



A Healthy People. A Wealthy Nation

IHDPC/Malaria & Other Parasitic Diseases Division

Mal & OPDD- RBC Annual Vector control report July 2013 – June 2014.

The activities achieved during this period from July 2013 to June 2014 are regrouped into the following main points:

1. Implementation of vector control Interventions.

1.1. Coordination of Indoor Residual Spaying campaign in three targeted districts

During this financial year 2013 to 2014, two IRS campaign were organized instead one campaign planned in high risk of malaria transmission respectively Bugesera, Gisagara and Nyagatare districts. At each IRS campaign, an operational plan was developed and discussed with representatives of targeted districts. In collaboration with Abt Associates, all required insecticide and logistic items have been procured.

The 10th round of IRS campaign was performed from 02 September to 06 October 2013 in 37 sectors of Gisagara (11 out of 13 sectors), Nyagatare (entire district: 14 sectors) and Bugesera (12 out of 15 sectors) districts. It was used bendiocarb 80 WP as insecticide in Nyagatare and Deltamethrin or K-Othrin 250 WG in the remaining two districts. In total 224708 structures have been sprayed with a coverage of 98,1% and population protected was estimated to 975,259 inhabitants.

From 10 February to 08 March 2014, the 11th round of IRS campaign was again organized for targeted sectors in Gisagara (06 out of 13 sectors), Nyagatare (08 out of 14 sectors) and Bugesera (06 out of 15 sectors) districts and using bendiocarb 80 WP as insecticide. In total 123,919 structures have been sprayed with a coverage of 98,6% and population protected was estimated to 512,789 inhabitants. The quantity of insecticide used was 95922 sachets of 100 gram per sachet.

1.2. Performance of IRS for prevention of malaria outbreaks in targeted areas.

In the framework of prevention of malaria outbreaks or control of malaria transmission foci, two IRS campaigns were conducted respectively in Bugarama area, Rusizi district in 4 targeted sectors from 20 December 2013 to 20 January 2014 and in Busoro sector from 06 February to 10 March 2014. In Bugarama area, 13983 structures have been sprayed with a coverage of 94% and 5389 structures were sprayed in Busoro sector with a coverage of 98,8%. Insecticide used in the two campaigns was Deltamethrin 250 WG.

1.3. Support of implementation of IRS following the partner requests.

- Participation to the Lice control campaign in 6 Prisons (Rilima, Miyove, Musanze, Rubavu, Muhanga, Ntsinda) from 23 to 27 May 2014. In total, 23400 sachets of Permethrin 0,5% Dusting Powder (Residex-P) packaged in 50gr per sachet has been used. It was a collaborative effort between Rwanda Biomedical Center, the MININTER and Rwanda Correctionnal Service (RCS).
- Organization of IRS campaign at the Military School of Infantry of Gabiro in March 2013 for preparation of Government retreat. Another IRS and fumigation campaigns were implemented at the Kigali Camps in preparation of African Bank annual meeting held in May 2014.

2. LLINs durability monitoring.

2.1. LLINs tracking survey in 6 study sites (30 months after LLINs distribution)

A 3 year longitudinal study to track net durability and efficacy in 3,000 LLINs (1500 polyethylene/incorporated deltamethrin; 1500 polyester/ coated deltamethrin) at 6 sites (2 sites in Bungwe sector-Bulera district as Hypo-endemic, 2 sites in Kinazi sector-Ruhango as hyperendemic and 2 sites in Masaka sector, Peri-urban of Kigali as Urban malaria trend) was launched in December 2010. The main parameters monitored were respectively loss level, physical deterioration and WHO cones bioassays. The results of 30 months post LLINs distribution showed that the LLINs were not in good condition after 30 months of using. Therefore the loss was estimated to 49.8% and according to the thresholds developed by Albert Killian, 2010 after 30 months, only 9.4% LLINs were in good condition, 26.7% LLINs in

serviceable condition and 63.9% LLINs must be replaced. The bioassays tested found out 58.9 % mortality rate of *Anopheles gambiae* s.s after 24 hours post exposed to the nets surfaces.

A manuscript paper was prepared and submitted for publication to malaria Journal on 26 March 2014. This manuscript was entitled “Monitoring Long-Lasting Insecticidal (mosquito) Net (LLIN) Durability to Validate Net Serviceable Life Assumptions. Clarifications to the comments from the reviewers have been provided in June 2014.

2.2. Routine LLINs field monitoring

Through routine LLINs monitoring, the Mal&OPDD collected samples in 9 districts and with varying times (5 months and 9 months) for testing of LLINs physical deterioration, bioefficacy. Almost of bed nets (n=75) tested were substandard to the WHO bio efficacy thresholds of 80% of mortality of exposed mosquitoes. The average mortality of mosquitoes used for 5 months was 37% and 45% for LLINs used for 9 months.

Subsequent to the above results, another bio-efficacy test was conducted to 5 new LLINs as control and the mortality was also substandard of 56%. The physical deterioration was conducted on 160 samples used for 9 months and showed that only 46,9% (n=75) of LLINs were in good conditions and 12,5 % (n=20) needed immediate replacement due to the physical deterioration status.

Then 56 samples of NetProtect were sent to CDC for analysis of insecticide content by high performance liquid chromatography (HPLC). The target deltamethrin for NetProtect in good condition is 1,35-2,25 g/kg. Preliminary results of 40 NetProtect samples out of 56 sent to CDC and showed that particular samples of NetProtect have sub-standard insecticide levels which confirmed the bioefficacy results from field. These findings were highlighted by a sample of five NetProtect which were tested right out of their original bags collected from warehouse (0 months) and 4 out of 5 (80%) had unacceptable insecticide concentration by HPLC method. The average failure to insecticide content was 42,5% of Net Protect used at least for 9 months . The failure rate for LLINs used for 5 months was 50% and 40% of LLINs used for 9 months.

A negotiation of Contract Agreement for LLINs Quality Control of LLINs with has been undertaken with Walloon Agricultural Research Center (CRA-W). This contract agreement was signed on 12 May 2014.

3. Entomology surveillance.

Different activities were achieved in term of vectors surveillance which include vector bionomics, vector resistance to insecticide and bioassays for quality control and status of residual efficacy of IRS campaigns and LLINs.

3.1. Longitudinal entomology surveillance in 12 sentinel sites.

An entomology surveillance was established in 12 sentinel sites (Bungwe, Rukara, Bukora, Kicukiro, Busoro, Karambi, Mashsha, Kivumu, Rwaza, Mubuga, Mareba and Mimuli). From July 2013 to June 2014, 159,191 mosquitoes have been collected among them 23,4% are represented by *Anopheles gambiae s.l.* which is the main malaria vector collected. It represents 90,7% (n=41154) of all species of *Anopheles* collected. Malaria vector showed a trend of exophilic behavior biting of 48,3 % (n=37,322). Therefore, it was noted a spread of exophilic biting behavior in the most mosquito collecting sentinel sites except the site of Karambi where the endophile rate is 54% (n=1282). The average density of *Anopheles gambiae s.l.* for the period of 12 months is estimated to 7,2% bites per night and per person and ranging from 0,0% for Bungwe and 38,1 at Mashsha. The average nuisance (density) for mosquitoes is estimated to 30,7 bites per person and per night. The highest was recorded in Kicukiro, Kigali City with an average of 62,2 bites/night/person followed by Mashsha 57,1 bites/night/person, Mareba with 54,4 bites/night/person. The lowest nuisance was recorded at Bungwe sentinel site with an average 1,7 bites/night/person.

An ELISA test for detection of infection of *Anopheles gambiae s.l.* was carried out on 549 samples. The average infection rate for *Anopheles gambiae s.l.* was estimated to 0,9%. The calculation of entomological inoculation rate showed an average of 23,6 infected bites per person and per year. Each person has a risk to be bitten by an infected mosquito every two weeks.

Sentinel sites	Total Culicidae	% An.g vs Culicidae	An.g Endo. Rate (%)	Density Culicidae (bi/p/n)	Density An. g. sl (bi/p/n)	S. index (%)	EIR/year (bi/per)
Bukora	13,357	2,0	47,2	30,9	0,6	1,1	2,5
Bungwe	731	0	N/A	1,7	0,0	0	0
Busoro	15,989	15,5	49,1	37	5,8	0	0
Karambi	21,618	5,9	54,4	50	3,0	0	0

Kicukiro	26,889	15,8	45,8	62,2	9,8	0	0
Kivumu	9,301	0,8	48,1	21,5	0,2	0	0
Mareba	23,492	27,1	45,8	54,4	14,7	1,1	60,2
Mashesha	24,667	66,7	49,2	57,1	38,1	1,4	190,3
Mimuli	13,462	39,1	49,6	31,2	12,2	0	0
Mubuga	3,120	6,2	49,0	7,2	0,4	0	0
Rukara	3,957	17,5	44,1	9,2	1,6	3,6	20,9
Rwaza	2,608	0,5	16,7	6,0	0,0	0	0
Total	159,191	23,4	48,3	30,7	7,2	0,9	23,6

3.2. Entomology monitoring in IRS targeted districts.

1.1. Insecticide resistance tests.

A monitoring with WHO standard protocol, 1998(Cylinder tubes) has been performed in 26 sites countrywide from July 2013 to February 2014 with target to cover 7 of the following insecticides: Bendiocarb 0,1%, Fenitrothion 1%, DDT 4%, Permethrin 0,75%, Deltamethrin 0,05%, Lambdacyalothrin 0,75% and Etofenprox 0,5%. The mosquitoes to be tested were obtained from larvae collected from field and reared in field insectary established in place and following the standard conditions of temperature (28°C) and humidity (80%). The method of dipping described by WHO (Malaria Entomology and Vector Control – Learner’s Guide, WHO, 2002) for larvae collection was used and *Anopheles* larvae were sorted with pipettes. The results showed that Fenitrothion (Organophosphates) 1% was susceptible to mosquito tested in all sites surveyed. The resistance to Bendiocarb 0,1% was found out in two sites (Remera and Gahini, Eastern Province) and DDT likewise in two sites of Kicukiro in Kigali City and Mimuli in Nyagatare, Eastern Province. Therefore, it was discovered a widespread of resistance to insecticide Pyrethroids in 42% of sites surveyed. The resistance affects more than Eastern Province, Southern provinces and Kigali city. The resistance tests conducted in 2011, predicted resistance development as it was noted suspicious trend of resistance of *Anopheles gambiae s.l.* to the class of pyrethroids in many sites. A continuous resistance monitoring and resistance mechanism is required in order to guide the best strategies of malaria prevention.

Table 2: Results of resistance tests for 7 insecticides performed 2013-2014

Provinces	Sites surveyed	DD T	λ _Cyhal.	Etofenpro x.	Per m.	Delta .	Ben d.	Fen .
Kigali City (1 site)	Kicukiro	R	R	TC	S	TC	S	S
Northern Province (4 sites)	Kajevuba	TC	R	TC	TC	TC	S	S
	Rwesero	TC	R	R	R	S	S	S
	Bungwe	S	S	S	S	S	S	S
	Rwaza	S	S	S	S	S	TC	S
Southern Province (8 sites)	Busoro	TC	R	TC	TC	TC	S	S
	Karambi	TC	TC	S	TC	S	S	S
	Mbuga	S	S	S	S	S	S	S
	Mbazi	S	TC	S	TC	S	S	S
	Kirarambogo	R	R	R	R	R	S	S
	Gitarama	TC	TC	TC	S	S	TC	S
	Gakoma	TC	TC	S	S	S	S	S
Western Province (3 sites)	Mashesha	TC	TC	TC	TC	S	S	S
	Nkanka	S	S	S	S	S	S	S
	Mbuga	S	S	S	S	S	S	S
Eastern Province (10 sites)	Rukara	TC	R	S	TC	TC	S	S
	Bukora	TC	R	R	TC	R	S	S
	Ngarama	TC	TC	TC	TC	TC	S	S
	Nyagatare	S	R	R	R	TC	S	S
	Rilima	S	S	S	S	S	S	S
	Mwogo	S	TC	R	TC	TC	TC	S
	Gahini	TC	TC	TC	TC	TC	R	S
	Cyondo	S	S	TC	S	S	S	S
	Remera	TC	R	R	R	TC	R	S
	Mimuli	S	R	R	R	TC	S	S

S:susceptible, TC: to be confirmed, R: resistance confirmed.

A-cyhal: Lambdacyalothrin, Perm.: Permethrin, Delta.: Deltamethrin., Bend. Bendiocarb., Fen.:Fenitrothion

Wall Bioassays.

A wall bioassays was performed in three targeted districts for IRS (Nyagatare, Bugesera, Gisagara) on monthly basis from July 2013 to June 2014 and covering the two rounds of IRS campaign respectively in September 2013 and February 2014. It was performed in 2 sectors per district with 6 houses per sector (2 plastered non painted, 2 plastered painted and 2 mud). The Kisumu susceptible strains of *Anopheles gambiae* s.s. reared at the Malaria & OPD Division insectary based at Kigali Health Institute (KHI)

has been used. The mosquitoes aged from 3 to 5 days old were exposed in each house at the top, middle and bottom level of the walls. Two replicates for each type of house (mud, plastered painted and plastered none painted) were used. The mortality was counted after 24 hours post exposure both for exposed and control samples.

Following the IRS campaign conducted in September 2013, the deltamethrin 250 WG displayed a decline of residual efficacy at the third month post spraying while the Bendiocarb remains effective until the fourth month. The same trend has been displayed after the next IRS round conducted in February 2014, and that time in the three districts. The results confirm a residual efficacy of Bendiocarb 80WP of four months in the context of Rwanda and two cycles per year will be needed in order to cover the two annual pics of malaria.

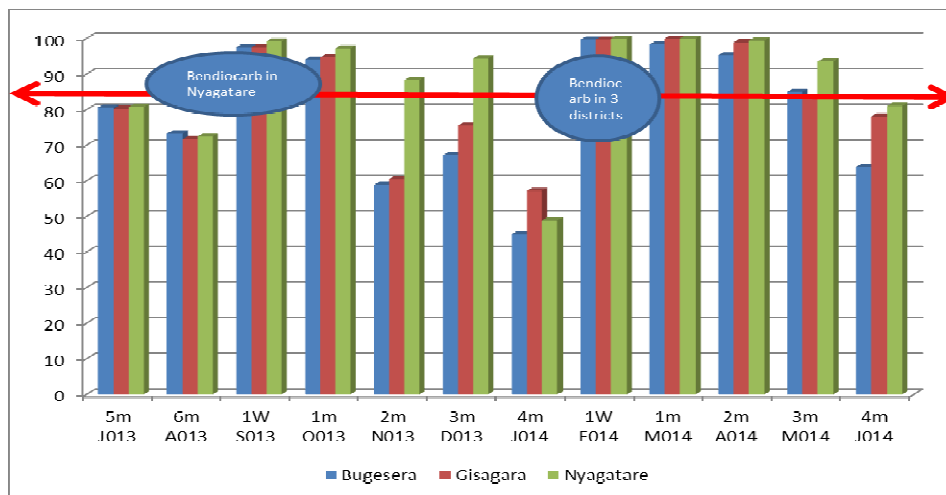


Fig1: Insecticide decay on wall after IRS campaign, from July 2013 to June 2014.

2. Policy and guidelines development.

After development of vector control needs Assessment report in 2011, an integrated Vector Management strategic plan 2012-2017 and insecticide resistance management strategic plan 2013-2017, an IVM policy was prepared and was endorsed by the Ministry of Health. In May 2014, a validation workshop was organized with participation of different stakeholders. Then, it was presented to the RBC/SMT, SMM/MOH for validation. Another step was undertaken by its validation through the Social cluster Minister's meeting in June 2014. A validation workshop with all stakeholders was organized at Gorilla Hotel, Nyarutarama on June 07th, 2012, and where 61 participants attended this workshop.

3. Capacity building.

In order of extension of entomology surveillance postes, 15 entomology technicians were trained in entomology techniques for one month in Mashasha, Rusizi district from 29 January to 26 February 2012. These entomology technicians came from the new entomological posts of Kivumu (Rutsiro district), Rwaza (Musanze district), Mubuga (Karongi district), Mareba (Bugesera district) and Mimuli (Nyagatare district). The above new entomology posts were launched the activities of monthly entomology surveillance since April 2012.

Another main activity for capacity building was related to the establishment of an integrated vector control and entomology laboratory which will have facilities and equipment for PCR, ELISA for infection and mosquito blood meals, insectary and animal house, bioassays and resistance tests and training hall.