsibo, Kayonza, Rwamagana in Eastern Province; Gisagara, Huye, Nyanza, Ruhango, Kamonyi in Southern Province and 7 sectors (Gikundamvura, Gitambi, Bugarama, Nyakabuye, Muganza, Kamembe and Nkanka of Rusizi district in Western Province.

Figure 1: Indoor Residual Spraying Districts, FY2019/2020

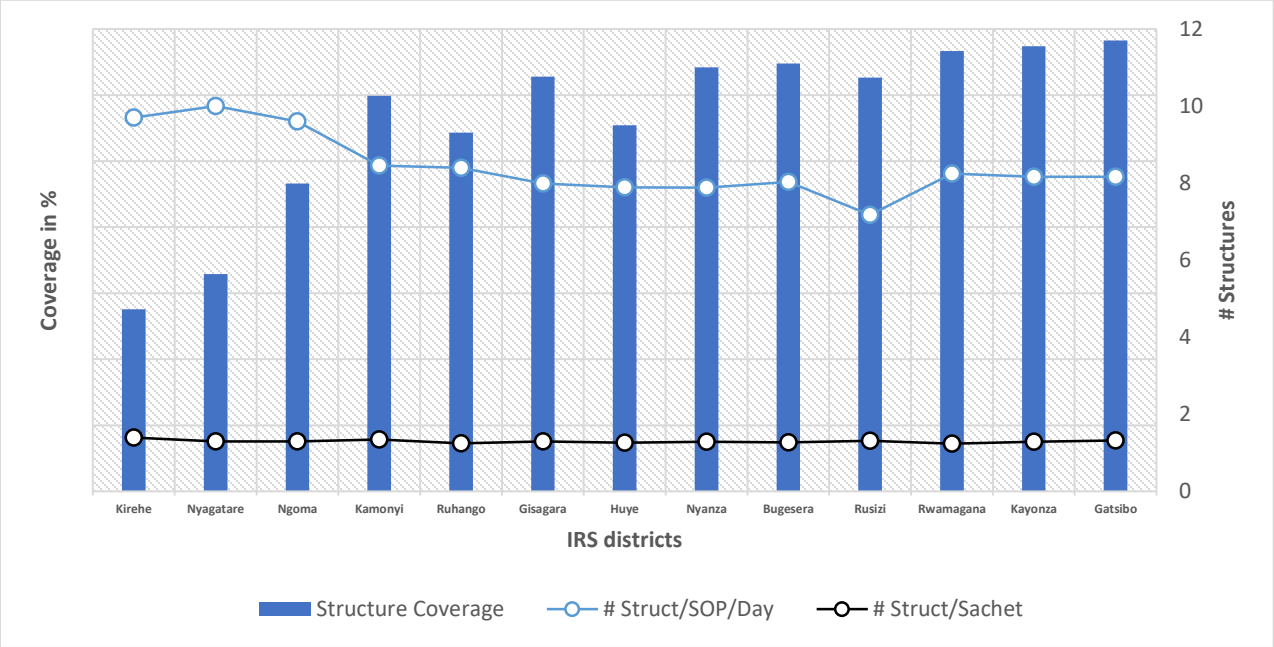


Over the FY 2019-2020, a total number of 1,231,070 out of 1,239,880 structures were sprayed making a coverage rate of 99,3%. The PMI/VectorLink project sprayed 314,517

out of 320,073 structures found with a coverage of 98.3% while the support from GF/GoR covered 916,553 out of 919,807 found structures with a coverage of 99.6%. The support from the GF/GoR represented 74.5% and 25.5% from PMI/VectorLink Project. In the targeted districts, the IRS intervention was performed with blanket coverage in 12 districts (153/153 administrative sectors) and focal coverage in Rusizi districts where 7 sectors (39%) were sprayed out of the 18 sectors (table 1). In terms of rooms covered, 4,681,635 were sprayed from 4,742,186 rooms found with a coverage of 98.7%. The total population protected with IRS was 4,867,811 out of 4,899,459 targeted populations with an estimated population covered of 99,4%. Among the population protected, 58,666 were pregnant women (1,21%) and 658,544 were children below five years (13,53%). The total insecticide used is 945,405 sachets of Fludora Fusion® 56.25 WP including 235,444 procured by PMI and 709,961 sachets of Fludora Fusion® 56.25 WP procured by GOR/GF (Table 2).

In terms of performance, one sprayer operator (SOP) performed 8.9 structures per day with 9.8 and 8.1% structures/SOP/Day in districts supported by PMI and GF/GoR and ranging from 7.2 to 10 structure/SOP/Day in Rusizi and Nyagatare. The average rooms per sprayed structure were 3.8 and ranging from 3.3 in Ruhango and 4.2 in Rusizi. In average, 1.30 structures were sprayed by one sachet of insecticide with 1.34 structures in districts supported by PMI and 1.31 structures in districts supported by GF/GoR and ranging from 1.40 in Kirehe district to 1.24 structures in Rwamagana district (Figure 2).

Figure 2: Performance of IRS (Coverage, Structures per SOP per Day and per Sachet)



Regarding the sources of funds for IRS operational cost, in total, 2,471,323,258 RFW were disbursed from GF/GOR and transferred to the district hospitals, with 834,322,289 RFW (33.8%) from GF, 1,233,704,491 RFW (49.9%) from GoR and 403,296,478 RFW (16.3 %) from Malaria Program Savings/Incomes.

Table 3: IRS Coverage per Partner and per District, FY 2019/2020

Nº	District	IRS Start	IRS Ending	# Structures Targeted	# Structures Found	# Structures Sprayed	Structures Coverage Rate (%)	# Structures Sprayed/SOP/Day
1	Kirehe	02/09/2019	24/09/2019	91,133	98,729	96,635	97.9	9.7
2	Nyagatare	02/09/2019	24/09/2019	122,771	127,441	125,077	98.1	10
3	Ngoma	20/01/2020	11/02/2020	90,618	93,903	92,805	98.8	9.6
Total Covered by PMI				**304,522**	**320,073**	**314,517**	**98.3**	**9.8**
1	Kamonyi	07/10/2020	29/10/2019	94,224	101,623	101,110	99.5	8.5
2	Ruhango	07/10/2020	29/10/2019	88,515	94,692	93,950	99.2	8.4
3	Gisagara	20/01/2020	11/02/2020	87,456	89,116	88,794	99.6	8.0
4	Huye	20/01/2020	11/02/2020	85,312	85,831	85,206	99.3	7.9
5	Nyanza	03/03/2020	22/03/2020	83,495	83,891	83,648	99.7	7.9
6	Bugesera	03/03/2020	25/03/2020	90,970	93,306	93,063	99.7	8.0
7	Rusizi	09/03/2020	31/03/2020	48,106	44,067	43,905	99.6	7.2
8	Rwamagana	11/05/2020	2/06/2020	90,930	95,642	95,483	99.8	8.2
9	Kayonza	11/05/2020	2/06/2020	99,638	103,874	103,738	99.9	8.2
10	Gatsibo	11/05/2020	2/06/2020	122,727	127,765	127,656	99.9	8.2
Total Covered by GF/GoR				**891,373**	**919,807**	**916,553**	**99.6**	**8.1**
Grand Total				**1,195,895**	**1,239,880**	**1,231,070**	**99.3**	**8.9**

Table 4: Population Protected, Room Coverage and Insecticide Used per IRS District

Nº	District	Population Targeted	Population Protected	Children < 5 years Protected	Pregnant Women	Total Rooms Sprayed	Coverage Sprayed Rooms	Average Room per Structure	Total Insecticide Used	# Structures Sprayed per Sachet
1	Kirehe	422,948	415,507	59,399	6,142	377,371	96.8	3.9	69,159	1.40
2	Nyagatare	508,986	499,527	71,248	331	454,534	97.1	3.6	96,545	1.30
3	Ngoma	377,578	373,918	48,445	5,271	387,114	98.8	4.2	69,740	1.30
Total PMI		**1,309,512**	**1,288,952**	**179,092**	**11,744**	**1,219,019**	**97.6**	**3.9**	**235,444**	**1.34**
1	Kamonyi	380,285	378,423	48,636	4,267	361,245	99.0	3.6	78,067	1.35
2	Ruhango	339,557	336,993	42,885	3,815	309,105	98.6	3.3	69,740	1.25
3	Gisagara	361,665	360,336	50,546	5,500	351,812	99.2	4.0	68,555	1.30
4	Huye	333,861	331,432	42,550	4,575	341,150	98.6	4.0	67,404	1.26
5	Nyanza	316,219	315,333	40,567	3,809	287,692	99.2	3.4	65,027	1.29
6	Bugesera	376,365	376,122	55,027	5,448	365,069	99.2	3.9	73,042	1.27
7	Rusizi	201,761	201,155	29,995	3,162	184,061	99.3	4.2	33,485	1.31
8	Rwamagana	367,204	367,045	48,402	4,759	387,279	99.6	4.1	77,150	1.24
9	Kayonza	413,269	412,734	54,172	5,410	398,561	99.7	3.8	80,599	1.29
10	Gatsibo	499,761	499,286	66,672	6,177	476,642	99.0	3.7	96,892	1.32
Total GF/GoR		**3,589,947**	**3,578,859**	**479,452**	**46,922**	**3,462,616**	**99.1**	**3.8**	**709,961**	**1.31**
Grand Total		**4,899,459**	**4,867,811**	**658,544**	**58,666**	**4,681,635**	**98.7**	**3.8**	**945,405**	**1.30**

3. Insecticide Resistance Monitoring and Quality Control of IRS

3.1. Insecticide Resistance Monitoring

a. Biological Resistance

From July 2019 to June 2020, the biological resistance tests were carried out in 25 different sites. The tests followed the WHO mosquito susceptibility guidelines using the cylindrical tube method[2] for the eight insecticides belonging to the four classes: Carbamates (Bendiocarb 0.1%); Organophosphates (Fenitrothion 1%, and Pirimiphos methyl 0.25%); Organochlorines (DDT 4%); Pyrethroids (Deltamethrin 0.05%, Permethrin 0.75%, and Lambdacyalothrin 0.05%); and the new class of Neonicotiniod (Chlothianidin 2%) .

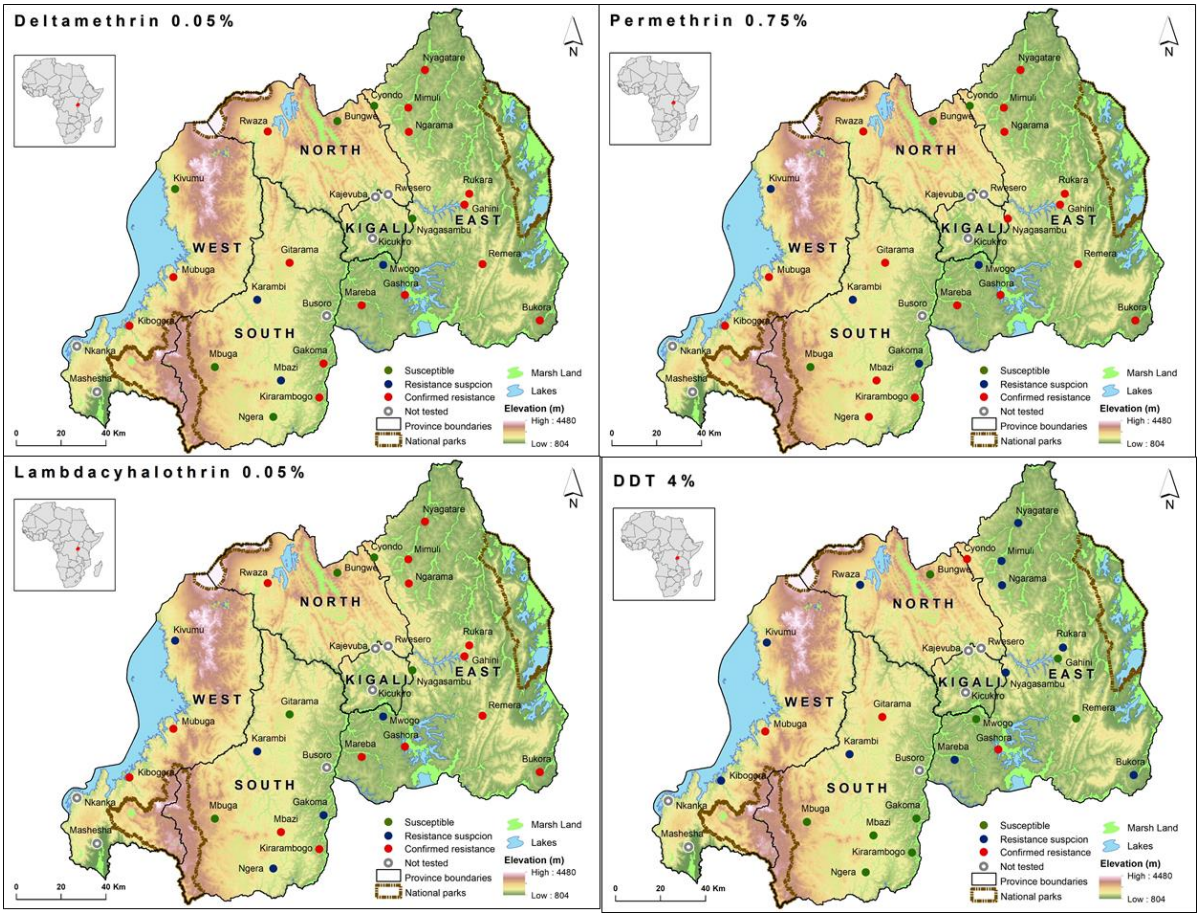
Thus, larvae collections of *Anopheles* genus were conducted using the dipping method as described by the WHO[3]. Mosquito larvae were subsequently reared in the locally established insectary in different sites following the standard conditions of temperature (26-28°C) and relative humidity (70-80%). The susceptibility test was conducted on *Anopheles gambiae* s.l aged 3 to 5 days, and fed on glucose. For testing, a minimum of 100 mosquitoes were used in 4 replicates with 20-25 females per tube for each insecticide, each test had two control replicates of 50 mosquitoes.

The mosquitoes were exposed to the standard dose of insecticide for one hour (knock down test) and observed for 24 hours' post-exposure for mortality assessment. The exposure mortality was calculated as number of dead mosquitoes over the total number exposed. A mortality rate between 98% and 100% is considered to indicate fully susceptibility; 90-97% mortality suggests the possible resistance that needs to be confirmed. Mortality that is < 90% indicates confirmed resistance. It was found that resistance status to at least one insecticide was more prevailing in endemic districts of low land areas than in high land (Figure 3).

[2] WHO (2013). Test procedures for insecticide resistance monitoring in malaria vector mosquitoes

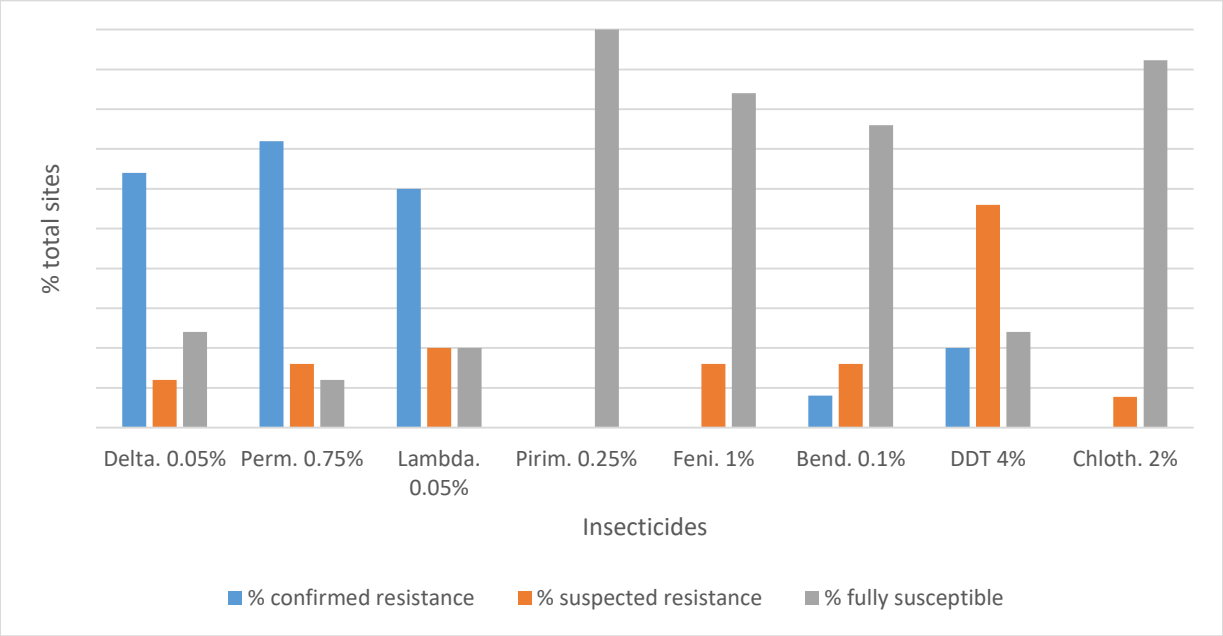
[3] WHO (2013) Malaria entomology and vector control – Learner's Guide

Figure 3: Distribution of Insecticide Resistance to Pyrethroids and DDT 4%



The biological resistance was determined for each insecticide tested from 25 sites for all seven insecticides except the Chlothianidin 2% where the resistance was carried out in 13 sites. The proportion of sites with confirmed resistance was respectively: Deltamethrin (64%), Permethrin 72%, Lambdacyalothrin (60%, Bendiocarb (8%) and DDT (20%). The Pirimiphos methyl was the only insecticide with full susceptibility to Anopheles mosquitoes in all surveyed sites. The suspicion of resistance was detected to Fenitrothion from 4 sites (16%) of Gashora, Gitarama, Kirarambogo and Karambi; and to Chlothianidin in one site (7.7%) of Mareba (Figure 4).

Figure 4: Insecticide Resistance Status per Surveyed Site (N=25) 2019/2020



b. Resistance Mechanism

In the ten sites with confirmed resistance to deltamethrin and permethrin; 9 sites with confirmed resistance to Lambdacyalothrin, the addition of synergist, the piperonyl butoxide: PBO restored the susceptibility in all sites. The results suggest a significant role of metabolic mechanisms in mediating pyrethroid resistance in malaria vectors. The addition of PBO to insecticide pyrethroids increases the effectiveness of insecticide in resistance settings. The choice of vector control intervention has to consider the above findings.

Table 5: Results of Resistance Tests for Insecticides (with PBO) Performed, 2019-2020

Susceptibility Status	Product Name					
	Delta. 0.05%+PBO		***Perm. 0.75%+PBO***		***-cyhal 0.05%+PBO***	
	# Sites (n=10)	**%**	**# Sites (n=10)**	**%**	**# Sites (n=9)**	**%**
Resistance with PBO confirmed	0	0	0	0	0	0
Resistance with PBO suspected	0	0	0	0	0	0
Susceptibility restored with PBO	10	100	10	100	9	100

c. Resistance Intensity using WHO Susceptibility Test Kits

The intensity of the resistance was also tested in 16 sites where the resistance at diagnostic doses was confirmed to deltamethrin, permethrin, lambda-cyhalothrin. The intensity assays were performed at five (5x) and ten (10 x) times the diagnostic dose described for biological resistance tests. The resistance was found low to be moderate levels. The intensity was found low in all 16 sites for deltamethrin; low in 14 sites (78%) and moderate in 4 (22%) sites of Mimuli, Nyagatare, Mareba and Mubuga for Permethrin, low in 16 sites (89%) and moderate in 2 sites (11%) of Rukara and Nyagatare (table 6).

Table 6: Insecticide Resistance Intensity in 18 Sites with Confirmation Resistance

No	Sites	Deltamethrin 0.05%		Permethrin 0.75%		Lambdacyhalothrin 0.05%	
		0.25%	0.50%	3.75%	7.50%	0.25%	0.50%
1	Mimuli	99		83	99	91	98
2	Nyagatare	97		85	100	80	100
3	Remera	97	100	92	98	99	100
4	Mareba	99		84	93	93	100
5	Gashora	100		100	100	100	100
6	Mwogo	100		100	100	100	100
7	Bukora	98		91	92	96	98
8	Gahini	98		94	100	94	100
9	Gakoma	92	97	100	100	99	100
10	Gitarama	100		99		99	99
11	Kibogora	97	99	90	100	96	100
12	Kirarambogo	95	98	92	95	91	99
13	Mbazi	100	100	100	100	98	100
14	Mubuga	97	99	49	98	98	100
15	Ngarama	99	100	96	100	98	100
16	Nyagasambu			100	100	98	98
17	Rukara	100	100	99	100	66	100
18	Rwaza			95	100	96	100

Remark: Susceptibility of mosquitoes categorized according mortality levels as following:
Susceptible (SS) >= 98%, Resistance Suspicion (RS) >=90-97%, Confirmed Resistance (RR) < 90%

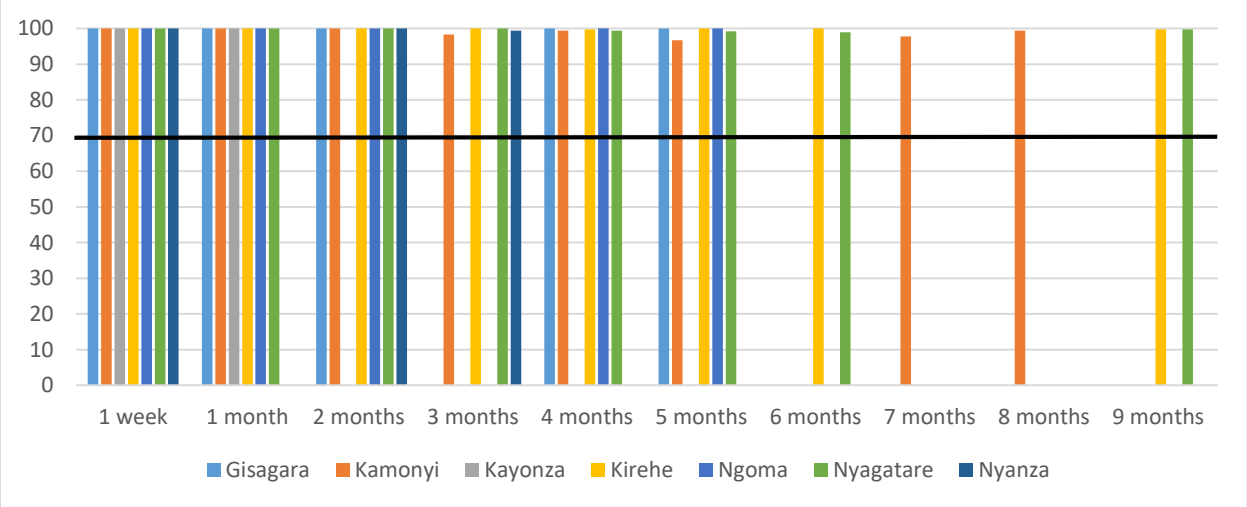
3.2. Quality Control of Interventions and Entomology Surveillance

Quality Control of IRS using Wall Bioassays

IRS quality control (wall bioassays) was performed one-week post IRS as well as on a monthly basis to determine the residual efficacy of the insecticide on sprayed house walls. The IRS campaigns were performed in different periods as indicated earlier. The districts were sampled for IRS Quality Control as following: Nyagatare and Kirehe in September 2019, Kamonyi in October 2019, Gisagara and Ngoma in January 2020, Nyanza in March 2020 and Kayonza in May 2020. The IRS quality control was performed in 2 sectors from each of the seven out of the 13 IRS districts. At each sector, 6 houses (2 plastered non-painted, 2 plastered painted, and 2 mud) were selected for bioassay tests. The susceptible Kisumu strains of *Anopheles gambiae* s.s. reared at the MOPDD/RBC insectary based at national entomology laboratory were used to run appropriate tests. Mosquitoes 2-5 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. Mortality were red after 96 hours of exposure to the insecticide, the **Fludora Fusion 56.25WP**. The mortality was calculated for both exposed and control samples.

The results of the post IRS wall bioassays are shown in figure above. Until June 2020 post IRS campaign, the results of the wall bioassay were available up to nine months in Nyagatare & Kirehe, eight months in Kamonyi, five months in Gisagara & Ngoma, three months in Nyanza and one-month post spraying in Kayonza. In all districts the insecticide was still effective at the end of the year with mortality of exposed mosquitoes above the cut off mortality of 80% as recommended by WHO. Results confirm a residual efficacy of Fludora Fusion 56.25 WP of more than nine months in the context of Rwanda as shown the nine-month results from Kirehe and Nyagatare (Figure 5).

Figure 5: Post IRS Wall Bioassays Performed in FY 2019-2020



3.3. Quality Control of IRS using Entomology Monitoring

The entomological monitoring was carried out, from July 2019 to June 2020 in two sites located in each IRS district respectively Nyagatare (Nyagatare & Rukomo), Kirehe (Gatore & Nyamugali), Ngoma (Zaza & Remera). The control district was Kamonyi (Musambira) from July 2019 to August 2019 then Nyaruguru (Ngera) from September 2019 to June 2020. Between July 2019 and June 2020, mosquitoes were collected from indoor and outdoor on a monthly basis for assessment of the following parameters: vector bionomics using human landing catching method and indoor resting behavior of mosquitoes using Pyrethrum Spraying catching method.

1. As shown in tables below, during the period of activities, 25, 086 mosquitoes (*Culicidae*) were collected using human landing catching method and out of them, 92.8 were *Culicinae* and 7.2 Anopheles mosquitoes. The *Anopheles gambiae* s.l. were the major malaria vectors and representing 79.3 % (n=1804) of the total catches of anopheles mosquitoes. Other Anopheles mosquitoes collected were respectively *An. coustani 0.4%, An. funestus 0.7%, An. maculipalpis 3,7%, An. pharoensis 1.1%, An. ziemanni 14.6%* and *An. rufipes 0.2%.* Of the *An. gambiae* s.l. collected, 57.9% (n=1431) caught outside the houses while the 67% (n=373) of other Anophelines mosquitoes were also collected outside the dwellings.
2. The biting rate by *Anopheles gambiae s.l.* varied from 0.6 to 10 bites per person per night within sites, with an average of 2.5 bites per person per night. The average biting rate of mosquitoes in general *(Culicidae)* was 25 bites per person per night and ranging from 11.3 to 46,3 bites per person per night.
3. The total collected mosquitoes through PSC method were 2,238 mosquitoes including *276 Anopheles gambiae s.l.*, 340 total *Anophelines* and *1898 Culicinae* from seven sites. Among *Anophelines*, 243 (71.5%) were unfed and 97 (28.5%) were found fed. In total 39 were fresh fed, 47 half-gravid and 10 gravid.
4. The determination of parity on a sample 495 ***Anopheles gambiae s.l.*** dissected and collected from inside and outside in IRS sites and 45 ***Anopheles gambiae s.l.*** dissected and collected from inside and outside in none IRS site (control) showed respectively that the parous rates were 18.9% (n=495) in intervention sites and 60% (n=45) in none IRS sites. The results showed that the IRS intervention affects the longevity of malaria vectors.
5. The entomological inoculation rate (EIR) which is the number of infectious bites per person per unit time was measured and expressed per year. The EIR was 0 infected bite per person and per year for 1507 Anophelines tested with a sporozoite infection rate of 0 in seven sites.
6. Out pf 60 anopheles mosquito tested for blood meal, 53.3% were fed on bovine, 16.7% mixture from bovine and goat, 13.3% on human, mixture of 3.3% on human and goat, while 15% was unspecified blood source.

7. The speciation of *Anopheles gambiae* s.l. was performed in the entomology lab to identify the siblings of *Anopheles gambiae* complex. Out of 256 samples analyzed using PCR-identification, 3% samples were found to be *Anopheles gambiae s.s.* and 97% were *Anopheles arabiensis*. The dominant malaria vector recently became *Anopheles arabiensis* in the most entomological monitoring sites within IRS districts.

Table 7: Distribution of Malaria Vectors/HLC –July-August 2019

No	Site name	Anopheles gambiae s.l. / HLC			Other Anopheles / HLC			Cn/HLC	PSC			Tot. An	Tot. Cn	Cd	Biting behavior %				Biting rate person/night			Inf rate (%) An	EIR An
		In	Out	Total	In	Out	Total		An.g	Ao	Cn				Ag. Endo	Ag. Exo	Ao. Endo	Ao. Exo	An	Culc	Culd		
1	Gatore	2	5	7	0	3	3	1682	1	0	218	11	1900	1 911	28,6	71,4	0,0	100,0	0,4	70,1	14,1	0,0	0,0
2	Nyamugali	0	6	6	0	0	0	391	0	0	6	6	397	403	0,0	100,0	0.0	0.0	0,3	16,3	3,3	0,0	0,0
3	Remera	2	1	3	4	4	8	486	0	0	16	11	502	513	66,7	33,3	50,0	50,0	0,5	20,3	4,1	0,0	0,0
4	Zaza	1	0	1	1	1	2	629	1	0	42	4	671	675	100,0	0,0	50,0	50,0	0,1	26,2	5,3	0,0	0,0
5	Nyagatare	14	9	23	0	1	1	791	6	0	20	30	811	841	60,9	39,1	0,0	100,0	1,0	33,0	6,8	0,0	0,0
6	Rukomo	23	12	35	1	0	1	1124	3	0	126	39	1250	1 289	65,7	34,3	100,0	0,0	1,5	46,8	9,7	0,0	0,0
7	Musambira	87	98	185	3	6	9	107	20	0	22	214	129	343	47,0	53,0	33,3	66,7	8,1	4,5	2,5	0,0	0,0
Total		**129**	**131**	**260**	**9**	**15**	**24**	**5210**	**31**	**0**	**450**	**315**	**5660**	**5 975**	**49,6**	**50,4**	**37,5**	**62,5**	**1,7**	**31,0**	**6,5**	**0,0**	**0,0**

Table 8: Distribution of Malaria Vectors/HLC – September 2019 to June 2020

No	Site name	Anopheles gambiae s.l. / HLC			Other Anopheles / HLC			Cn/HLC	PSC			Tot. An	Tot. Cn	Cd	Biting behavior %				Biting rate person/night			Inf rate (%) An	EIR An
		In	Out	Total	In	Out	Total		An.g	Ao	Cn				Ag. Endo	Ag. Exo	Ao. Endo	Ao. Exo	An	Culc	Culd		
1	Gatore	53	118	171	11	61	72	4729	86	6	174	335	4903	5 238	31,0	69,0	15,3	84,7	2,0	39,4	41,4	0,0	0,0
2	Nyamugali	19	60	79	1	6	7	2347	14	1	119	101	2466	2 567	24,1	75,9	14,3	85,7	0,7	19,6	20,3	0,0	0,0
3	Remera	36	50	86	34	40	74	1585	10	0	85	170	1670	1 840	41,9	58,1	45,9	54,1	1,3	13,2	14,5	0,0	0,0
4	Zaza	63	107	170	10	31	41	2990	27	5	76	243	3066	3 309	37,1	62,9	24,4	75,6	1,8	24,9	26,7	0,0	0,0
5	Nyagatare	105	141	246	10	16	26	2782	1	0	45	273	2827	3 100	42,7	57,3	38,5	61,5	2,3	23,2	25,5	0,0	0,0
6	Rukomo	167	175	342	11	18	29	2485	37	3	847	411	3332	3 743	48,8	51,2	37,9	62,1	3,1	20,7	23,8	0,0	0,0
7	Ngera	31	46	77	37	63	100	1154	67	49	102	293	1256	1 549	40,3	59,7	37,0	63,0	1,5	9,6	11,1	0,0	0,0
Total		**474**	**697**	**1 171**	**114**	**235**	**349**	**18072**	**242**	**64**	**1 448**	**1 762**	**19520**	**21 282**	**40,5**	**59,5**	**32,7**	**67,3**	**1,8**	**21,5**	**23,3**	**0,0**	**0,0**

Table 9: Results of Pyrethrum Spraying Catches: Anopheles gambiae s.l.–July 2019 to August 2019

Period	Site	# of houses	# of Occupants	*An. gambiae* s.l	*Other Anopheles*	Abdominal/Blood Digestion stages				Proportion of gravid	*An. gambiae* s.l. *per house*	Fed per house	Fed/human host	Culicinae
						UF^	F^	HG^	G^					
July 2019 - August 2019	Gatore	30	126	1	0	1	0	0	0		0,0	0,0	0,0	218
	Nyamugali	30	142	0	0	0	0	0	0		0,0	0,0	0,0	6
	Remera	30	110	0	0	0	0	0	0		0,0	0,0	0,0	16
	Zaza	30	124	1	0	1	0	0	0		0,0	0,0	0,0	42
	Nyagatare	30	156	6	0	3	1	1	1	67%	0,2	0,1	0,0	20
	Rukomo	30	159	3	0	2	1	0	0	0%	0,1	0,0	0,0	126
	Musambira	30	116	20	0	12	4	4	0	50%	0,7	0,3	0,1	22
Total		**210**	**933**	**31**	**0**	**19**	**6**	**5**	**1**	**50%**	**0,1**	**0,1**	**0,0**	**450**

Table 10: Results of Pyrethrum Spraying Catches: Anopheles gambiae s.l.– September 2019 to June 2020

Period	Site	# of houses	# of Occupants	*An. gambiae* s.l	*Other Anopheles*	Abdominal/Blood Digestion stages				Proportion of gravid (HG+G/ HG+G+F)	*An. gambiae* s.l. *per house*	Fed per house	Fed/human host	Culicinae
						UF^	F^	HG^	G^					
September 2019 - June 2020	Gatore	150	546	86	6	70	5	12	1	72%	0,6	0,1	0,0	174
	Nyamugali	150	732	14	1	13	0	2	0	100%	0,1	0,0	0,0	119
	Remera	150	557	10	0	6	2	1	1	50%	0,1	0,0	0,0	85
	Zaza	150	533	27	5	24	2	6	0	75%	0,2	0,1	0,0	76
	Nyagatare	150	729	4	0	4	3	0	0	0%	0,0	0,0	0,0	45
	Rukomo	150	686	37	3	28	10	1	1	17%	0,3	0,1	0,0	847
	Ngera	150	701	67	49	79	11	20	6	70%	0,8	0,2	0,1	102
Total		**1050**	**4484**	**245**	**64**	**224**	**33**	**42**	**9**	**61%**	**0,3**	**0,1**	**0,0**	**1448**

Abbreviations: HLC: Human Landing Catching; PSC: Pyrethrum Spray Catch; In: Inside; Out: Outside; An: Anophelines; An.g: *Anopheles gambiae* s.l.; Cn: *Culcinae*; Cd: *Culicidae*; Inf: Infectivity; endo: Endophagic; exo: Exophagic, UF^: Unfed, FF^: Fresh fed, HG^: Half gravid, G^; Gravid, EIR: Entomological Inoculation Rate

3.4. Entomology Surveillance in 12 Sentinel Sites

Entomological surveillance was carried out over twelve sentinel sites located in different districts according to malaria eco-epidemiology strata (Bungwe and Rwaza in Nothern Province, Rukara, Bukora, Mareba and Mimuli in Eastern Province; Busoro, Karambi in Southern Province; Mashesha, Kivumu, Mubuga in Western Province and Kicukiro in Kigali City. Between July 2019 and June 2020, mosquitoes were collected using human landing catching method from indoor and outdoor on a monthly basis for assessment of the different entomological parameters.

As shown in table 9, during the activity, a total of **122,624** mosquitoes (Culicidae) were collected out of them 32% were *An. gambiae* s.l., 34.4% total anopheles and 65.6% culicines. Out of 42,154 total anopheles mosquitoes, 93% were *An. gambiae* s.l., 1.2% *An. funestus* and 5.8% other anopheles species. Over that period**,** 56.7% *Anopheles gambiae s.l.* were collected outside and ranging from 4% in Bukora to 65.3% in Karambi. The average of outdoor biting was 53.1% in non IRS sites while it was 63.1% in IRS sites. Overall, 512 *Anopheles funestus* were caught with more than 95% total collections in only three sites of Bungwe (14.6%), Kivumu (14.6%) and Mubuga (65.8%). An intervention of focal IRS should be deployed and eliminate the above indoor malaria vector where it is appearing as the dominant species in malaria transmission.

Regarding the biting rate by *Anopheles gambiae s.l.*, it varies from 0 (Bungwe and Rwaza) to 61.9 (Mashesha) bites per person per night (b/p/n), with an average of 7.5 b/p/n. The average biting rate of *An. gambiae s.l.* was found respectively 4.1 and 10.1 b/p/n in IRS and non IRS sites while it was 30.8 b/p/n in *Culicidae* and ranging from 1.8 (Karambi) to 93.6 (Mashesha) bi/p/n with 17.2 and 28.3 b/p/n in IRS and non IRS sites. There was an increase of mosquito density respectively of 100% in *An. gambiae* s.l. and 66% in total *Culicidae* in comparison with mosquito catches of 2018/2019. The increase of mosquito density both to *An. gambiae s.l.* and *Culicidae* was the most important in the following four sites of Mashesha, Mimuli, Mareba and Kicukiro (Figure 4 and 5). The above increase in mosquito density should be linked to the abnormal rainfall reported in the above sites.

The entomological inoculation rate (EIR) which is the number of infectious bites per person per unit of time was measured and expressed per year (ib/p/y). The average of EIR was 17.9 ib/p/y for *An. gambiae* s.l. and 1.05 ib/p/y for *An. funestus*. All infected mosquitoes were reported in non IRS sites. The *An. gambiae* s.l. carrying *Plasmodium* infections were found out in three sites of Mashesha, Kicukiro and Mubuga while the *An. funestus* carrying malaria infections were found in two sites of Kicukiro and Mubuga (Table 5). This information, particularly the prevailing of malaria infection at site level should be used to inform the control methods and to set the priorities in specific district.

Figure 6 : Trends of *An. gambiae* s.l. and *Culicidae* Mosquitoes FYs 2018/2019 and 2019/2020

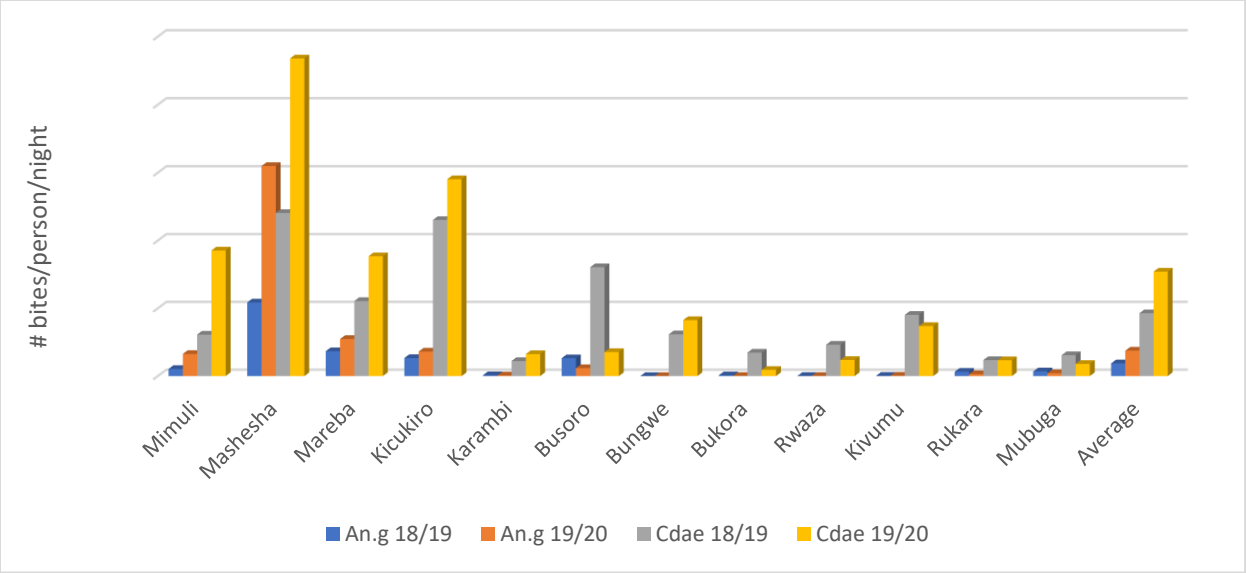


Table 11: Distribution of Malaria Vectors in 12 Sentinel Sites in Number

No	Site Name	*Anopheles gambiae s.l.*			*Anopheles funestus*			Total Anoph	Total Culic.	Total Culic.	% Anoph vs Total	% Culic./Total	% Anoph vs Culic.
		Inside	Outside	Total	Inside	Outside	Total						
1	Mimuli	1,427	1,390	2,817	0	0	0	2,817	13,194	16,011	6.7	16.4	17.6
2	Mareba	1,202	3,523	4,725	1	1	2	4,791	10,492	15,283	11.4	13	31.3
3	Busoro	461	549	1,010	2	1	3	2,305	760	3,065	5.5	0.9	75.2
4	Bukora	24	1	25	0	4	4	171	620	791	0.4	0.8	21.6
5	Rukara	147	103	250	2	1	3	340	1,679	2,019	0.8	2.1	16.8
IRS Districts		**3,261**	**5,566**	**8,827**	**5**	**7**	**12**	**10,424**	**26,745**	**37,169**	**24.7**	**33.2**	**28**
1	Mashesha	12,782	13,980	26,762	0	0	0	26,785	13,643	40,428	63.5	17	66.3
2	Kicukiro	1247	1882	3,129	7	6	13	3,230	21,864	25,094	7.7	27.2	12.9
3	Karambi	25	47	72	0	0	0	86	2,721	2,807	0.2	3.4	3.1
4	Bungwe	0	0	0	27	48	75	484	6,652	7,136	1.1	8.3	6.8
5	Rwaza	7	10	17	0	0	0	18	2,036	2,054	0	2.5	0.9
6	Kivumu	26	20	46	48	27	75	384	6,000	6,384	0.9	7.5	6
7	Mubuga	175	193	368	185	152	337	743	809	1,552	1.8	1	47.9
Non-IRS Districts		**14,262**	**16,132**	**30,394**	**267**	**233**	**500**	**31,730**	**53,725**	**85,455**	**75.3**	**66.8**	**37.1**
Total		**17,523**	**21,698**	**39,221**	**272**	**240**	**512**	**42,154**	**80,470**	**122,624**	100	100	34.4

Table 12: Distribution of Malaria Vectors in 12 Sentinel Sites

No	Site Name	Biting Behavior, %				Biting Rate Person/Night			Infectivity Rate (%) Ag	EIR Ag	Infectivity Rate (%) Af	EIR Af
		Ag. Endo	Ag. Exo	Af. Endo	Af. Exo	Ag	Af	Culicidae				
	IRS Sites											
	Mimuli	50.7	49.3	0	0	6.5	0	37.1	0	0	0	0
1	Mareba	25.4	74.6	50	50	10.9	0	35.4	0	0	0	0
2	Busoro	45.6	54.4	66.7	33.3	2.3	0.01	7.1	0	0	0	0
	Bukora	96	4	0	100	0.1	0.01	1.8	0	0	0	0
	Rukara	58.8	41.2	66.7	33.3	0.6	0.01	4.7	0	0	0	0
	Sub-Total	**36.9**	**63.1**	**41.7**	**58.3**	**4.1**	**0.01**	**17.2**	**0**	**0**	**0**	**0**
	Non-IRS Sites											
3	Mashesha	47.8	52.2	0	0	61.9	0	93.6	0.99	223.9	0	0
4	Kicukiro	39.9	60.1	53.8	46.2	7.2	0.03	58.1	1.44	38.1	6.25	0.69
5	Karambi	34.7	65.3	0	0	0.2	0	6.5	0	0	0	0
7	Bungwe	#DIV/0!	#DIV/0!	36	64	0	0.17	16.5	0	0	0	0
9	Rwaza	41.2	58.8	0	0	0	0	4.8	0	0	0	0
10	Kivumu	56.5	43.5	64	36	0.1	0.17	14.8	0	0	0	0
12	Mubuga	47.6	52.4	54.9	45.1	0.9	0.78	3.6	0.49	1.5	1.34	3.82
	Sub-Total	**46.9**	**53.1**	**53.4**	**46.6**	**10.1**	0.17	**28.3**	**0.99**	**36.3**	**1.06**	**0.64**
Total		**43.3**	**56.7**	**53.1**	**46.9**	**7.5**	**0.1**	**30.8**	**0.53**	14.5	**1.05**	0.38

Abbreviations: In: Inside; Out: Outside; An.: *Anophelines*; An.g: *Anopheles gambiae* s.l.; EIR/Y: Entomological inoculation rate per year, ibp/y: infected bites per person and per years

4. Climate Surveillance

The spatial variation of the three climatic variables (temperature, rainfall and R. humidity) is the mostly contributing to the distribution of *Anopheles* mosquitoes. Bukora (Kirehe) and Mashesha (Rusizi) are the highest warmed stations with respectively 22.4°C and 22.0°C. Two stations of Mashesha and Kivumu (Rutsiro) have registered high annual rainfall (above 2000 mm). Mashesha in Rusizi district, Bungwe in Burera district and Kivumu in Rutsiro district had a high humidity with respectively 71.1 %, 71.5% and 75.3% (table 10).

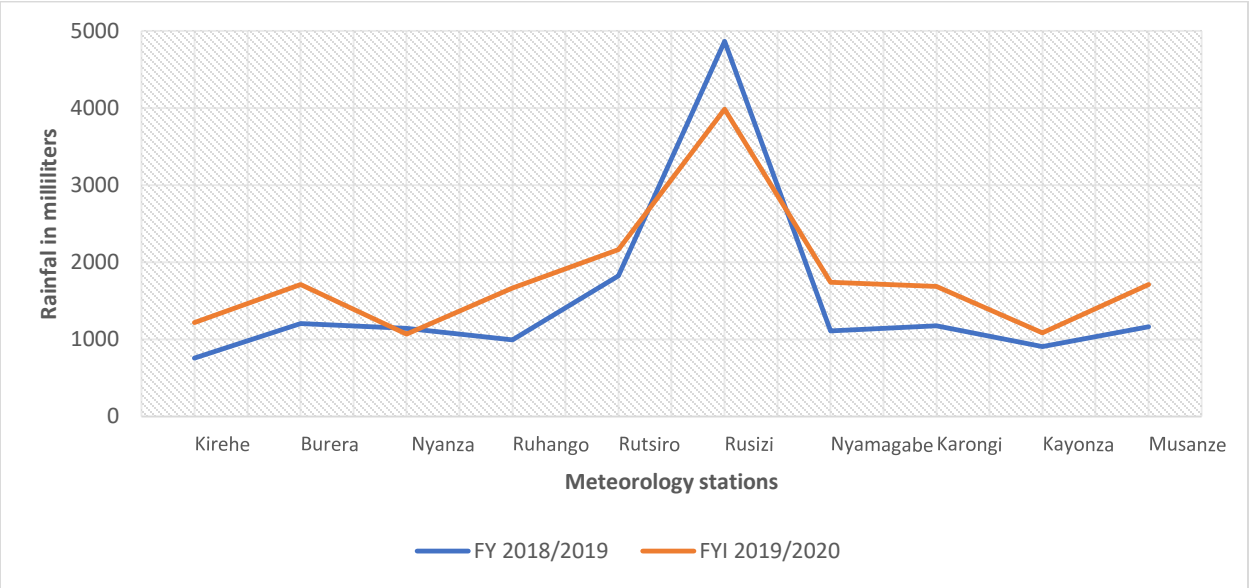
Table 13: Annual Average Rainfall, Temperature, and Humidity from Sentinel Sites

District	Station	An. Max Temp	An. Min Temp	An. Mean Temp	An. Rainfall	R. Humidity (%)
Kirehe	Bukora	27,24	14,45	22,4	1218,6	68,9
Burera	Bungwe	19,44	12,60	16,8	1710,3	71,5
Nyanza	Busoro	25,52	11,79	19,6	1069	59,4
Ruhango	Karambi	24,13	13,95	20	1666	59,3
Rutsiro	Kivumu	23,08	10,23	17,6	2164	75,3
Rusizi	Mashesha	27,20	14,61	22	3984,8	71,1
Nyamagabe	Mbuga	21,27	12,58	17	1738,1	-
Karongi	Mubuga	24,00	15,99	21	1688	65
Kayonza	Rukara	25,85	15,80	21,9	1085,1	65,2
Musanze	Rwaza	22,18	11,88	17,9	1712,1	62,7

The comparison of the annual rainfall trends between 2018-2019 and 2019-2020 shows a general increase of rainfall depth in 2019-2020 (290.0 mm of increase). Hence, malaria transmission should be high in the area with high temperature (≥18 ≤ 35), rainfall (> 80 mm) and R. humidity (> 60 %)[4] if prevention measures are not optimized.

[4] Ceccato P., Connor S. J., Jeanne I., Thomson M.C. **Application of Geographical Information Systems and Remote Sensing technologies for assessing and monitoring malaria risk**. *Parassitologia* .47.1 (2005), 81-96

Figure 7: Comparison of Rainfall 2018-2019 and 2019-2020



This indicates that Mashesha sentinel site is more likely to collect more mosquitoes compared to other nine sites. Consequently, more than 63.5 % of all *Anopheles* collected at 12 sites were reported from Mashesha (Table 12).

5. Maintenance of Insectary and Laboratory Animals

The susceptible Kisumu strain of *Anopheles gambiae* s.s. were maintained at the Mal&OPDD/RBC insectary based at national entomology laboratory of Kicukiro which comply with the WHO mosquito rearing standards. The total of 74,000 females *Anopheles gambiae s.s.* 2-5 days old were supplies for IRS quality control in sprayed districts, evaluation of impact of smoke on mosquito behaviors at Ruhuha experimental huts and in different exhibitions. For IRS quality control in seven districts, the total number 65,000 females *Anopheles gambiae* s.s Kisumu strains were supplied. A total number of 9000 female *Anopheles gambiae s.s.* 2-5 days old were supplied for the impact evaluation of smoke produced by different cooking fuels such as LPG Gas, charcoals and woods. The above evaluation was conducted at Ruhuha experimental huts, Bugesera district. During the period of July 2019 to June 2020, the total of 98 Guinnea pigs were kept at insectary for feeding mosquito colony and out of them 75 were supplied in the community to improve food deficiency for the poor families around the entomology laboratory. Current 23 are kept healthy and ready to supply blood for mosquitoes.

6. Capacity Building in Research and Dissemination of Results

Research

Within the framework of capacity building of vector control and entomology surveillance, the following activities were performed or still ongoing mainly as field operational research:

a) **Estimating the Malaria Prevention Impact of New Nets: Observational Analyses to Evaluate the Evidence Generated During Piloted New Nets Distribution in Rwanda**. The vector control team participated in development of the protocol regarding the entomology component in collaboration with PATH and University of Rwanda. The entomological baseline data were collected in March 2020 from three sites of Mbuga (Nyamagabe), Mubuga (Karongi) and Karambi (Ruhango). The follow-up entomological surveys still ongoing for a period of three years until 2022.

b) **Evaluation of the impact of coils and lotion mosquito repellents used in combination with LLINs on the prevention of malaria vector transmission in high and low malaria endemicity areas, Rwanda.** The research project is under implementation in two sites of Kinazi in Ruhango district and Mubuga in Karongi district. The distribution of products (LLINs, lotion and coils mosquito repellents were distributed in August 2019 and baseline information collected in September 2020. Follow up data collection on entomological component are being collected every two months until December 2020 while the qualitative and quantitative data have been collected at the baseline, the mid-term qualitative data collected in June 2020. The end line surveys covering qualitative and quantitative will be carried out in December 2020.

c) In collaboration with SC Johnson and SFH-Rwanda, another experiment was conducted and entitled "**Field evaluation of Raid® Shield and Baygon® all night mosquito repellents treated with transfluthrin in preventing the human-wild mosquito contacts in two high malaria endemic sites of Rwanda".** The trial was conducted in two sites with confirmed resistance to pyrethroid insecticides of Busoro in Nyanza district and Mareba in Bugesera district. The trial confirmed that the two mosquito repellent products are effective against malaria vectors and other non-anopheles mosquitoes (culicinae) in the two sites.

d) Another study was developed and presented to the RNEC for ethic clearance before the starting of the research. This research entitled "**Assessing the Durability of Long Lasting Insecticidal Treated Nets (LLINs) Post Mass Distribution in Rwanda"** was developed in collaboration with PSI, Abt Associates, IVCC and other partners. The following activities were achieved respectively: The development and presentation of the protocol to the RNEC for ethic clearance, field reconnaissance of the four study sites (Bungwe in Bulera, Masaka in Kicukiro, Kinazi in Ruhango and

Mubuga in Karongi). The enumeration of houses for household surveys and sampling of nets for bioassays, the partial tagging and distribution of nets were performed.

e) Experimental and field evaluation of the impacts of traditional and clean cooking fuels on *Anopheles* mosquito behavior and malaria risk in Rwanda. The experiments were successively conducted under experimental huts of Ruhuha and in Kayonza district at community level and covering 240 houses. The experiment was under collaboration with US institutions of Emory University, Rollins School of Public Health, the Department of Environmental Sciences, and Fogarty International Center, National Institutes of Health (NIH), Bethesda, MD, United States. It was focused on the evaluation of three cooking fuels: wood, charcoal and gas commonly used in for cooking in Rwanda. Under the above trial, entomology technicians of MOPDD were training on collecting other insects such as flies using sticky fly traps, aedes with ovitraps, malaria vectors using CDC-Light traps and Prokopak aspirators and handling the Household Air pollution monitors.

f) **Evaluation of ProVector Flower and Super Netty kits on control mosquito population in three malaria endemic sites of Rwanda.** The three sites were Kabeza in Jabana sector of Gasabo district, Mareba in Bugesera and Busoro in Nyanza districts. The kits of products **have been** provided for free of charge by MedEnvVet Laboratories, Inc. Three active ingredients have been used for the treatment of the above products: (1) Bti from Vectobac and Aquabac, 2) Deltamethrin from Suspend SC and (3) Methoprene from Altosid. These products have been designed for indoors control of mosquitoes and flies and one per large room of 49 m^2 (7mx7m). Per study site, 10 houses with distance interval of 50 meters were selected respectively and 4 houses received ProVector Flower, 4 houses Super Netty kits and 2 houses as control. In total, 30 houses were subject of the trial. Unfortunately, the two products were not conclusive to protect against mosquito biting in the three study sites both for malaria vectors and non-anopheles mosquitoes. The trial has to be redesigned and efficacy of the products improved.

Abstracts Presented to International Meetings/Conferences

- **Methodology of observational analyses to evaluate the impact of new net distributions in Burkina Faso, Mozambique, Rwanda, and beyond**. ASTHM annual conference**,** Maryland-USA, 20-24 November 2019. Poster Presentation **LB-5298.**
- **Citizen science for mosquito monitoring and malaria vector control in Rwanda**. ASTHM annual conference**,** Maryland-USA, 20-24 November 2019. Poster Presentation **LB-1068.**
- **Experimental evaluation of the impacts of traditional and clean cooking fuels on *Anopheles* mosquito behavior and malaria risk in Rwanda**.

ASTHM annual conference**,** Maryland-USA, 20-24 November 2019. Poster Presentation**. LB-5474**

- **Indoor Residual Spraying and Malaria Averted Cases in Ngoma District, Rwanda.** Submitted to ASTMH annual conference, November 2020.

PART II: MALARIA CASE MANAGEMENT

Objective 2: By 2020, All Malaria Cases Will Be Treated in Accordance with the National Treatment Guidelines

Diagnosis and treatment is a primary component in malaria control. Regarding diagnosis and treatment, the following activities were implemented through program strategies to improve access to early diagnosis and appropriate case management to reduce malaria morbidity and mortality.

In this FY 2019-2020, RBC/MOPD Division in collaboration with partners are supporting the strengthening of diagnostic testing to ensure that all patients with malaria are properly diagnosed and can receive timely and appropriate treatment. All suspected malaria cases are parasitologically confirmed by either RDT or Blood Smear (BS), then malaria is categorized either uncomplicated or severe malaria for the purpose of prescribing appropriate treatment.

With the roll out of Home-based Management of Malaria (HBM) to all ages since October 2016, Community Health Workers are well equipped to provide timely diagnosis and treatment in the community for all cases of uncomplicated malaria, preventing severe malaria and death, and limiting malaria transmission. Malaria diagnosis, the proportion of suspected malaria cases that received a parasitological test at public health facilities and in the community (for children under 5 years and adults) was sustained at 99.9 % over the review period. Likewise, the proportion of confirmed malaria cases that received the first line antimalarial treatment was sustained at 100% in FY 2019-2020.

The proportion of the population tested for malaria through RDT or slide microscopy (Annual Blood Examination Rate - ABER) decreased from 71% in 2018/19 to 56.6% during the FY 2019-2020. The ABER indicates that the endemicity of malaria and the risk of contracting malaria is still high.

Strategy 1: Provide Malaria Diagnosis to all Suspected Malaria Cases at all Levels

1. Update of Integrated Malaria Control Guidelines

The Integrated Malaria Control Guidelines 4th edition, 2020 was reviewed by RBC/MOPD Division team and partners (Impact Malaria, WHO, USAID/Ingobyi). Key changes include the real time notification of severe malaria and stock status by community health workers through Rapid SMS.

In order to improve the management of malaria cases in community, different tools and guidelines were produced and distributed to all CHWs (binomes) in collaboration with INGOBYI Project supported by PMI:

Table 14: Tools Distributed to CHWs

S/N	Description	Quantity	Beneficiaries
1	Community registers for treating malaria in adults	69,543	CHWs/Binomes
2	iCCM register Folio papers	19,098	CHWs/Binomes
3	Compilation register for iCCM and malaria in adult integrated for binomes	19,098	CHWs/Binomes
4	Monthly report	10,996	CHWs/Binomes
5	Drug request register	1,447	CHWs/Binomes
6	Store cards	190,980	CHWs/Binomes

During this year through remote and face to face meeting, RBC/MOPDD in collaboration with USAID/Ingobyi Project reviewed the manual of HBM/Malaria training guide in adults where HBM Curriculum, 4 Learning units and 13 Learning outcomes for participant and facilitator were aligned with the competence-based approach.

2. Case Management of Under 5 Years at Community Level

Since 2016, the community case management in children under five, children above five and adults has been implemented countrywide. The figure below shows that 95% of children above five and adults who presented malaria symptoms received treatment within 24 hours of signs and symptoms onset at community level in 2019/2020.

Figure 8: Community Malaria Case Management in Under 5 and Adults, FY2019-2020

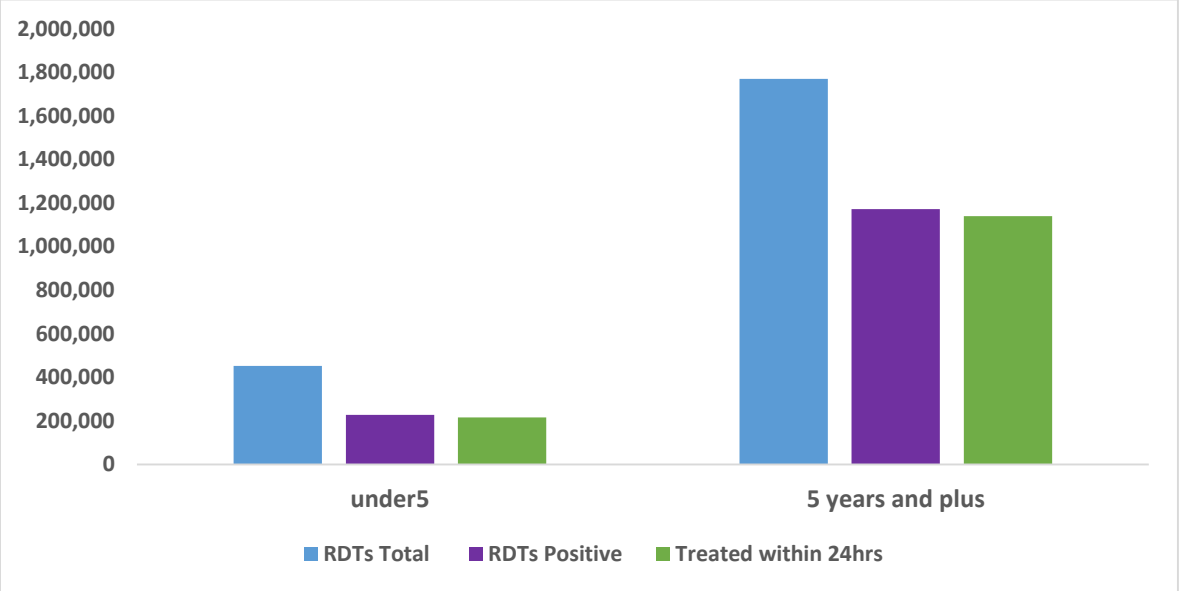


Figure 9: Severe Malaria Management and CCM Scale Up, 2014-2020

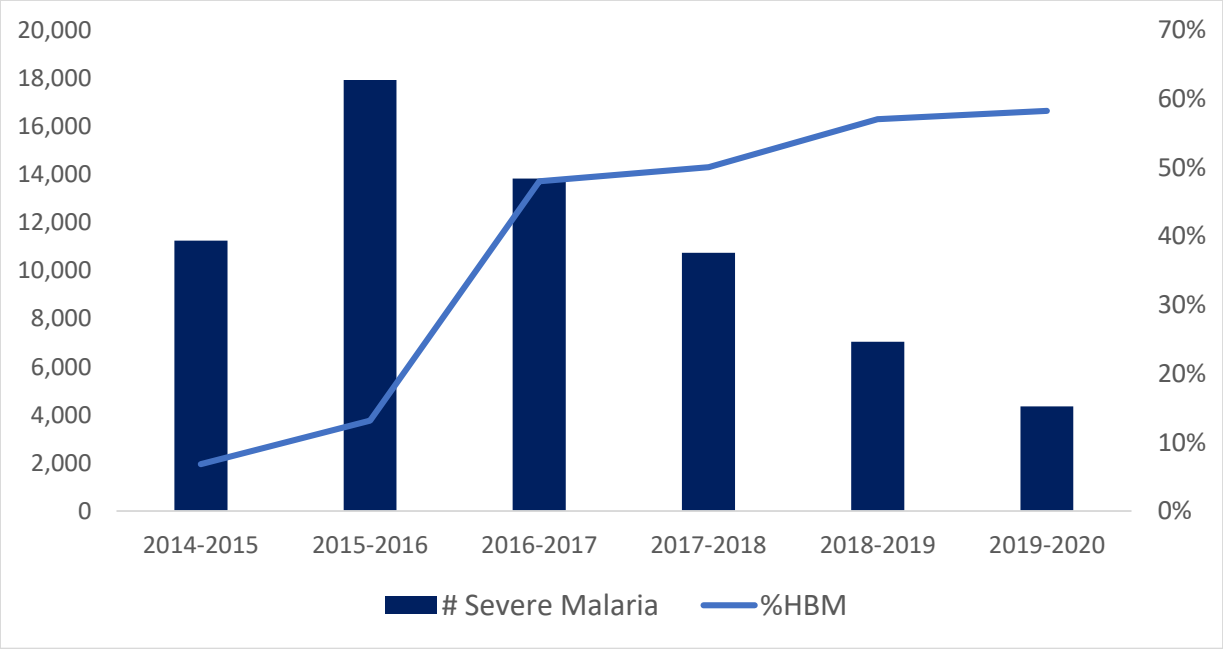
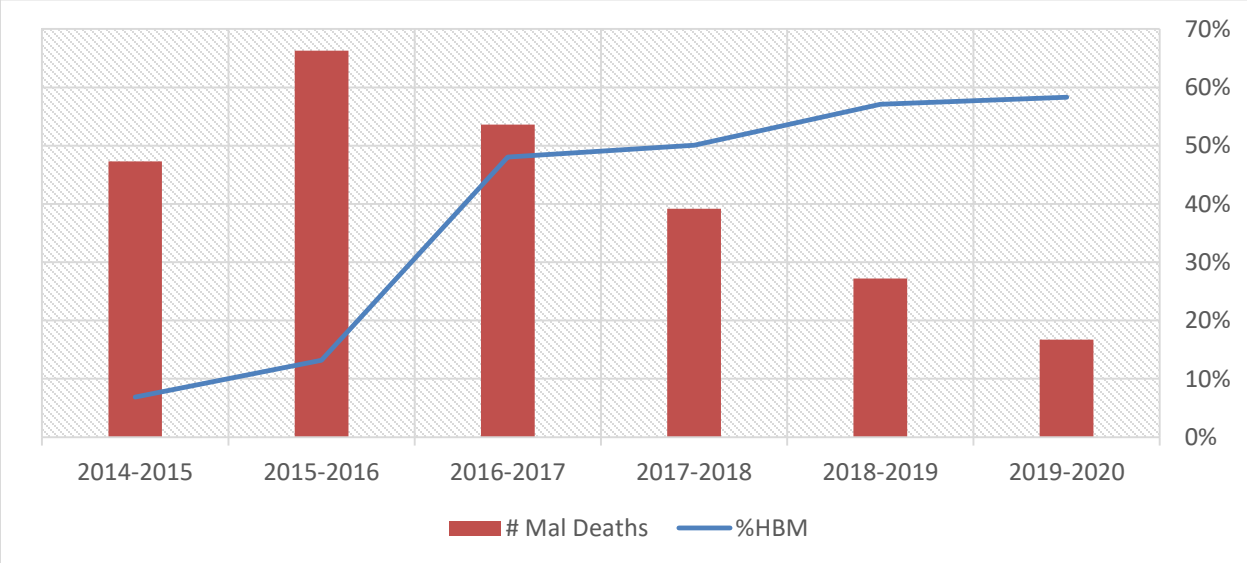


Figure 10: Impact of Extended HBM on Malaria Mortality, 2014-2020



Since 2016, the HBM was scaled up and implemented in all districts. The above figure shows a steady increase of proportion of children under 5 and above 5 years old and adults who are seeking care in community from 13% to 58% in 2015-2016 and 2019-2020 respectively. The inverse trends are observed in severe malaria cases from 7,054 severe

malaria cases in FY2018/2019 to 4,358 severe malaria cases in 2019/2020 as shown in Figure 9. Deaths due to malaria decreased significantly in District, Provincial and Referral Hospitals in the last four years from 663 in FY2015/2016 to 167 in FY2019/2020 (Figure 10).

These are results of early diagnosis and treatment by CHWs and increased efforts in malaria prevention (IRS and LLINs)

Strategy 2: Strengthen Prompt Access to Treatment for Severe Malaria

1. **Strengthening of Community Case Management through Capacity Building**

In FY 2019-2020, the RBC/MOPD Division conducted a Home-Based Management (HBM) Supervision in order to ensure malaria cases are managed correctly in the community. During this reporting period, 3796 CHWs from 168 HCs (31 Hospitals), were reached. CEHO and CHWs were mentored on malaria management, real time notification on severe malaria and malaria commodities stock management through RapidSMS, proper drug storage, availability of community health tools, adhering to treatment and RDT algorithms. Gaps identified include the lack of follow up by HC and Hospital staff (clinical page was not filled).

In addition, Mal & OPDD in collaboration with PMI/Impact Malaria supported the capacity building of Lab Technicians through the PMI-supported Antimalarial Resistance Monitoring in Africa (PARMA) as shown in the table below.

Table 15: Training of CHWs and Health Providers in Malaria Case Management

N/S	TOPIC	TARGET GROUP	ACHIEVEMENT
1	PCR Analysis of the Rwanda Artemether Lumefantrine efficacy study	Initiation of DBS Sample collection at 5 HCs in preparation of TES	DBS Samples collected
2	Training on iCCM and HBMA	Community and Environmental Health Officer at Health Center level.	111 CEHOs from 8 districts (Kamonyi, Gasabo, Burera, Musanze, Rwamagana, Kicukiro, Nyanza and Ngoma) trained

2. Formative Supervision at Health Facility Level and Malaria Death Audits Visits

Routine formative supervisions and malaria death audits were conducted by MOPDD Staff as a part of ongoing monitoring, evaluation, and quality assurance efforts in collaboration with district hospital teams.

From Oct 2019 to June 2020, MOPDD in partnership with USAID Ingobyi Activity, Rwanda professional associations (RPA and RSOG) and child health and malaria district-based mentors conducted monthly clinical mentorship in the 25 hospitals within 20 districts. The support focused on management of severe malaria cases and other pediatric and maternal emergency care. In total, 300 supportive supervision visits were conducted at hospital level. At health center level, providers were mentored on early malaria diagnosis and treatment, pretransfer management of severe malaria, functionality of Integrated Management of Childhood illness and availability of IMCI guidelines. 142 district-based mentors conducted 3900 visits to 325 health centers. Major challenges observed during SS included: inadequate skills and knowledge to diagnose and manage severe malaria cases, Lack of community awareness on early health care seeking, improper coordination and shortage of ambulances, lack of providers update on changes in the new malaria protocol.

In this reporting period, 35 district hospitals were visited as far as Malaria death audit is concerned. In total 167 deaths were confirmed country wide.

These regular death audits visits have greatly contributed to a decrease in malaria related deaths and improved quality of severe case management.

However, there is still a need to educate the community for early treatment and regularly support all health care providers in all districts for a proper management of malaria cases and early consultation either CHWs or nearest Health Facility.

Strategy 3: Ensure Quantification and Distribution of Quality Malaria Commodities

In collaboration with MPDD and the National Reference Laboratory (NRL), the malaria program has established the new approach Laboratory Malaria Diagnosis EQA program to ensure the quality of malaria diagnosis is available to the population. Besides the laboratory routine testing, it 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 will be enforced in health facilities. The quality assurance will strengthen the whole supply chain by availing clear products specifications

1. **Quality Control of Blood Smears at District Hospitals RDTs**

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. In addition to routine laboratory quality assurance processes, EQA includes blinded slide retesting, proficiency testing, 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, and district hospitals are supervised by the NRL.
Among the 42 district hospitals in which EQA/QC of blood smears was conducted during the FY 2016-2017, 2017-2018, 2018-2019, 2019-2020 EQA/QC was noted compared to the previous fiscal year with a decrease in overall discordance from 4.12% to 1.36% to 1.64% to 1,74% which remain below the cut off 5% acceptable range with 4 district hospitals (Kabutare (8,89%), Masaka(6,67%), Muhororo (6,67%), Mibilizi(6,67%)) exceed the acceptable range. This figure includes only 3 quarters; the QA/QC was not conducted in Q3 due to Covid19.
The malaria program will continue to work closely with NRL to correct reported discrepancies in district hospitals through formative and refresher training during the next fiscal year 2020-2021.

2. **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.

In this fiscal year 2019-2020 the Division in collaboration with all partners has managed to keep the stock available on the desired stock level due to the new strategy of regular supply plan reviews, use of appropriate quantification tools and willingness of partners to

support the entire process. Several quantification reviews took place over the reporting period to adjust the real need in malaria commodities. All needs identified during the quantification exercise and supply plan reviews were procured (as per the table below) by the Government of Rwanda, Global Fund and partner of the RBC, the PMI/GHSC-PSM Project and distributed to all levels (District Pharmacies, Health facilities and Community) for use.

Table 16: List and Quantities of Malaria Commodities Procured in FY2019/2020

Product	Quantity Procured	Source of Funds
Artemether-Lumefantrine 1x6, Blisters	275,000	PMI
Artemether -Lumefantrine 1x6 , Blisters	210,000	GF
Artemether-Lumefantrine 2x6, Blisters	323,400	PMI
Artemether-Lumefantrine 3x6, Blisters	330,400	PMI
Artemether-Lumefantrine 4x6, Blisters	810,000	PMI
Artemether-Lumefantrine 4x6, Blisters	936,843	PMI
Artesunate 60mg/Ml Vials	142,476	PMI
Malaria RDTs	1,504,170	GF
Quinine 300mg Tablets	400,000	GOR

Below are key observations for commodities procured:

- By the end of the fiscal year, shipments received were 60% of the planned shipments and 40% of them were postponed to the next year due to decrease of malaria cases
- There was a difference of $1,285,420.15 between the planned cost and the actual cost of commodities procured

- AL 6x2, AL 6x3, AL 6x4 were postponed from June to August 2020 after the supply plan review which showed that there was significant reduction of malaria cases and those shipments were postponed to October 2020. With the COVID -19 situation, there was no guarantee to have them in October 2020 based on the supplier communication, and the team agreed to receive them in August 2020 rather than risk of stock out in coming months. There is only one shipment that was not been received among the planned shipments.
- Quinine tablets procurement was also postponed and revised due to decrease of malaria cases in general and severe malaria especially.

3. Validation of District Pharmacy (DP) Reports and Distribution of Malaria Commodities and Equipment

The objective of the validation of malaria commodities is to:

- Ensure that the DPs and lower levels receive the right amount of malaria commodities at the right time.
- Ensure that DPs are given the quantities they need to be stocked according to plan (stock to be between the minimum and the maximum levels) and that they receive feedback on the validation report. To ensure e-LMIS data accuracy is improved as the validation is currently based on the information found in
- Rationalize the quantities available at the central medical store (MPPD) in case of understock. This was done through the redistribution of commodities within districts not only to save the stock at MPPD but also to avoid expiration of commodities.
- In the validation exercise, in May and June 2020 the team started to evaluate the number of DPs orders validated as requested and orders revised for different reasons. In May 2020 41% of orders were validated as requested while 59% of orders were revised. In June 2020, 71% were validated as requested while 29% were revised.

4. Stock Status of Malaria Commodities, End June 2020

By end of the FY2019-2020, the stock status of malaria commodities was good in general as there was no products at risk of stock out.

Table 17: Stock Status of Malaria Commodities

Product	Qty (MPPD)	Qty (DPs)	Qty (HFs)	Stock all Levels	MoS all Levels	MOS Shipment
A/L 1 x 6	184,020	185,844	94,865	464,729	30	
A/L 2 x 6	304,740	52,927	67,890	425,557	14	6
A/L 3 x 6	342,060	116,735	110,253	569,048	20	7
A/L 4 x 6	550,320	188,040	223,757	962,117	14	9
Artesunate Inj.	93,591	39,077	18,612	151,280	17	0
Quinine Tablets	317,500	214,370	276,749	808,619	31	0
Quinine Inj.	55,180	305	622	56,107	68	0
mRDTs	1,504,170	427,469	808,679	2,740,318	11	11

Note: *Some commodities such as Quinine were over stocked due to the important decrease of malaria cases as a results of prevention measures as well as reduced severe malaria cases as a result of Home-Based Management. Efforts to donate Quinine to other countries through WHO were not successful since most of countries are phasing out this treatment as per the new WHO recommendations and therefore, are most likely to expire.*

5. Monitoring of Stock Status

The monitoring of malaria commodities done on quarterly and monthly monitoring of malaria commodities helped to monitor on regular basis the status of each of commodities, calculate the month of stock that allow the program to know if products are between maximum and minimum required levels (9 months minimum and 12 months maximum at national level).

In this year FY2019-2020, the monitoring allowed the program to plan for redistribution of commodities from districts with over stock to districts in need of stock to minimize the risk of expiration.

PART III : MALARIA SURVEILLANCE AND EPIDEMIOLOGY

Objective 3: By 2020, All Health Facilities Will Provide Complete Reporting to Strengthen Surveillance, Monitoring and Evaluation and Operational Research

Strategy 1: Strengthen Malaria Reporting from Monthly to Real Time Notification

Since September 2018, in order to strengthen the treatment of malaria at community level, RapidSMS notification was introduced for tracking stock-outs and community-based drugs replenishments in real time. This was also aimed at preventing stock outs among community health workers.

Through the same system, community health workers notify the national level on severe malaria cases received to the health centers and the hospital to enable them to follow up and to intervene in a timely manner in order to prevent deaths due to Malaria.

In July 2019, the data in the HMIS was updated to a single dataset was dedicated to malaria in order to improve data quality.

Strategy 2: Strengthen Malaria Epidemiology, Surveillance, Monitoring and Evaluation

For the proper and effective use of data to guide decision making, the Malaria Program regularly collects data from HMIS and SISCOM and generate key malaria epidemiological data.

The table below summarizes the key malaria indicators for the period FY 2019-2020 and performance compared to previous period:

Table 18: Key Malaria Program Indicators

Nº	Indicators	2017/18	2018/19	2019/2020
1	Malaria Incidence per 1,000 persons per year	401	321	198
2	Slide Positivity Rate (%)	47.1	44.4	34.5
3	Uncomplicated Malaria Cases	4,659,404	3,973,973	2,504,222
4	Severe Malaria Cases	10,748	7,054	4,358
5	Malaria Deaths	392	272	167
6	Case Fatality Rate (per 100,000 Malaria cases)	8.4	6.8	7
7	Proportion of malaria cases treated at community level (HBM)	50%	57%	58%

Based on available data, below the key program successes during the FY 2019/2020

- 38% Reduction of in Malaria Incidence from 2018/19 to 2019/2020
- 37% Reduction in Un-complicated Malaria Cases from 2018/2019 to 2019/2020
- 38% Reduction in Severe Malaria Cases from 2018/19 to 2019/2020
- 39% Reduction in Malaria Deaths from 2018/19 to 2019/2020
- Today, 58% of all malaria cases are being treated at Community Level by CHWs

1. Malaria Incidence

Malaria incidence has been calculated based on the average projected population for 2019 and 2020 using medium projection. Data shows that the national malaria incidence in Rwanda reduced from 401 cases per 1,000-person year in 2017-2018 to 200 cases per 1,000-person year FY 2019-2020.Nine districts had incidence above the national average these being: Nyamasheke, Rusizi, Kamonyi, Ruhango, Kayonza, Gasabo, Rwamagana, Karongi and Muhanga districts.
The following districts have incidence bellow 100 per 1000: Kirehe, Gakenke, Ngororero, Rubavu, Huye, Nyagatare, Gatsibo, Musanze, Burera and Nyabihu districts. The Map bellow show more details of malaria incidence per districts

Figure 11: Malaria Incidence per 1,000 by District in the FY 2019-20

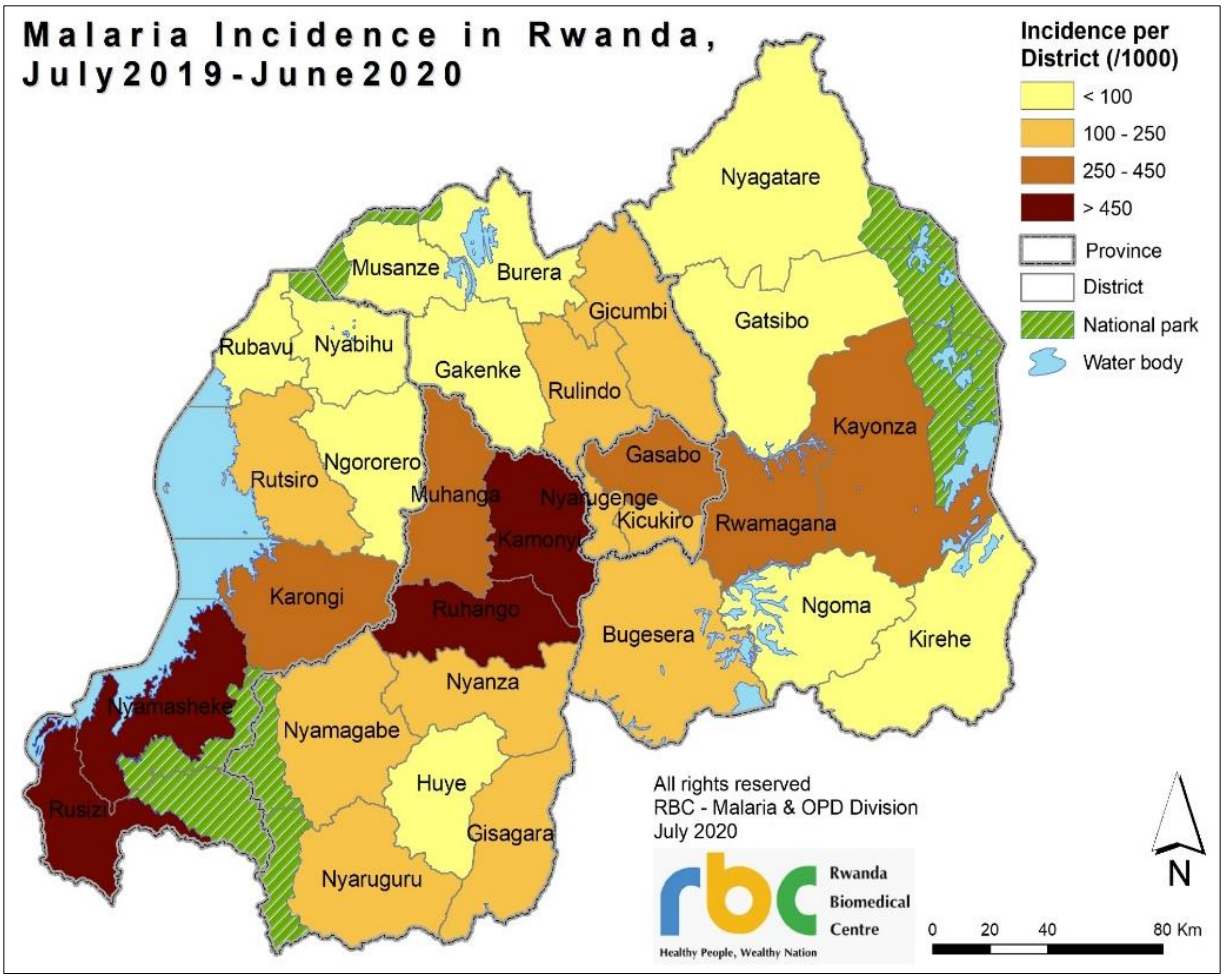
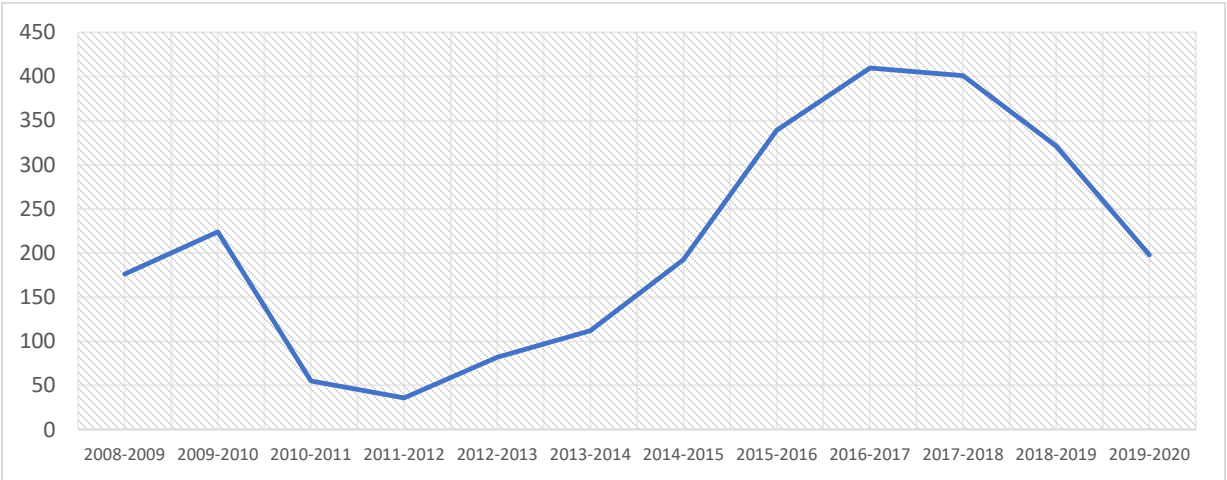


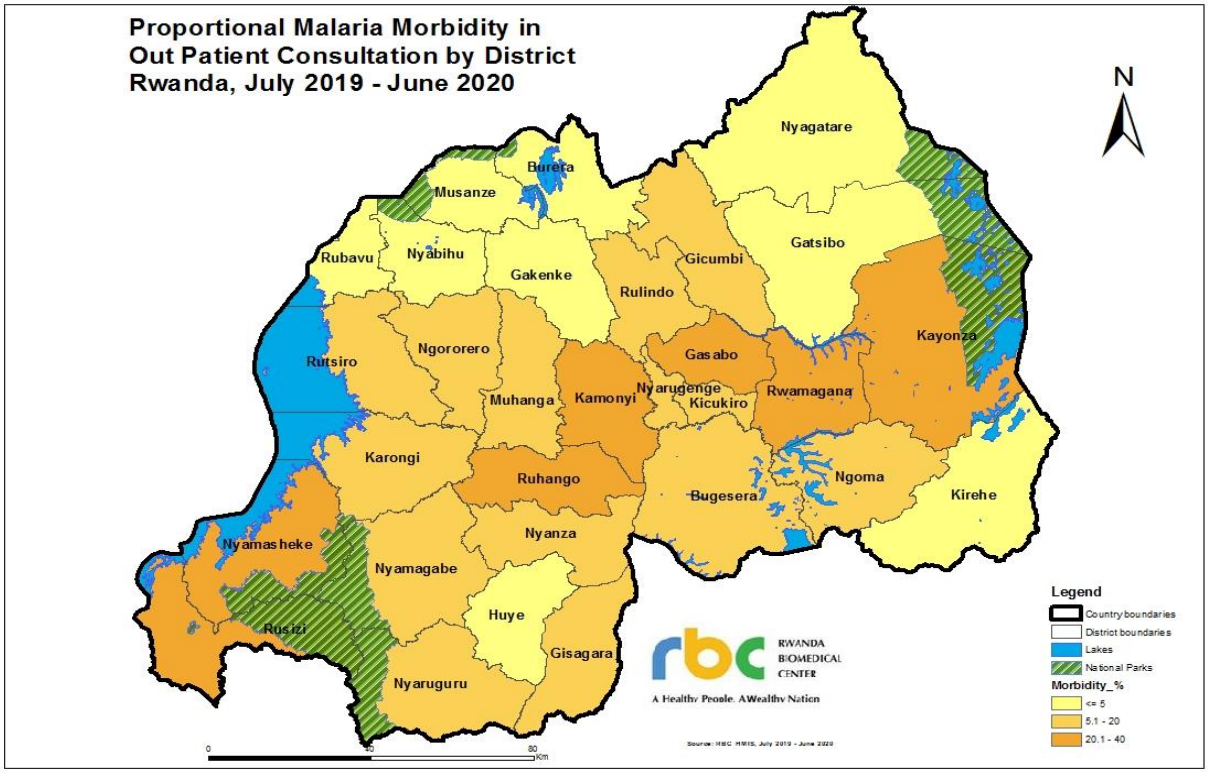
Figure 12: National Malaria Incidence per 1,000 Persons Year, 2008-2020



2. Malaria Morbidity

During the FY2019-2020, malaria out patient cases (OPD) represented 13% of all OPD new cases of consultation compared to 22 % of all of individuals attending outpatient's consultation in health facilities during 2018-2019. The proportional morbidity of malaria varies across districts from 1% in Nyabihu, Musanze, and Burera districts to more than 30% in Kamonyi, Kayonza and Rusizi districts.

Figure 13: Malaria Outpatient Morbidity by District, FY2019-2020



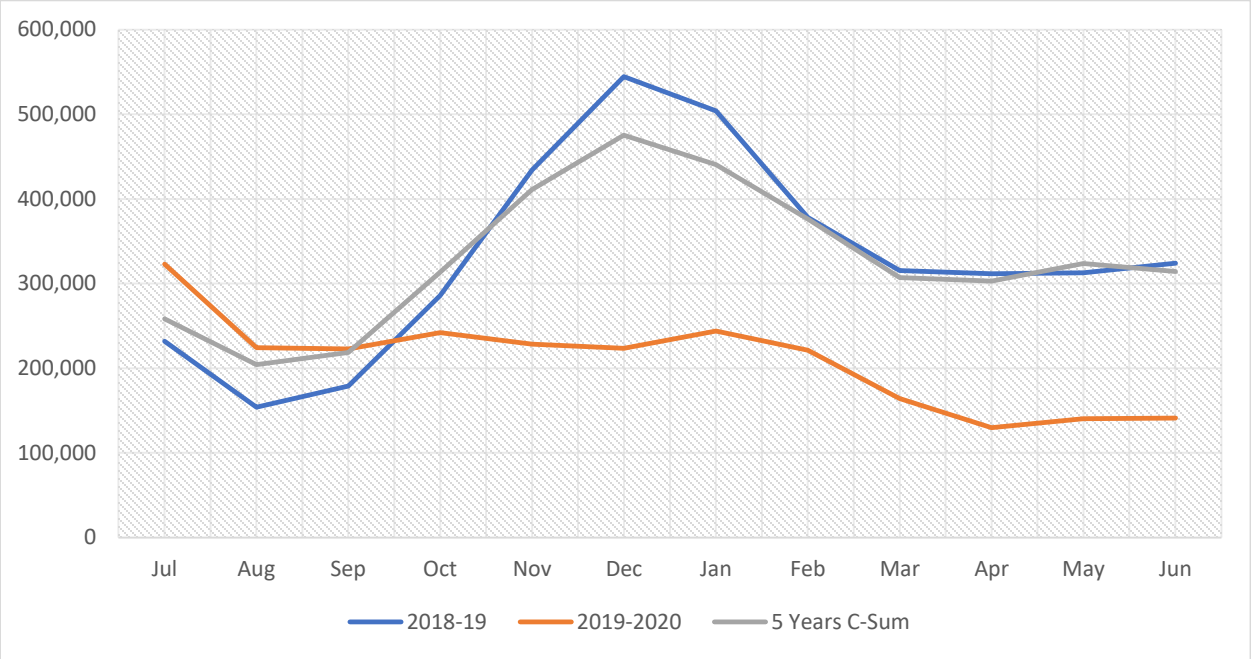
3. Malaria Test Positivity Rate

During the FY 2019-2020 at total of 7,168,149 lab tests were performed compared to 9,028,161in 2018/2019. This includes 3,528,882 blood smears exams and 3,639,267 rapid diagnostic tests. The number of RDTs done by community health workers was 2,220,635 representing 31% of all malaria tests performed. The average slide positivity rate was 34.5% (63% at Community level and 22% at Health Facility level)

4. Uncomplicated Malaria Cases

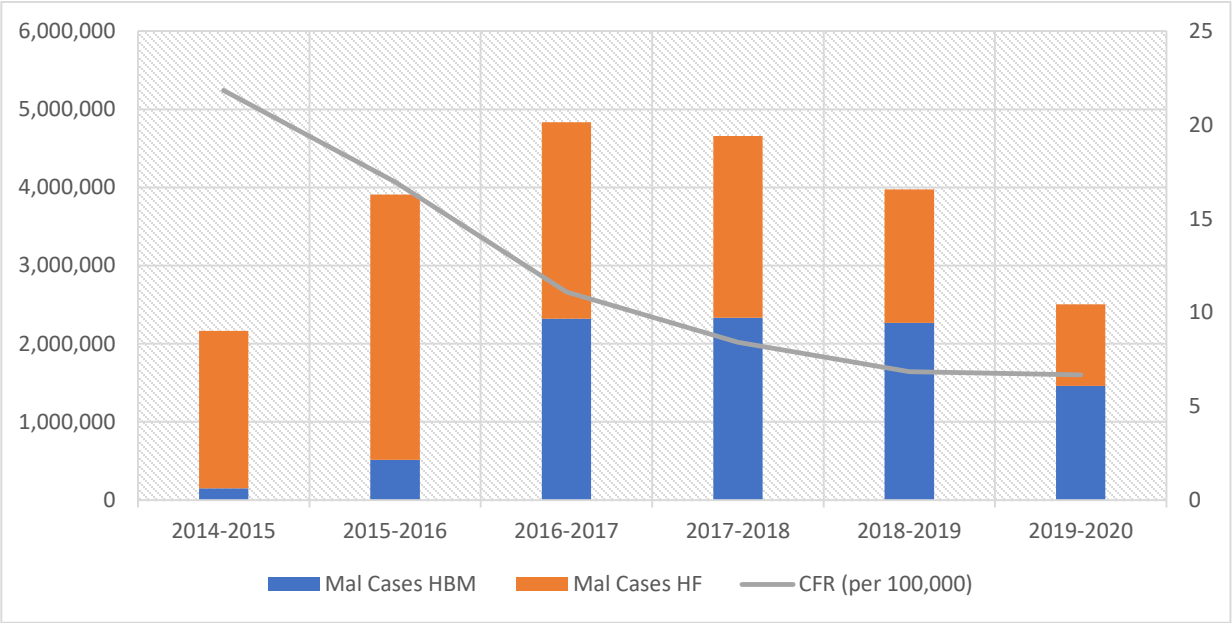
From July 2019 to June 2020 a total of 2,504,222 outpatient malaria cases were notified including 1,458,501 (58%) malaria cases treated at community level. The private health facilities account for 35,845 (1.4%) and 367,569 (14.7%) treated by private health posts. Under5 children account for 338,898 malaria cases (13.5%) and Pregnant Women 18,684 (0.7%).

Figure 14: Malaria Cases, Rwanda, FY 2019-2020, 2018-2019 and Last 5 Years Average



Note: The 5 years average was calculated using C-Sum method.

Figure 15: Malaria Cases per Level of Services Delivery and Cases Fatality Rate, 2013-2020



Despite malaria increase from the last few years, the case fatality rate (CFR) has been decreasing from 22 per 100,000 people in 2014-2015 to 7 per 100,000 in 2019/2020 following the scale up of Home-Based Management of Malaria in all ages.

5. Severe Malaria Cases

Over the reporting period, 4,358 cases of severe malaria were reported at the health facility level compared to 7,054 in the FY 2018-2019 representing a 38% reduction of severe malaria cases. This indicates that interventions such home based treatment of children and adults that contributed to early diagnosis and treatment have been successful in decreasing the number of severe cases and consequently the number of malaria deaths. The free treatment of poor people in Ubudehe Category I and II also removed the financial barriers for access to health care.

6. Malaria Mortality

Over the FY 2019-2020, 167 malaria deaths were recorded following hospitalization for severe malaria compared to 272 deaths in the FY 2018-2019. The number of malaria deaths was 41 among under5, which represents 25% of all malaria deaths. Report from malaria deaths audit shows that 80% had malaria cerebral form. The decrease in malaria deaths may be a result of the malaria HBM interventions and the free treatment of malaria for Category I and II of Ubudehe and the quality of care at health facility level.

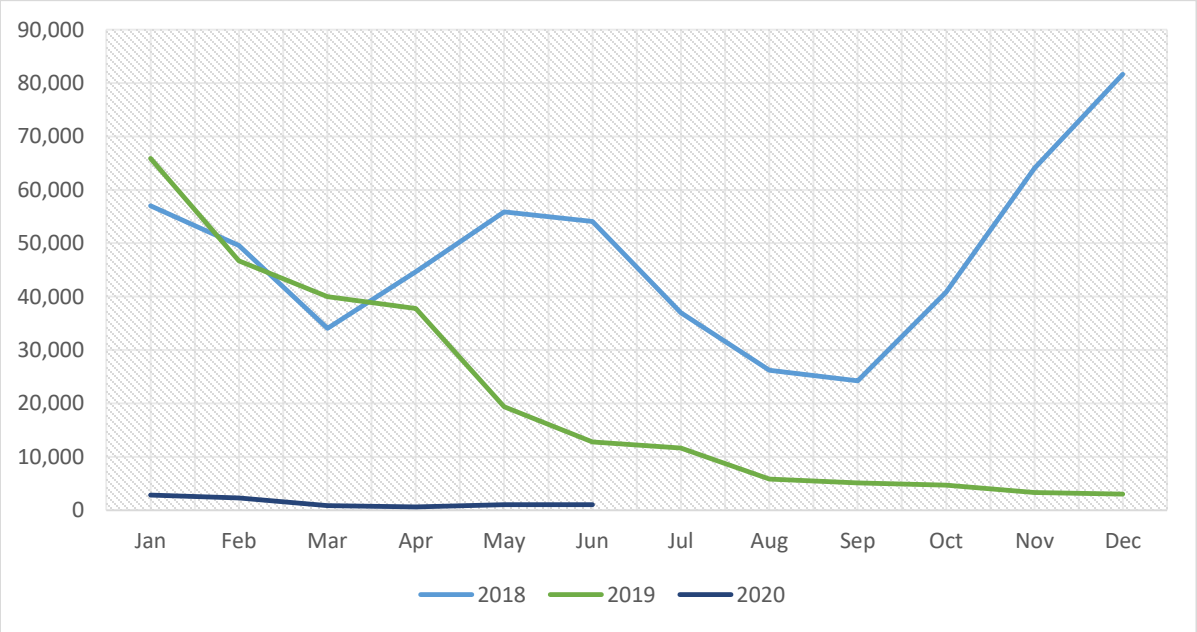
In the FY 2019-2020, the proportional mortality due to malaria represented 1.5 % of all deaths with the highest rate being in Rusizi District (6.8%). The top ten districts represent 72% of malaria deaths countrywide.

7. Impact of IRS Targeted Districts

As noted earlier, the scale up of indoor residual spraying using effective insecticides has the greatest impact in reducing malaria in Rwanda. The figures below show the impact in Ngoma district where IRS was introduced in April 2019 with a significant decrease in malaria cases from more than 80,000 malaria cases per month in 2018 to 1,000 cases per month in 2020 (Figure 16). This has also been the case in seven districts (Bugesera, Kirehe, Gatsibo, Nyagatare, Huye, Nyanza and Gisagara) where malaria incidence reduced from 563 per 1,000 in 2016/2017 to 79 per 1,000 in 2019/2020 (Figure 17).

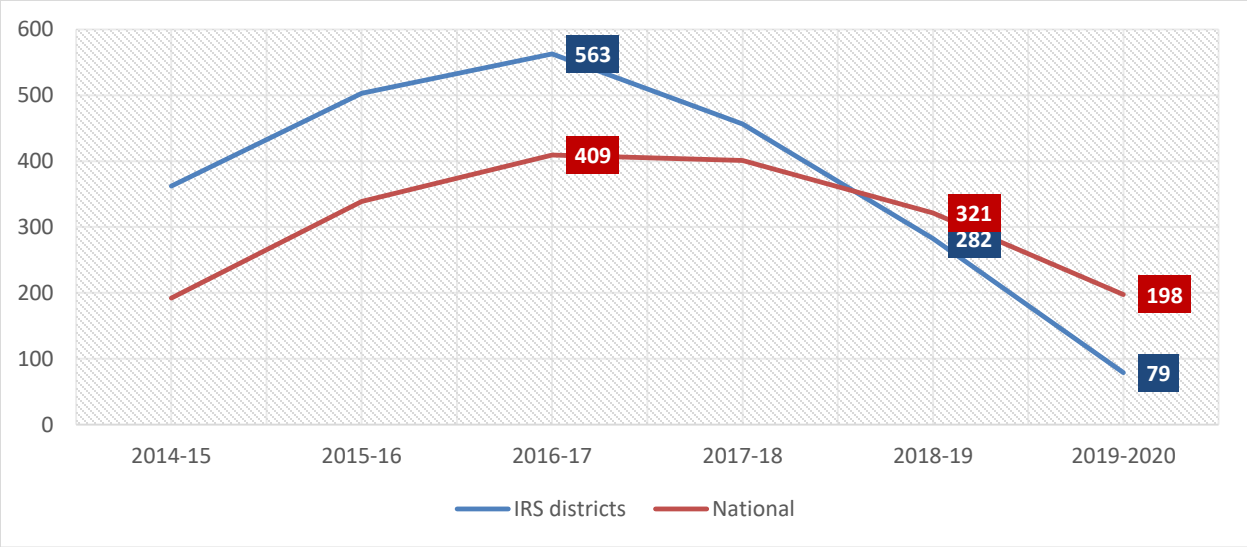
a. IRS district: Ngoma

Figure 16: Malaria Cases, Ngoma district, 2018-2020



IRS was introduced in Ngoma in April 2019 with a significant decrease in malaria cases from more than 80,000 cases per month in 2018 to 1,000 cases per month in 2020

Figure 17: Impact of Sustained IRS in 7 Districts, 2016-2020



8. Strengthening Health Information System

Health system strengthening is the process of identifying and implementing the changes in policy and practices in a country's health system so that the country can respond better to its health and health system challenges. As part of health system strengthening mechanism, Rwanda Biomedical Centre (RBC) has adopted reinforcement of availability of services and health policies, capacity building of health worker through mentorship, on-job training, Integrated Supportive Supervision and Data Quality Assessment (ISS/DQA) as well as Malaria death audits. The various health facilities reported data related to malaria cases in the HMIS and the completeness rate was 97% during the year 2019_2020 and the on-time reporting was 99%.

8.1. Supportive Supervision and Mentorship

Integrated Supportive Supervisions is conducted twice a year and targets all District Hospitals and selected Health Centers and community health workers in its catchment area in collaboration with malaria implementing partners. During the FY 2019-2020, it was conducted at the end of December 2019, in all the 43 Districts Hospitals/Provincial Hospitals and 42 sampled Health Centers within the District Hospitals' catchment areas. Key findings showed that at all District Hospitals/Provincial Hospitals use blood smear to diagnose malaria. It was also observed that national protocols on the malaria case management were available in all visited hospitals. Ninety three percent (93%) of the hospitals visited, had malaria deaths audit reports available for that period of assessment (July-September 2019).

At Health Center level, Evaluations in the malaria services focused mainly on malaria case management and prevention and on reporting using the IDSR system.
Assessments on the malaria e-reporting system was done comparing cases reported in registers and those available in the system. Timely upload of e-data was also evaluated.
Other questions on malaria programs were grouped into four categories including: malaria treatment, malaria diagnosis and malaria prevention with LLINs as well as training of providers on case management. In all health centers (HCs), 90.7% had malaria case data was fully uploaded in the e-IDSR system. Malaria treatment in 95.8% of health centers was based on parasitological confirmation and 93.4% of these facilities had the national malaria case management protocols accessible to all health care providers and these were portrayed in the health centers.
Data from this assessment showed that microscopes were used in all health centers to diagnose malaria. Rapid diagnostic tests were used in 98.6% HCs. A portion of HCs (16.9%) reported to have based their treatments on clinical symptoms.

8.2. Training

Every year, the DHIS2 academies build a community of DHIS2 users and experts in the different regions and facilitate sharing of experiences on DHIS2 deployments and strategies for national scale Health Information System implementation. PMI/Impact Malaria Project supported five MOPDD staff to participate in the East Africa DHIS2 academy training, which took place in Kigali, from the October 28th to 2nd November 2019.
In this training, participants were introduced to basic concepts of designing, collecting, analyzing, and performing preliminary administration on event and case-based data through a mix of lectures and hands-on exercises.
This training has contributed to capacity building of MOPDD in improving data quality, management, analysis, and utilization at central, district and health facility levels.

MOPDD staff has been trained on eLMIS to provide them the capacity to supervise the health facilities and to become more involved in the implementation of this strategy because, the latter also contributes to the improvement of data relative especially to drugs distributed to patients.

8.3. Data Quality Assessment

Integrated Supportive Supervision and Data Quality Assessment, which is now on its sixth year, has been adopted by Rwanda Biomedical Center and the Global Fund as a reliable country's mechanism for assessing the quality of service and quality of data from health facilities. It provides a picture on how the country stands in terms of quality of data reported by health facilities at the national level for the selected keys indicators as well as how the quality of services is provided from those selected Health Facilities. Indicators for which quality is assessed are chosen among the key programmatic key performance indicators and, they are approved at high level prior to the assessment. This means that, prior to the filed visit at Health Facilities, the list of indicators and the checklist pass through the process of validation at RBC management level.

At the completion of the ISS DQA in health facilities where discrepancies and other gaps/weaknesses were identified, implementation plans were issued to them by the central level supervisors. This included, amongst other things, the request to Health Facilities to correct data in Rwanda Health Information System with respect to the Standard Operating Procedures, compliances with the guidelines, etc. with the overall aim of not only minimizing errors from reported data but also increasing quality of services from the identified weakness.

In this line, Data Quality Assessments (DQAs) were conducted in end September 2019, and the assessment period was July-September 2019 for some key malaria indicators. It consisted mainly at verifying the quality of data reported by health facilities at central level through the Rwanda Health Management Information System (R-HMIS). The particularity of this DQA is that, it was conducted a data triangulation of some specific Malaria indicators to ensure internal consistency detailed. Below the specifics:

- ***Data Triangulation of Malaria Cases and Tests)***

Triangulation was conducted at health centers and community levels and consisted of comparing number of malaria cases treated against registered malaria positive tests and distributed ACTs (***July-September 2019).***

Data were extracted from HMIS and SISCom systems and compared to those in respective registries. At the community health workers level, data quality assessments compared data from

CHWs registers and reports submitted to CHWs Cell Coordinators. With all the health centers assessed, discrepancies were observed between malaria cases treated and positive tests as well as between positive tests and consumed ACTs. Results showed that the ratio malaria treated cases/ Positive tests was 98% while the ACTs/malaria positive tests was 96%. Data variance shows an acceptable data quality range though more efforts are still needed to reduce discrepancies.

- ***Malaria Laboratory Tests (GE or RDT): Data Discrepancies between HMIS and Registers***

The graph below represents discrepancies between positive tests in data source documents and in the HMIS system. Overall, 98% of health centers reported discrepancies below 5%.
This wave reported 2% of health facilities with discrepancies beyond 10% compared to 7% reported last year.

a. ACT dispensed - Data discrepancies between HMIS and pharmacy distribution Register

Data Quality for this area was carried out by comparing monthly consumption data at HCs captured in pharmacy Registers to related data elements reported in HMIS.
Fifty-nine percent of HCs were in acceptable discrepancies ranges of below 5%, and 36% beyond 10% between reported data and verified data.

b. Comparison of Positive Tests, Malaria cases and ACTs dispensed at community level (July-September 2019)

At the community health workers' level, the assessments compared data between treated cases, the number of positive tests and prescribed ACTs by CHWs.
Considering positives tests as a reference, the number of treated patients was 0.9% more than counted positive tests, and about 0.3% ACTs were not prescribed to positive cases.

c. Positive tests (RDTs) in Community: Discrepancies between monthly hardcopy reports and CHWs registers (July-September 2019)

Comparing positive RDTs data recorded in registers against reports submitted by the two community health workers to their cell coordinators, this exercise found that 76% of HCs had discrepancies below 5% and 14% HCs beyond 10%.

d. ACTs- Discrepancies between monthly hard copy report and CHWs Registers

The number prescribed ACTs in the CHWs registers was compared to the number in the reports that the community health workers submitted to their cell coordinators. Overall, 79% of health centers reported discrepancies at a 5% level compared to 76% reported last year. Discrepancies at 10% were observed in 12% of health centers.

e. Verification Factors Results

Verification for key malaria indicator as Health Center and Community levels was also conducted. It refers to the assessment of reporting 'correctness', that is, comparing health facility source documents to health information system reported data to determine the proportion of reported numbers that can be verified from source documents.

It verifies whether the information contained in source documents has been transmitted correctly to the next higher level of reporting, for each level of reporting- from health facility levels to the national level; this also allows to identify systematic errors as well as sources of reporting errors. Data verification provides a quantitative measure ("verification factor") on the proportion of reported events that are verifiable using source documents. A verification ratio of one (1) means an exact match between source documents and HMIS reports while a verification ratio higher than 1 implies that there are underreporting of events in the HMIS for the verification period. If the verification ratio is less than 1, this signifies an over reporting of events in the HMIS during the assessment period. In general, these differences are often attributed to missing documents or poor filling.

Relative data discrepancy was also calculated to compute levels of data discrepancies as defined by the MoH data management standard operating procedures.
The table below shows that verification factor is very closed to one for the two selected Malaria indicators assessed at both Health Center and Community. This means that indicators are of high good quality, or in other words, that sources documents are matching with HMIS reports for the selected data elements.

Table 19: Data Verification Results from the DQA for Key Malaria Indicators

Programmatic Key Indicators	Verified Result	HMIS Result	VF	Absolute Difference	Status	Relative Discrepancy
Total number of malaria cases treated at health centers	15,051.00	14,800.00	1.02	251	Acceptable as per SOPs	1.67%
# of confirmed simple malaria treated at Community level	3,660.00	3,665.00	1.00	5	Exact Match	0.14%

8.4. Tools Development

Reporting template for Malaria at Health Center has been revised and it's now capturing all the data elements in a single dataset. This aimed at reducing errors for monthly reported data in HMIS

Strengthening the use of the eLMIS system has also been a strategy to improve data quality and ensure the continual supply of commodities in Health facilities. eLMIS is an Electronic Logistics Management Information System (eLMIS) is a revolutionary and cost-effective health data management system aimed at ensuring greater product safety and better health outcomes for populations.

Challenges

The major challenges that were faced regarding with the strengthening of the health system was the pandemic COVID-19 that affected calendar regarding with the supportive supervision and data quality assessment that were planned to be conducted from central level to Health Facility.

Strategy 6: Develop and Implement an Operational Research Agenda for Malaria

In line with improving the quality of malaria related services, the malaria program regularly conducts researches. In this reporting period, the following research projects have been implemented:

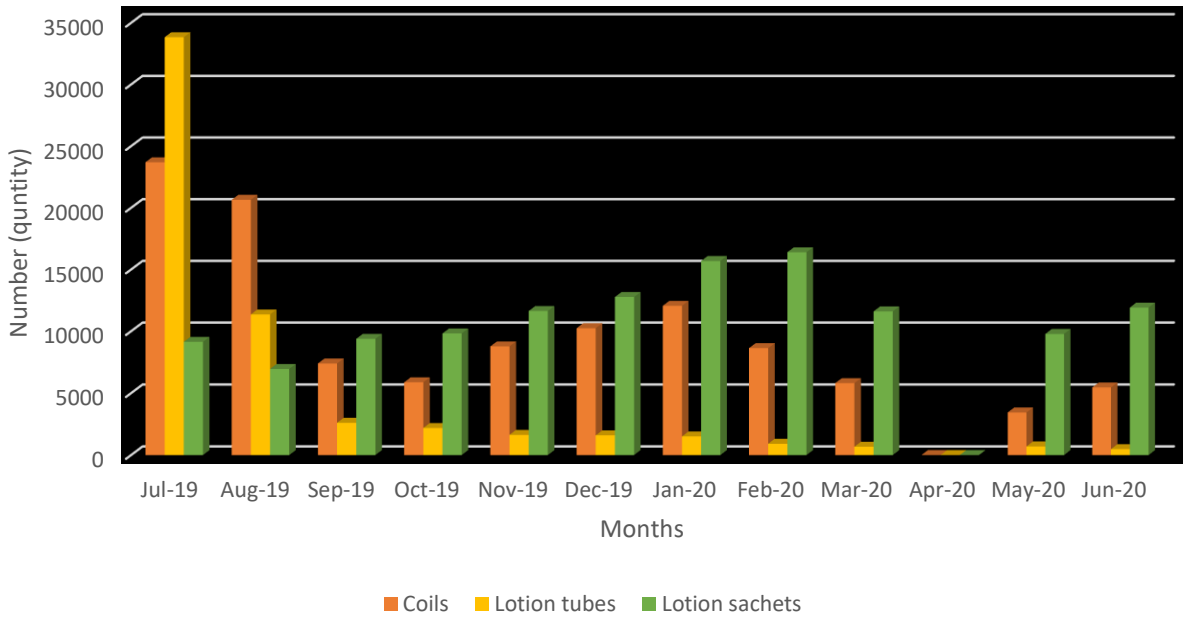
Study Title	Status
Therapeutic Efficacy Study	Protocol Development
Estimating the Malaria Prevention Impact of New Nets: Observational Analyses to Evaluate the Evidence Generated During Piloted New Nets Distribution In Rwanda	Implementation
Assessing the Durability of Long Lasting Insecticidal Treated Nets (LLINs) Post Mass Distribution in Rwanda	Protocol Development
Evaluation of the impact of coils and lotion mosquito repellents used in combination with LLINs on the prevention of malaria vector transmission in high and low malaria endemicity areas, Rwanda	Implementation

PART IV: INNOVATIONS FOR MALARIA CONTROL INTERVENTIONS

1. Distribution of Mosquito Repellents

In collaboration with the Society for Health Family (SFH), 294,611 mosquito repellents were distributed through socio-marketing channels. Three formulations were distributed: Coils or Baygon coils -38%, lotion tubes 19.5%, and lotion sachets 42.5%. For the three above formulations, it appears an incremental decline of sold quantity overtime for lotion tubes and coils. The trends may be resulted from the stock out of the two products due to the increasing of demand and also the lockdown context due to the mitigation measures of COVID-19 experienced from March to May 2020 (Figure 18). The repellents are recommended as an additional personal protective measure.

Figure 18: Quantity of Mosquito Repellents Distributed per Month and per Product



2. Stocking of Larvivorus Fish for Mosquito Larvae Control

The mosquito larval control includes stocking ponds, rivers, and water bodies near human settlements with **larvivorous** fish as one of the oldest biological control of malaria vectors. The species of ***Oreochromis niloticus*** commonly known as Tilapia is a widely **larvivorous** fish grown in Rwanda and elsewhere. Its introduction in **rice fields** and **irrigation schemes** as well as channels is a very quick solution for mosquito abatement in stagnant water bodies. In the FY 2019/2020, and in collaboration with Rwanda Agricultural Board (RAB) and the Ministry of Agriculture and Livestock, **20 millions of Tilapia fingerings were stocked in water bodies** with a plan to scaling up to 30

million of fingerings during FY 2020/2021. In addition to fisheries, the aquaculture has been implemented through 128 fish farming cooperatives with 3248 members, 42 irrigation schemes (dams) with 2940 members and 42 private operators. The above performance has been enabled by the involvement of private operators and the establishment of 12 hatcheries of fingerings of Tilapia. The four units are classified as of high capacity while the remaining 8 units are of medium capacity to produce fingerings.

3. Use of Drones for Larviciding

The trial for larval source management was developed and entitled "**Mosquito bio-control using *Bacillus thuringiensis* var israelensis (Bti) through aerial spraying with drones in irrigated rice marshlands of Gasabo district, Kigali City-Rwanda".** The trial is a collaboration work between CHARIS UAS, RBC-Medical Research Centre, Kigali-Rwanda, USF Health-South Florida University, Florida-US, African Leaders Malaria Alliance (ALMA). The trial evaluating the impact of Bti on larval and adult stages of mosquitoes will be conducted from July 2020 up to February 2021 in rice marchlands of Jabana in Gasabo districts and covering 336 ha. The spraying will be conducted through a mixture methods using drones and hand applications with knapsack sprayer pumps. The experiment will allow to evaluate the impact of Bti as supplement intervention to the existing indoor vector control interventions for instance LLINs and IRS. The activity performed during FY 2019/2020 were the development of the trial protocol, mapping of study sites, collection of baseline information and the training of surveyors and spray operators

Image: Drone Spraying Bti for Mosquito larvae Control in Kigali, 2020

4. School Health Program

The MIS 2017 showed that the most affected group with malaria was children in school age with malaria prevalence of 11% while general population was 7%. Therefore, MOH, MINEDUC in collaboration with Partners In Health/Inshuti Mu Buzima (PIH/IMB) piloted the program intending to screen and treat malaria at school by Teachers within Kayonza. District for early diagnosis and treatment but using school as channel of Social Behaviour Communication Change.

The program has been integrated into existing health system and CHWs trained teachers under supervision of Health Centers.
The following achievements were made through School Health Program:

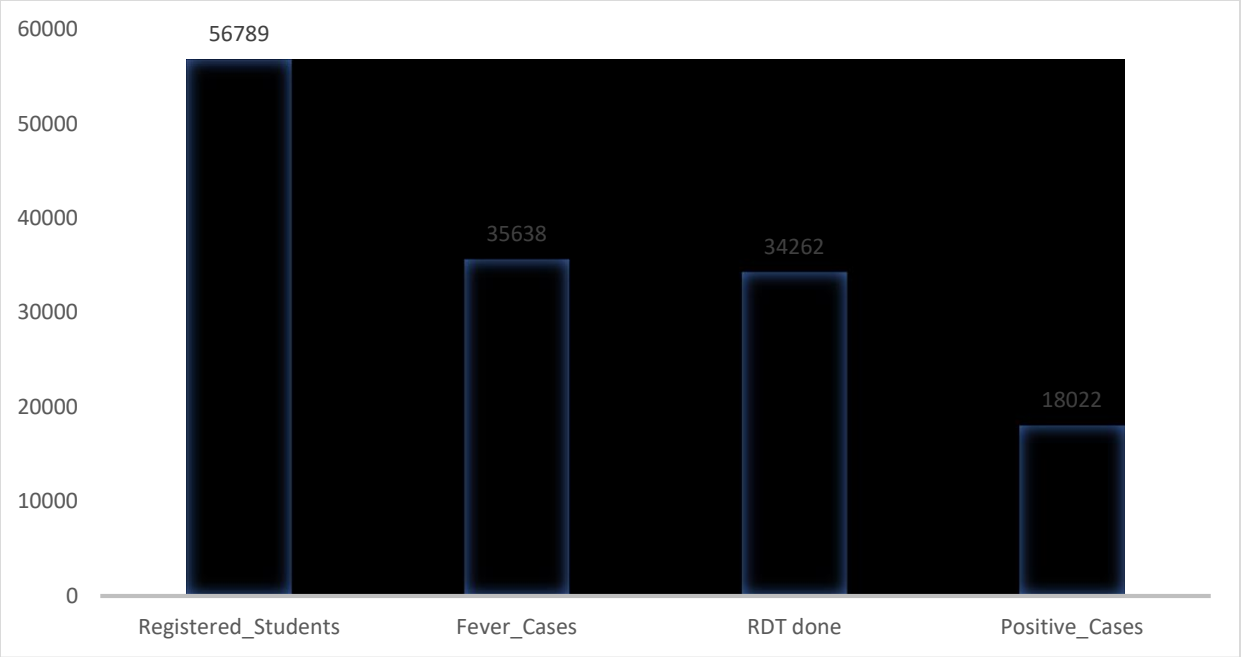
a. Training of Teachers by Community Health Workers

From the introduction of School Health Program in Kayonza District, a total of 531 Teachers from 15 schools in Rwinkwavu District Hospital catchment area were successfully trained on malaria diagnosis and treatment by Rwinkwavu DH, Health Centers and Community Health Workers.

*The CHW at Group Scolaire Rwinkwavu was training Teachers on malaria diagnosis using **RDT***

b. Clinical Outcomes of School Health Program

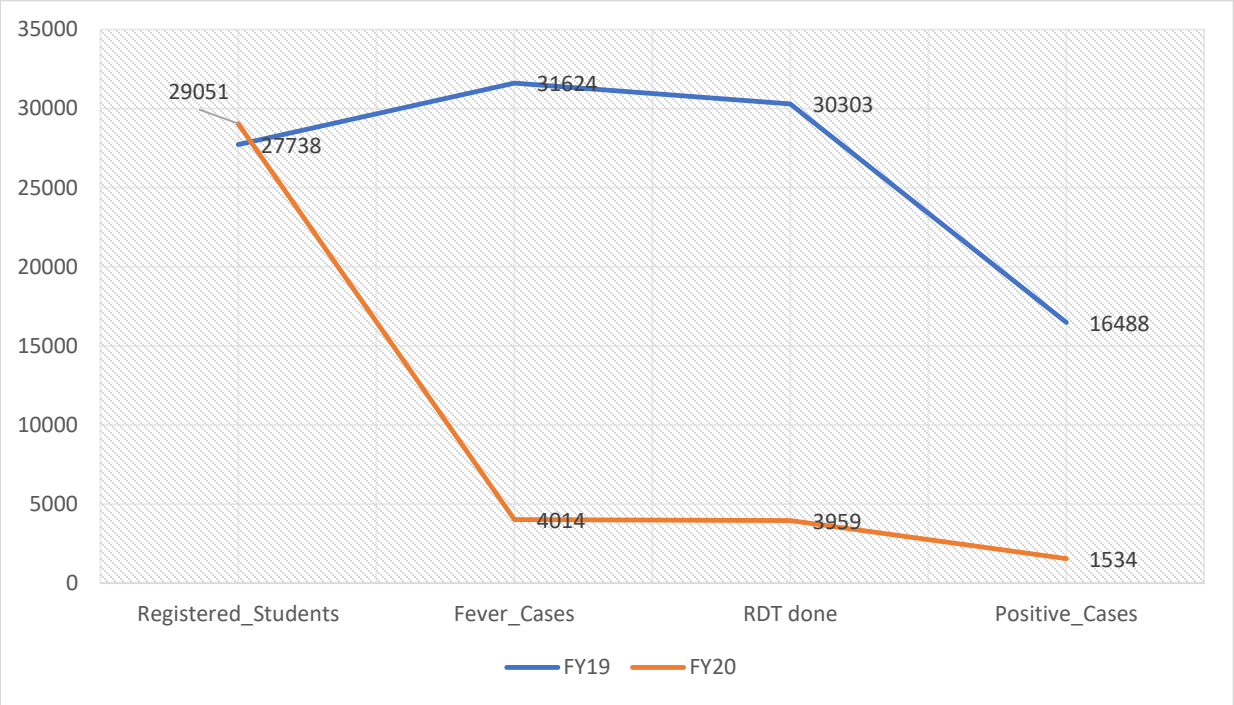
Figure 19: Cascade of Malaria Testing and Care at School from May 2018-Feb 2020



Since the beginning of SHP, 35,638 fever cases have been received by teachers at school among 56789 ever registered. Among fever cases almost 100% have been tested using RDT and 52% (18022) of tested were confirmed and treated for simple malaria at school. Only 6 cases presented with severe malaria signs and referred to high level.

c. The Effect of IRS on Fever Cases at School (2019-2020)

Figure 20: The reduction of Malaria Cases of Year 2019 and Year 2020

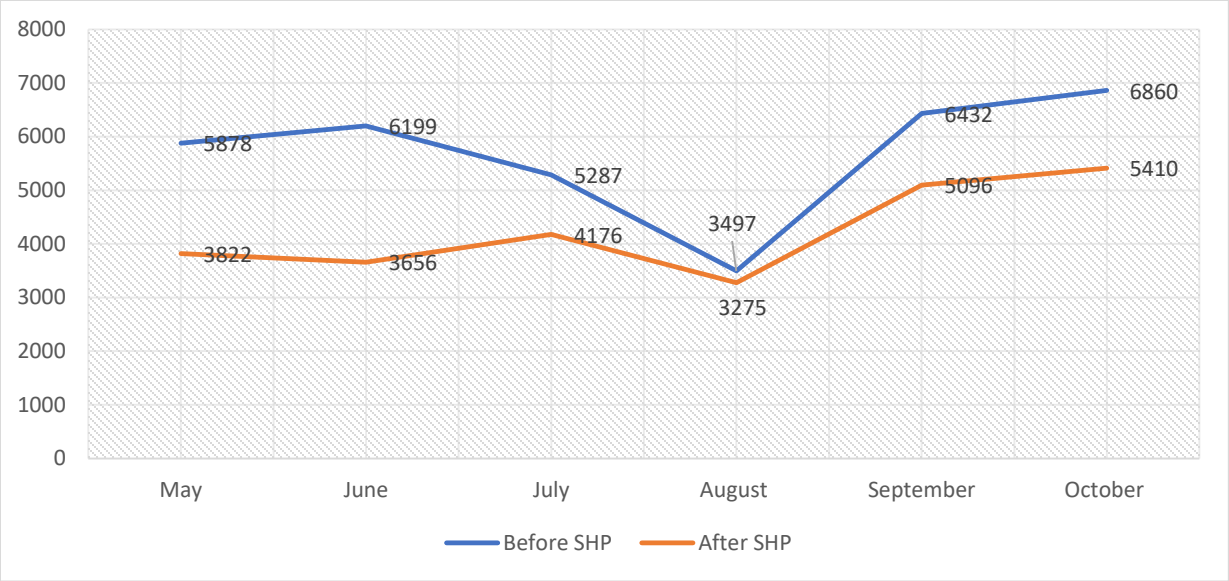


There has been a big decrease in suspected and confirmed malaria cases since the introduction of Indoor Residual Spraying in Kayonza in May 2019.

a. Reduction of School Missing (Absenteeism)

Data collected five months before and after School Health Program initiation within five school show that the overall proportion of students that missed schools decreased by 26.5% (p value 0.0001) and Headmasters testified the improvement of teachers' attendance after six months of SHP.

Figure 21: Cumulative of School Missing in 2017 and 2018 from May-Oct



b. Inter-School Competitions

The students used competition in spreading message on malaria prevention and care seeking through arts, football, music, etc.

Integrated Malaria Control Story Drawn by a Student of Ndego School

Students from Gihinga School won the football cup which aimed to spread message of malaria prevention

PART IV: PROGRAM COORDINATION AND MANAGEMENT

Objective 4: By 2020, Strengthen Coordination, Collaboration and Effective Program Management at All Levels

The focus of the program in this plan is to maintain the achievements so far and move forward to further reduce the burden of malaria. The program has put more efforts to develop and strengthen collaborative and partnership initiatives to accelerate malaria prevention and control in Rwanda and the region. The following are the strategies used to achieve the above objective.

Strategy1: Mobilization of Adequate Financial Resources

During this reporting period, the program prepared and submitted successful proposals to the Global Fund ((Value of US$55M). The United States Government through the President's Malaria Initiative (PMI) has also supported the program with an annual budget of US$18M.
In addition, with support from ALMA, the programme produced a Concept Note for the Creation of End Malaria and NTDs Council and Fund in Rwanda to be submitted to Cabinet for approval. This End Malaria and NTDs Council and Fund aims at mobilizing domestic and external resources to cover the gaps in the implementation of the National Malaria and NTDs Strategic Plans and increase political and community as well as private sector commitment in malaria and NTDs Control.

Strategy 2: Conduct Coordination and Planning Sessions for the Malaria Program and Key Stakeholder

- **Conduct Malaria Program Review for the NSP 2013-2020**

In October 2019, the MOH through the MOPDD/RBC in collaboration with partners undertook a comprehensive Malaria Program Performance Review (MPR) for the period of 2015/16 to 2019/20 with the aim of assessing the progress made by the malaria program, towards the epidemiological and entomological impact targets in the extended malaria strategic plan; reviewing the level of financing of the national malaria programme; reviewing the capacity of the national malaria control programme to implement planned activities; reviewing the attainment of programme outcome targets and; defining the recommendations and programming implications of the lessons learned in the implementation of the malaria strategic plan 2013-2020. The review aims to inform the development of the next malaria strategic plan (2020-2024), in line with the WHO

Global Technical Strategy 2016-2030 and the Fourth Health Sector Strategic Plan (2018-2024).

- **Development of the National Strategic Plan 2020-2024**

From November 2019 to May 2020, the Ministry of Health developed a National Strategic Plan (2020-2024). This strategic plan draws upon national experience and lessons learned from the MPR, global technical strategies and expertise, and from the current country context. Its content ensures that Rwanda's response to malaria remains aligned with global malaria goals and guidance. It was developed through a process of intensive and participative analysis and planning which took place over a one-month period (November 2019) led by the Rwanda Malaria and Other Parasitic Diseases Division, facilitated by external WHO and RBM consultants, and involving active representation from all key stakeholder groups including the representatives from Government institutions (MOH/RBC, MINEDUC, MINIRENA, MINAGRI/RAB, RCS, UR, CHUK, DHs, DPs, districts and community representatives) and non-government institutions (WHO, USAID/ PMI, RBM, ALMA, PHI, University of Maryland GHSC-PSM, CCM-Rwanda, JHPIEGO, INGOBYI, WORLD VISION, RICH, RDO, SFH and Urunana DC).

Strategy 4: Advocate for Concerted Inter-country Efforts against Malaria

In January 2020, a Technical Meeting of EAC Partner States and DRC Malaria Experts with support of WHO, RBM, ALMA, SFH Rwanda, and SC Johnson, under the leadership of EAC Secretariat and Rwanda MoH was held in Zanzibar to develop the First Great Lakes Malaria Initiative (GLMI) Strategic Plan.

Today, the Final and Costed Draft of the GLMI Strategic Plan 2020-2025 is available and is waiting for the endorsement by the EAC Health Ministers.

PART V: SOCIAL BEHAVIOR CHANGE COMMUNICATION

Objective 5: By 2020, 75% of the Population will have Correct Practices and Behaviors Towards Malaria Control

The Behavior Change Communication (SBC) interventions for malaria prevention and control were conducted with the aim of increasing community awareness, acceptance, and sense of ownership for malaria prevention and control at households level. To reach the set objective, different approaches and strategies were used in promoting and adopting desired behavior and practices. In complementarity to the Government's efforts, different implementing partners played a key role in malaria prevention and control.

Strategy 1: The Launching of Zero Malaria Starts with Me Campaign

To accelerate the engagement and ownership for malaria prevention and control at the continent level as well as Rwanda as a Country, ***Zero Malar***
campaign was designed and launched on 10th March 2020. The campaign was organized by the Rwanda Biomedical Centre through Malaria Division with support from The Roll Back Malaria, ALMA, SC Johnson and SFH Rwanda and other different partners operating in Rwanda.

The main objective of this campaign was to keep malaria high on the political agenda and increase the awareness of the population and involvement of stakeholders in malaria prevention and control.
On that occasion, the Use of Drones for Larval Source Management was launched. In addition, the scale up of IRS to 12 high malaria endemic districts, the introduction of the new types of LLINs (PBO and IG2 Nets) as well as other innovative tools for malaria control was launched in Rwanda.

Photo: Zero Malaria Starts With Me Campaign launch by Hon Minister of Health (Dr Daniel NGAMIJE, Center) and Key Stakeholders, Kigali March 10th, 2020

<u>Strategy 2: Develop the Malaria Advocacy, Communication and Social Mobilization Strategy</u>

This year has been remarkable in advocating for malaria prevention and control. Through the advocacy, today, it is on high level commitment from police markers, partners, and communities at large. All levels have been working hard to achieve the Government's goal in the malaria prevention and control. Furthermore, Local Leaders from Districts to community level have included malaria prevention and control in their agenda, and therefore provide enabling environment for behavior adoption and practices at households' level, which have led to community engagement and ownership for malaria prevention and control.

The awareness messages focused on malaria prevention and control were produced and disseminated to improve behavior change and social norms including correct and consistent use of LLINs, environmental hygiene to destroy the mosquitoes breeding sites and early diagnosis and treatment of malaria at community level.

Communication materials/tools were integrated and disseminated through mass media, community outreaches and IPC by different partners including URUNANA DC/Ingobyi Activity, Society for Family Health (SFH) and Rwanda Development Organization (RDO) have improved behavior adoption and practices among individuals.

Various interventions for SBC have been put in place especially those focusing on mass media. The Rwanda Demographic Health Survey (RDHS) 2014/15 shows that 86% of Rwandans listen to radio especially in the morning news and evening, and radio drama. This motivated to use mass media in the implementation of malaria prevention and control to reach the wider range of population. In addition to this, community outreaches through community forums, MVU, Interpersonal communication, and community sketches were conducted at strategic place and hard to reach areas to increase skills and influence behavior adoption and practices towards malaria prevention and control as well as services to the Rwandans. Table 20 shows the SBC interventions by various partners.

Table 20: SBCC Activities Implementation by Institutions or Partners

Activities	SFH		Urunana DC		Ingobyi Activity		RDO		RBC MOPDD		Total Number	Total Frequencies
	#	Fc	#	Fc	#	Fc	#	Fc	#	Fc		
Mass Media												
Radio drama	56	1,120	12	84	-	-	-	-			**68**	**1,204**
Malaria radio spots	6	2,324	-	-	-	-	-	-	2	28	**8**	**2,352**
Educative Malaria community live and radio sketches	80	1,600	4	3,456	-	-	-	-	-	-	**84**	**5,056**
Malaria Radio talk shows	24	120	16	16	12	1	-	-			**52**	**137**
Production and airing of TV spots	4	176	-	-	-	-	-	-			**4**	**176**
Umuhoza Radio magazine	-	-	4	8	-	-	-	-			**4**	**8**
Production of booklet with malaria messages					2	4,400					**2**	**4,400**
Radio DJ mentions	6	2,112									**6**	**2,112**
Community Outreach and Social Mobilisation												
Community mobilization (Monthly Umuganda, MVU, Out and mass outreach	16	304			-	-	-	-	2	30	**18**	**334**
IPCs Sessions at Community throught Inteko z'abaturage	24	456	-	-	1	42	-				**25**	**498**
Integrated community outreach	24	456	-	-	1	32	1	64			**26**	**552**

PART VI: NEGLECTED TROPICAL DISEASES & OTHER PARASITIC DISEASES

1. Introduction

In Rwanda, Neglected Tropical Diseases ("NTDs"), include intestinal worms–Ascariasis, Trichuriasis and Hookworm, Schistosomiasis (SCH), Scabies and other ectoparasites (Tungiasis or Jigger disease), Podoconiosis, Rabies, Snakebite envenoming (SBE), Trachoma, Taeniasis/Cysticercosis, Mycetoma, Lymphatic filariasis, Onchocerciasis and Human African Trypanosomiasis (HAT). Other parasitic diseases (OPDs) include amibiasis and giardiasis.

Considering that NTDs continue to be a threat to the health and social and economic development, Rwanda has the vision to be free from NTDs. In this line, since 2008, the Ministry of Health started Mass Drug Administration (MDA), raised community awareness for preventive measures and strengthened WASH and case management in all health facilities. All combined efforts have resulted in the decrease of disease morbidity and national prevalence of intestinal worms from 66% in 2008 to 45% in 2014.

Although Rwanda has made progress in fighting NTDs in recent years, there is still much to do in order to achieve the elimination of NTDs&OPDs as a problem of public health.

By 2024, Rwanda plans to **(1)** reduce NTDs prevalence and incidence: e.g. reduce prevalence of intestinal worms by >50%; reduce incidence by 25% for scabies, by 25% for cysticercosis and by 20% for tungiasis; reduce 50% of cases and mortality of snakebite envenoming; reduce mortality of rabies (from dog bites) to 0% and **(2)** eliminate targeted NTDs as a public health problem: schistosomiasis, trachoma, onchocerciasis, lymphatic filariasis, yaws, leprosy and human African trypanosomiasis.

According to the Rwanda NTD strategic plan 2019-2024[5], the key to unlock the elimination potential is to empower and engage the community and local leadership to identify, own and solve their respective NTD&OPD problems, mainly in WASH sector, considering that one district or community may differ from another in terms of NTD&OPD transmission factors.

The 2019-2020FY efforts were concentrated on consultations with districts and other stakeholders aimed to design guidelines on implementation of NTD&OPD prevention measures, involving district for entire coordination, local leaders and engagement of

5 Rwanda NTD Strategic Plan 2019-2024, page 42, available via http://moh.gov.rw/fileadmin/templates/Strategic_Plans/RWANDA_NTD_STRATEGIC_PLAN_2019-2024-compressed.pdf

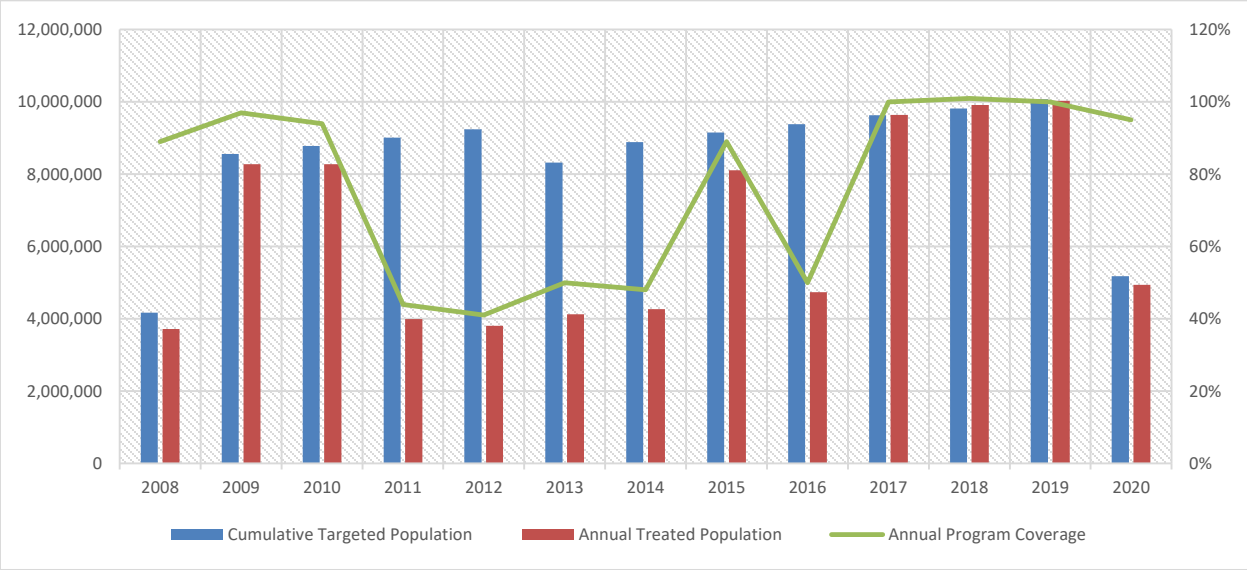
community members through a strategy termed as . The guidelines on this strategy were developed in Kinyarwanda. Mass Drug Administration was implemented twice and mobilization of partners and stakeholders was conducted to increase required resources (example: additional drugs for mass drug administration for adults and for a 3rd deworming round in highly endemic districts).
During this FY2019/2020, the following results were achieved:

2. NTD&OPD Prevention

MDA Coverage: The Figure 22 shows the national MDA coverage for STH whereby the 2 planned rounds per year for both pre-SAC and SAC were consistently implemented for the last 3 consecutive years (2017-2019). The missed MDA rounds were due to unavailability of funds to conduct the campaigns except for 2008 for which the treatment waited for the completion of initial mapping and 2014 for which the first round was cancelled to allow the remapping (June-July). For FY2019/2020, the coverage of MDA against intestinal worms exceeded 98% target planned in the HSSP IV (2018-2024) and NTD strategic plan 2019-2024. The cumulative STH MDA coverage for the current FY was >100%[6] (with 105% for the first round and 95% for the second round). MDA against schistosomiasis for school aged children was only conducted in 29 endemic sectors (sub-districts) of 12 districts due to a delay of praziquantel (PZQ) shipment. Leftover Praziquantel tablets that were expiring by November 2020 were used to treat SAC and adults in the aforementioned areas, reaching the coverage of 85% (242,355/286,472) and 81% (441,120/545,734) for SAC and adults, respectively. Targeted adults were also given albendazole (ALB) at 77% coverage (419,163/545,734). The planned PZQ-MDA in SAC in other sectors was postponed until the completion of SCH/STH community-based remapping rescheduled end of 2020.

[6] The coverage >100% may be explained by: (1) some children studying in O' level may take medicines while exceeding 15 years, (2) estimated targeted population based on 2012 census may not fit with field real number

Figure 22: Mass Drug Administration Coverage (STH) in Children 1-15YO, 2008-2020



Source: **RBC Program Data**

* Data for adults treated are not include

First-Ever Village-Based MDA: For the first time the second round of MDA (June/2020) took place in each village as planned in the NTD strategic Plan 2019-2024, shifting from outreach sites whereby a maximum of one campaign site per cell was used. This new approach was appreciated by CHWs, village leaders and all other district and health facility leaders met during and after the campaign. Targets were both pre-SAC and SAC and in some SCH endemic sectors SAC and adults were targeted.
The district officials interviewed appreciated the approach citing that this village-based MDA is close to the population and it does not take much working time to beneficiaries.

3. Orientation Meetings with District on Decentralization of NTD Activities

Conducted mainly to discuss with district and lower level implementers the new approach to prevent and control NTDs and other infections related to poor hygiene, with district coordination, multisectoral collaboration and improved community engagement. At the end of the meeting, except Ruhango district which was not able to attend, other 29 districts developed specific action plan to eliminate diseases related to poor hygiene.

4. HAT Coordination Meetings and Field Activity

During this reported FY, two coordination meetings were conducted in November 2019: stakeholders and progress meetings at WHO country office and in Rwamagana district respectively. The dossier requesting WHO verification of elimination will be submitted by quarter 2 of next FY2020-2021. Participants included RBC/NTD Program, NRL, MINAGRI, RAB, UR-Veterinary, WHO, FAO, Representative of Akagera National Park, Director general of hospital, Head of sentinel health centers, HAT focal points (MD or Nurse and Lab) in all sentinel sites.

5. Coordination of Drugs Donation

Existing drug donations: the FY has also been marked by the coordination of MDA drug donations from WHO and UNICEF.

Table 21: Details for Deworming Medicines Received During 2019-20FY

PC medicine	Target population	Received quantities of tablets	Donor
Albendazole 400 mg tabs	5-15 years old	7,232,000 (for 2 MDA round)	WHO
	12-59 months old	3,093,400 (for 2 MDA round)	UNICEF
Praziquantel 600mg	5-15 years old in 127 endemic sectors	0	WHO

6. CONCLUSION

The achievements made in FY 2019/2020 are efforts of the Government and its stakeholders/partners towards Rwanda free from NTDs&OPDs as stated in the HSSP IV and the NTD strategic plan 2019-2024. The multi-sectoral collaboration and the engagement of community and the ownership of local leadership will make the difference to achieve set targets.

The current COVID-19 pandemic has negatively impacted this FY's activities and there is need to adapt the next FY plan to the ongoing situation in collaboration with all stakeholders/partners.

PART VII: FINANCING THE MALARIA AND NTD PROGRAMS

1. Introduction

The financing of Malaria and NTD Strategic Plan becomes a high priority for the GoR. The MSP and NTDSP are funded by the Government of Rwanda, the Global Fund for HIV & AIDS, TB and Malaria Results Based Financing (GF), the US President's Malaria Initiative, END Fund and WHO.

Through SMART FMIS (Integrated Financial Management Information System), data of the actual financial report were generated given that HRTT captured so far budget and expenditures of the reporting period. To facilitate the collection of financial information for this year's report, a separate data collection process was adopted using for Global Fund grant and Government contribution; and directly from in country office for PMI.

2. Public and External Funding Sources for Malaria Program

Below a summarized table illustrates the Malaria and NTD budget by source of funding with: the Global Fund, PMI, GoR and END FUND for Fiscal year 2019-2020. The current total expenditures are amounting to **USD 65 505 929** which represents **96%** of total budget of **USD 68 161 327**.

Table 22: Malaria Budget and Expenditures by Source of Funds, FY2019-2020

Funding Sources	*Opening Balance in USD*	*Initial Budget for FY 2019-2020*	*Revised Budget in USD FY 2019-2020*	*Expenditures in USD FY 2019-2020*	*Budget Execution Rate in %*
GLOBAL FUND	8 076 874	12 456 422	20 533 296	18 517 439	90%
PMI		18 000 000	18 000 000	18 000 000	100%
GoR		29 474 779	29 474 779	28 907 060	98%
END Fund (Old)	80 209		80 209	75 725	94%
END Fund		73 044	73 044	5 705	8%
TOTAL	**8 157 083**	**60 004 245**	**68 161 328**	**65 505 929**	**96%**

3. Government Expenditures by MTEF Chapter for Fiscal Year 2019-2020

The total GoR contribution to malaria expenditures is USD 29 474 779, from this budget the total expenditures is USD 28 907 060 represents 98% of total budget.

As presented in Table below, of the total expenditure was allocated to : (i) Compensation of employees, (ii) Use of goods and services, (iii) Acquisition of fixed assets, (iv) Subsides (v) Grants (vi) Social assistance and (vii) Other expenditures MTEF Chapter.

Table 23 : Government Expenditures by MTEF Chapter for Fiscal Year 2019-2020

MTEF Chapter	Budget in USD	Expenditures in USD	Variance in USD	Performance in %
21 Compensation of employees	12 835 186	12 379 252	455 934	96%
22 Use of goods and services	4 075 501	4 101 543	(26 042)	101%
23 Acquisition of fixed assets	4 603 300	3 635 395	967 905	79%
25 Subsides	168 366	244 334	(75 968)	145%
26 Grants	3 205 987	3 331 947	(125 960)	104%
27 Social assistance	3 082 512	3 069 399	13 112	100%
28 Other expenditures	1 503 927	2 145 189	(641 262)	143%
Total	**29 474 779**	**28 907 060**	**567 719**	**98%**

4. Global Fund Contribution to Malaria Program

The Global Fund contribution for the FY2019–2020 was USD 20 533 296. From this budget, a total amount of USD 18 517 439 was spent, the variance of USD 2,015 857 is committed to pay the last invoice of LLINs.

Table 24: Global Fund Expenditures by NSP Budget Categories for July 2019 to June 2020

GF Budget Categories	Opening Balance in USD	Initial Budget for FY 2019-2020 in USD	Revised Budget for FY 2019-2020 in USD	Expenditures for FY 2019-2020 in USD	Variance in USD	Budget Execution in %
1.0 Human Resources (HR)		431 828	404 023	383 213	20 811	95%
10.0 Communication Material and Publications (CMP)			27 805	27 805	0	100%
11.0 Program Administration costs (PA)	206 763	91 179	297 942	297 942	- 0	100%
2.0 Travel related costs (TRC)	1 163 505	1 379 704	2 543 209	2 508 665	34 543	99%
4.0 Health Products - Pharmaceutical Products (HPPP)		1 479 064	1 479 064	1 135 935	343 130	77%
5.0 Health Products - Non-Pharmaceuticals (HPNP)	5 638 057	8 216 324	13 854 381	12 847 264	1 007 117	93%
7.0 Procurement and Supply-Chain Management costs (PSM)	1 068 549	858 323	1 926 872	1 316 616	610 255	68%
Total	**8 076 874**	**12 456 422**	**20 533 296**	**18 517 439**	**2 015 857**	**90%**

5. PMI Expenditures for the Fiscal Year 2019-2020

The PMI contribution for malaria expenditures went specifically to malaria preventive intervention and to malaria case management interventions. The budget for preventive interventions was spent mainly on the procurement of LLINs and IRS. The total budget of USD 18 000 000 was executed at 100%.

Table 25: END FUND (Old Grant) Expenditures by Cost Category for the Fiscal Year 2019-2020

Activity	Budget in USD	Executed Budget in USD	Variance in USD	Execution Rate in %
Conduct a workshop to review the October 2019 MDA implementation challenges and propose solutions/ Orientation meetings	35 018	31 941	3 076	91%
Organize twice a year mass drug administration of deworming medicines in children from 1 to 15 years old	45 191	43 784	1 407	97%
Total	**80 209**	**75 725**	**4 484**	**94%**

Table 26: END FUND Expenditures by Cost Category for the Fiscal Year 2019-2020

Activity	Budget for FY 2019-2020 in USD	Expenditure s for FY 2019-2020 in USD	Balance in USD	Execution rate in %
Conduct SCH/STH community-based remapping	73 044	5 705	67 339	8%
Total	**73 044**	**5 705**	**67 339**	**8%**

The budget of END FUND was executed at the 8% this low budget execution was due to delay or postponement of most of NTDs Activities following COVID-19 in Rwanda.

6. Conclusion

The overall Malaria Budget execution for Fiscal year 2019-2020 is at 96%. Unused budget is subject of carry over for the next fiscal year 2020-2021

Table 27: Other Sources of Budget to Support Malaria and NTDs Programs

FUNDING SOURCES	Opening Balance (USD)	Initial Budget FY 2019/2020	Revised Budget FY 2019/2020	Expenditures FY 2019-2020	Budget Execution Rate (%)
WHO for NTDs Program	8,484	8,484	8,484	8,484	100%
WFP for NTDs Program			71,871	0	0%
WHO for Malaria Program			57,362	57,362	100%
SFH for Malaria Program			54,026	54,026	100%
ALMA/RBM for Malaria Program			28,384	28,384	100%

PART VIII: MALARIA PERFORMANCE FRAMEWORK

Table 28: Malaria Program Performance Framework

ITEMS	INDICATORS	Baseline	Year of Baseline	2019-2020 Target	2019-2020 Results	%
Goal	**Impact Indicators**					
To reduce malaria incidence from 308/1,000 in 2016 to 198/1,000 by 2020; to reduce malaria deaths by at least 30% of 2016 levels by 2020 and to reduce malaria prevalence by 2020	Annual Parasite Incidence per 1,000 persons	308	2015-16	354	198	100
	Inpatient malaria deaths per 100,000 persons per year	6.2	2015-16	4	1.3	100
	Number of confirmed malaria deaths	698	2015-16	490	167	100
Objective 1:	**Outcome Indicators**					
By 2020, 90 % of population at risk will be effectively protected with locally appropriate preventive and vector control interventions based on evidence	Proportion of structures in targeted areas that received Indoor Residual Spraying (IRS) during the reporting period	98%	2015-16	98%	99.3%	100
	Proportion of population protected by indoor residual spraying within the last 12 months in targeted districts	98.90%	2015-16	98%	99.3%	100
Objective 2:	**Outcome Indicators**					
By 2020, all malaria cases will be tested with a quality assured diagnostic method and promptly treated in line with the national guidelines	Proportion of suspected malaria cases that receive a parasitological test at public sector health facilities	99%	2015-16	99%	100%	100
	Proportion of suspected malaria cases that receive a parasitological test at the community level	99%	2015-16	99%	100%	100
	Proportion of confirmed malaria cases that received first-line antimalarial treatment according to national guidelines at public sector health facilities	98.4%	2015-16	98.5%	99%	100
	Proportion of confirmed malaria cases that received first-line antimalarial treatment according to national guidelines at the community	79%	2015-16	85%	100%	100
Objective 3:	**Outcome Indicators**					
By 2020, strengthen surveillance, monitoring and evaluation and operational research	Proportion of public health facilities submitting malaria indicators timely	94	2015-16	95	99%	100
	Proportion of public health facilities submitting complete report on malaria indicators	98	2015-16	98	97%	100
	Proportion of private health facilities submitting complete report on malaria indicators	45	2015-16	50	56%	100
Objective 4:	**Outcome Indicators**					
By 2020, effective program management and coordination will be expanded to all levels including multi-sectorial and regional partnerships	Number of cross border initiatives set up	0	2015-16	1	1	100%

PART IX: IMPACT OF COVID-19 ON MALARIA AND NTD PROGRAMS

- Delayed shipment and inspection of LLINs
    - Delayed LLINs Distribution in 7 Districts (HH) and 10 Districts (ANC/EPI)
    - Stock Out in LLINs in Routine Services (ANC, EPI)
- Delayed IRS in 3 out of 13 Districts in FY2019/2020
- Additional Budget for IRS, LLINs Inspection and Distribution due to COVID-19 Prevention measures requirements (hand sanitizers, masks, transport cost, warehouses for LLINs Physical Inspection teams, new design of LLIONs mass distribution by Community Health Workers and Village Leaders through house to house distribution, etc.)
- Delay or postponement of NTDs activities (MDA, STH and SCH Remapping, etc.)

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