PRESIDENT'S MALARIA INITIATIVE

PMI | Africa IRS (AIRS) Project

Indoor Residual Spraying (IRS 2) Task Order Four

LIBERIA END OF SPRAY REPORT

MARCH – JUNE 2012 – FIRST ROUND

OCTOBER – NOVEMBER 2012 – SECOND ROUND

Contract: GHN-I-00-09-00013-00
Task Order: AID-OAA-TO-11-00039
Submitted to: United States Agency for International Development/PMI
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ACRONYMS

AML	Arcelor Mittal Liberia
BCC	Behavior Change Communication
COP	Chief of Party
CFR	Code of Federal Regulations
CHW	Community Health Worker
CHT	County Health Team
DDT	Dichlorodiphenyltrichloroethane
DEOH	Department of Environmental and Occupational Health
DHO	District Health Officer
EPA	Environmental Protection Agency
ECO	Environmental Compliance Officer
FL	Firestone Liberia
FY	Fiscal Year
GIS	Geographical Information System
GFATM	Global Fund to Fight AIDS, Tuberculosis, and Malaria
GPS	Global Positioning System
IEC	Information, Education, and Communication
HLC	Human Landing Catch
ICC	Inventory Control Card
KTC	Kpassaqoi Trading Corporation
LIBR	Liberian Institute for Biomedical Research
LLIN	Long-lasting insecticidal net
MIS	Malaria Indicator Survey
MOP	Malaria Operational Plan
MOU	Memorandum of Understanding
MOA	Ministry of Agriculture
MOHSW	Ministry of Health and Social Welfare
M&E	Monitoring and Evaluation
NMCP	National Malaria Control Program
NGO	None Governmental Organization
OPD	Outpatient Department
PCR	Polymerase Chain Reaction
PSC	Pyrethrum Spray Collection
PSIR	Pre-Spray Inspection Report
SEA	Supplement Environmental Assessment
CDC	Centers for Disease Control and Prevention
UNMIL	United Nations Mission in Liberia
UTM	Universal Transverse Mercator
GHEO	USAID Global Health Environmental Officer
VCU	Vector Control Unit

WHO	World Health Organization
USAID	United States Agency for International Development
PMI	Presidential Malaria Initiative
IRS	Indoor Residual Spraying
TOT	Training of Trainers
PPE	Personal Protection Equipment
RTI	Research Triangle Institute
SOP	Spray Operator

EXECUTIVE SUMMARY

In August 2011, Abt Associates was awarded a three-year Africa-wide IRS project (AIRS), funded by USAID under the President's Malaria Initiative (PMI) and Liberia is one of the countries that received support to implement Indoor Residual Spraying (IRS). The key objectives of the AIRS project in Liberia were to reduce malaria-associated morbidity and mortality in 14 districts located in five counties and build local capacity to implement sustainable IRS campaigns. The target for the 2012 IRS campaign was to spray a total of 80,000 structures located in the 14 districts that had been sprayed in the previous year. The IRS campaign used two classes of insecticides; in 12 select districts a long-lasting pyrethroid was applied and in the other two districts a shorter lasting carbamate was applied. Due to the short period of effectiveness of the carbamate, there were two spray cycles in the two districts. The first cycle, which was conducted in all of the 14 districts, was done in March and part of April, while the second spray cycle in two districts was done in October. This report covers activities that occurred during both the first and second spray rounds.

IRS project implementation was conducted in close collaboration with the National Malaria Control Program (NMCP), County Health Teams (CHTs) and local authorities in counties and districts, and the Environmental Protection Agency (EPA). The first round of spraying took 83 operational days, covering 14 districts, including 2 sites in the private sector. The second spray round took 31 operational days to complete and covered two districts.

Comment [FC(1]: How many days did the second round last?

Comment [BB2]: Noted and fixed.

The following are project achievements during the first and second rounds of spraying:

- AIRS Liberia trained 818 persons (82% male) on IRS delivery and operations over the two spray rounds. This included 756 spray operators, 16 clinicians (50% male) and 46 Training of Trainers (TOT) attendees (87% male).
- In the first spray cycle, a total of 96,901 eligible structures were sprayed out of 99,236 eligible structures found, resulting in 98% spray coverage. This exceeded the target of 80,000 structures. A total population of 869,707 people was protected, including 47,786 pregnant women and 145,845 children under 5 years.
- In the second cycle, a total of 21,152 eligible structures were sprayed out of 21,564 eligible structures found resulting in 98% spray coverage. A total of 196,279 people were protected, including 7,875 pregnant women and 28,860 children under 5 years.
- The IRS project conducted four susceptibility studies on three classes of insecticides, pyrethroids, carbamates and organophosphates. It was found that local mosquitoes in four IRS counties were resistant to pyrethroid insecticides (deltamethrin and cypermethrin); it was recommended that insecticide resistance management be implemented by switching to an organophosphate – pirimiphos-mehtyl – for the next spray season.
- Morphological and molecular identification of malaria vectors was also undertaken and it was found that *Anopheles gambiae* s.s. was the main malaria vector in the four IRS counties in Liberia.

Comment [FC(3]: Were some mobilizers also sprayers because 756+16+460 doesn't equal 818?

Comment [BB4]: Noted and fixed; only SOPs TOTs and clinicians should've been listed here.

AIRS LIBERIA AT A GLANCE

Number of districts covered by PMI-supported IRS in 2012	14 districts in 5 counties for Round One; 2 districts in 1 county for Round Two		
	Round 1	**Round 2**	**Total**
Insecticide	Carbamates: Margibi and Montserrado Pyrethroids: Grand Bassa, Bong, and Nimba	Carbamates	N/A
Number of structures covered by PMI-supported IRS in 2012	96,901	21,152	118,053
Number of structures targeted by PMI-supported IRS in 2012	99,236	21,564	120,800
2012 spray coverage	98%	98%	98%
Population protected by PMI-supported IRS in 2012	869,707	196,279	1,065,986 (including 55,661 pregnant women and 174,705 children under 5)
Dates of PMI-supported IRS campaign	March 23 – June 28, 2012	October 3 – November 9, 2012	N/A
Length of campaign	83 days	31 days	N/A
Number of people trained with USG funds to deliver IRS	665	153	818[1]

[1] This figure includes 16 clinicians trained after September 30, 2012.

I. INTRODUCTION

The year 2012 was the fourth year of indoor residual spraying (IRS) implementation in post conflict Liberia. The reintroduction of IRS has aimed to reduce malaria morbidity and mortality, save human lives and promote economic and social growth. The Africa IRS (AIRS) project's objectives were to spray 80,000 structures, build local capacity and transfer skills and knowledge in IRS planning, implementation, and environmental compliance, in addition to strengthening entomological monitoring with an emphasis on insecticide resistance surveillance and real-time efficacy monitoring.

The IRS operations in 2012 were conducted in 14 districts within five counties: Grand Bassa, Margibi, Montserrado, Bong, and Nimba. The first round of spray operations was conducted in two phases; in the first phase, spraying was conducted in the public sector while in the second phase, the spraying campaign was conducted in the private sector. The public sector campaign commenced on March 23rd and ended on June 2nd, and the private sector campaign began on June 5th and was completed on June 30th. The private sector spray campaign included providing support to spray the premises of Arcelor Mittal Liberia (AML), an iron ore mining company located in Yekepa, Nimba County with a base in Buchanan, Grand Bassa County. Because of the use of carbamate in two districts of the public sector, two spray rounds/cycles were conducted in those two areas. The second spray cycle started in the first week of October and ended November 9th 2012.

1.1 KEY IRS PROGRAM OBJECTIVES IN 2012

The two overall goals of the AIRS Liberia project were:

1. To contribute to the National Malaria Control Program (NMCP) and President's Malaria Initiative (PMI) goal of reducing malaria associated morbidity and mortality in the 14 selected districts located in five counties in Liberia.
2. To establish a model IRS program at the county and district levels that will set national performance standards and serve as a best practice model among national and international implementers.

The specific objectives for the 2012 spray campaign were:

- To achieve spray coverage of at least 85% percent of the target number of 80,000 structures in 14 selected districts.
- To strengthen the capacity for IRS implementation, monitoring and supervision at the national, district, and county levels.
- To support the NMCP to conduct entomological surveillance and monitor insecticide resistance and quality assurance of the program.
- To comply with environmental regulations and establish local capacity for best practices in the target districts for insecticide handling and usage for IRS.
- To establish an effective monitoring and evaluation system of IRS activities.

2. PRE-SPRAY ACTIVITIES

2.1 DISTRICT SELECTION AND GENERAL PLANNING

The IRS districts were selected based on Liberia's strategic approach to give priority to rural communities where the malaria burden is high, and also factor in technical and epidemiological considerations, and geographical and logistical information for cost-effective operations. The Ministry of Health and Social Welfare (MOHSW) policy on IRS strategy outlines three criteria to be taken into consideration in the selection of IRS sites:

- Areas with the highest malaria burden
- Under-served areas, in terms of access to health services
- Areas with relatively easy physical or geographical access

IRS implementation began from the coastal counties in the South Central region (Grand Bassa, Montserrado and Margibi) and moved into the interior counties of the North Central region (Bong and Nimba). The project targeted the 14 districts that were sprayed in the 2011 IRS campaign (see **Table 1** below). Among the concession areas, two sites controlled by Arcelor Mittal Liberia (AML Yekepa in Nimba and AML Loop in Buchannan) were sprayed as part of a public-private partnership.

Table 1: List of operational sites in the 2012 IRS campaign

County	Districts and Targeted Areas
Grand Bassa	Compound #1/ Worr; District # 2; Districts # 3A; # 3B; and # 3C; District # 4; Neekreen /Owen Groove/ Buchanan/ Commonwealth
Margibi	Mamba Kaba
Montserrado	Careysburg
Bong	Kokoya, Kpaai, Panta and Fuamah
Nimba	AML Concession Area owned by Arcelor Mittal

The first round of spraying was scheduled to commence in the second week of March 2012, in order to avoid any disruptions of the IRS campaign in areas that are not easily accessible during the rainy season that starts in late April. As part of the preparations and taking into consideration time constraints, the program heavily relied on demographic and geographic information used in the previous 2011 IRS campaign.

Initial IRS awareness and advocacy meetings were held with community leaders and district health authorities, which included numerous field visits. The AIRS project collaborated with local authorities and health authorities to select spray operators and community mobilizers, and also to encourage participation of the community at large. During this preparatory phase, the major activities consisted of the following: community awareness campaign on IRS activities, community leaders' meetings, and selection of spray operators and community mobilizers. A resource assessment was also conducted during this phase to determine the availability of IRS supplies and need gaps so that local and international procurement orders could be placed.

2.2 INSECTICIDE SELECTION

The selection of classes of insecticides that were to be used during the 2012 IRS campaign was done by the IRS Task Force during a meeting held on November 2, 2011. The IRS Task Force reviewed the susceptibility and bioassay data presented by RTI International (RTI) and decided that pyrethroid insecticides would be sprayed in the whole of Grand Bassa county and parts of Bong (Fuamah, Kokoyah, Panta & Kpaai districts) and Nimba counties. A carbamate was selected to be sprayed in Montserrado (Careysburg district) and Margibi (Mamba Kaba district) counties. The IRS Task Force is co-chaired by the Assistant Minister for Preventive Health in the MoHSW and the NMCP Program Manager and it has members from MoHSW, MoA, EPA, Department of Environmental and Occupational Health (DEOH), PMI/USAID Resident Advisors and other international and local partners working on malaria control in Liberia. Please refer to **Annex 1** and **Annex 2** for the data collected by RTI on susceptibility and the wall bioassay results, and **Annex 6,** which shows the minutes of the IRS Task Force meeting.

2.3 MICROPLANNING

Micro planning for spray operations took place in February. This exercise was facilitated by Abt Associates, and it involved officials from the NMCP, County Health Teams (CHTs) and local authorities (District Commissioners, County Superintendents and Clan Chiefs, as well as youth and women group leaders) from the selected 14 districts. An activity plan was prepared containing personnel requirements and criteria for staff recruitment and mobilization. The logistic requirements were outlined, which included the number of vehicles needed and locations of stores and soak pit sites, IRS equipment and insecticide requirements, the training schedule, and the commencement date for spray operations.

The following issues were highlighted during micro planning meetings:

- The need for the county, local authorities and community leaders to promote and support the IRS project: their support is needed to achieve community compliance and acceptability, which are essential to the success of the IRS program.
- The importance of recruiting IRS personnel from IRS districts: by recruiting personnel from the areas where we spray, it increases community confidence and promotes a sense of ownership of the program among the local communities. This in turn increased compliance and acceptability of the IRS program.
- The recruitment criteria was also discussed and the qualifications that were agreed upon were: minimum age (above 18 years), possessing academic qualifications required for each position, previous IRS experience, good reputation in the community, physical fitness, and knowledge of the terrain. In addition, prospective female recruits were not allowed to participate if they were pregnant or lactating during the spray exercise.

2.4 PROCUREMENT

Tables 2a, 2b, and 3 below list the items available in stock before the commencement of the spray campaign and those procured locally and internationally. The insecticide required for the 2012 spray campaign was procured and delivered in March, 2012; the amount was adequate to cover both spray cycles in 2012.

Table 2a: List of materials in stock and purchases made locally, first spray cycle

Description	Quantity in Stock Before IRS Campaign	Quantity Procured Locally	Total
Overalls	1,554	50	1604
Rain Boots	572	50	622
Nose Masks	4,628	21,000	25,628
Hand Gloves (Heavy duty)	832	1,200	2,032
Helmets	579	100	679
Helmets Inserts	0	87	87
Large Barrels	48	0	48
Medium Barrels	65	0	65
Small Barrels	13	0	13
Face Shields	579	500	1,079
First Aid Kits	0	100	100
Vitamin "E" Cream	1	200	201
Pregnancy Tests	50	150	200
Apo Furosemide tablets	0	3	3
Atrop 50 X1MC Ampules	0	13	13
Green Vests	85	0	85
Orange Vests	36	0	36

Table 2b: List of materials in stock and purchases made locally, second spray cycle

Description	Quantity in Stock Before IRS Campaign	Quantity Procured Locally	Total
Overalls	1,604 pcs	0	1,604 pcs
Rain Boots	350 pairs	100 pairs	450 pairs
Nose Masks	10,675 pcs	0	10,675 pcs
Hand Gloves (Heavy duty)	1,092 pairs	100 pairs	1,192 pairs
Helmets	679 pcs	0	679 pcs
Helmets Inserts	87 pcs	0	87 pcs
Large Barrels	48 pcs	0	48 pcs
Medium Barrels	65 pcs	0	65 pcs
Small Barrels	13 pcs	0	13 pcs
Face Shields	500 pcs	0	500 pcs
First Aid Kits	1 pack	100 packs	101 packs
Vitamin "E" Cream	16box	25box	41boxs
Pregnancy Tests Strip	0	100 Strips	100 strips
Apo Furosemide tablets	3 tins	0	3 tins
Atrop 50 X1MC Ampules	0	20 packs	33 pcks
Green Vests	70 pcs	0	70 pcs
Orange Vests	34 pcs	0	34pcs
Back bags	37pcs	300pcs	337pcs
Malaria Service Cards	6,000pcs	24,000pcs	30,000pcs
IEC/BCC Data Collection Forms	104,680pcs	5,000pcs	109,680pcs
Stock Cards	300pcs	2,000pcs	2,300pcs
Mobilizer Training Manuals	0	100pcs	100pcs

Description	Quantity in Stock Before IRS Campaign	Quantity Procured Locally	Total
Spray Operator Manual	0	200pcs	200pcs
Vehicle Log Sheets/Book	8pcs	15pcs	23pcs
Laundry Detergent	(150pcs in carton)13carton & 83pcs	40 carton	53cartons +83pcs
Tablet Soap for Washing	(60pcs in carton) 2cartons & 2pc	40 carton	42cartons + 2pcs
Bathing Soap	(72pcs in carton) 19carton & 34pcs	17 carton	36carton + 34pcs
Tissue	(36 in bags) 3bags & 33pcs	34bags	37 bags + 33pcs
Towel	0	600pcs	600pcs
White Chalk	13packs	50packs	63packs
Writing Pen	(50pcs in pack) 34packs & 40pcs	10packs	44packs +40pcs
Plastic Folder	8pcs	1,100pcs	1,108pcs
Paper Glue	19pcs	50pcs	69pcs
Hard Cover Ledger	15pcs	50pcs	65pcs
Correction Fluid	3pcs	50pcs	53pcs
Note Pad	30pcs	1,500pcs	1,530
Flip Chart	26pcs	12pcs	38
Marker	(12pcs in pack) 19packs & 1pc	5packs	24packs + 1pc
Flip Chart Stand	0	2pcs	2

Table 3: List of materials in stock and purchases made internationally

Description	Quantity in Stock Before the First IRS Cycle	Quantity Procured Internationally	Total
Insecticide: FENDONA	20,365	0	20,365
Insecticide: FICAM	1,544	42,000	43,544
Insecticide: K-Othrine	19	55,050	55,069
Spray pumps (10 liters)	230	0	230
Spray pumps (8 liters)	130	0	130
Spray canisters	100	0	100
Face Shield	500	250	750
Hardhat	671	300	971
Hardhat Suspension	87	500	587
Coverall	50	800	850
Back Pack	37	500	537
Hand Glove	1,092	2,000	3092
Respirator/Nose Marks	10675	15,000	25675
Insecticide Comp. Spray	10	420	430
Hose Assembly	10	120	130
Ward Assembly	0	800	800
Strip	0	120	120
Cotter Pin	0	120	120
Chain Cover	0	120	120
Cotter Pin	0	120	120

Cotter Pin	0	120	120
Spring	0	120	120
Valve Assembly	25	120	145
Cover Assembly	0	120	120
Gasket	0	120	120
Adaptor Supply Tube	35	120	155
O ring	0	120	120
Supply Tube	0	120	120
Filter	0	1,000	1,000
Gasket	10	1250	1260
Nozzle Tip	0	1,000	1,000
Extension Sub Assem.	0	150	150
Cup Replacement Kit	10	800	810
Gauge	1	100	110
Filter Assembly	21	1,000	1021
Gauge	0	120	120
Filter Assembly	0	120	120
Adaptor House	0	120	120
Supply Tube Adaptor	0	120	120

2.5 OPERATIONAL AND LOGISTICS ASSESSMENT

Logistics planning and coordination are core activities of an IRS campaign. The assessment of the logistics needs was part of the 2012 IRS work plan development, and it took place in the first three months of the planning stage of the IRS activities. Planning considered the budget vis-à-vis all AIRS project materials to be procured both locally and internationally. The logistics assessment also considered the geographical layout and accessibility to various IRS districts and communities. After careful planning and assessment it was agreed that 3 central warehouses, 12 regional stores, and 14 soak pits could support spray activities in 14 districts. The central warehouses and stores were rented from local communities and then refurbished to ensure optimal storage of project equipment and materials.

The main focus during the IRS operations was on warehouse management, transport management, commodity distribution, and utilization tracking. In addition, spray staff attendance and vehicle utilization were also closely monitored and tracked. A total of 3 field logisticians, 19 store keepers, and 3 logistics assistants were assigned to manage storage facilities used for the first spray cycle. Logistics management tools were introduced and utilized in the warehouses and all of the stores to ensure the security of materials and equipment in storage and in transit during IRS operations. During the second spray cycle only 2 districts were sprayed and 3 store keepers were assigned; one to manage the central warehouse and the other two each managed a sub-warehouse, located in Mamba Kaba and Careysburg.

2.6 HUMAN RESOURCE REQUIREMENTS

The logistics assessment performed during the planning stages revealed that on average one spray operator could spray 8 structures per day. The total number of targeted structures to be sprayed for the first cycle was 80,000 so it was determined that approximately 520 spray operators would be sufficient for the first round of the IRS campaign. In the second cycle, the total number of targeted

structures to be sprayed was 20,500, so it was determined that 110 spray operators would be sufficient to complete the work in approximately 28 days.

The spray operators were selected at the district level with assistance from the District Health Officers and local authorities from each of the operational districts, including the mayor and community leaders. The selection was done according to the following criteria: reading and writing ability, physical and medical fitness, and residence in the target community. Female spray operators were encouraged to apply. Staff members of the AIRS Liberia project actively contributed to the successful implementation of IRS through regular field visits to oversee and supervise spray activities. Abt Associates collaborated closely with the EPA and NMCP teams, who also monitored and supervised implementation of IRS activities.

2.7 TRAINING

The objective of the trainings was to build the capacity of the host country at the national and district levels to implement a well-organized IRS program. Training was organized in two parts, the training of trainers (TOT) at the national level and the training of spray operators and community mobilizers at the district level. Field workers' training took place in March 2012 for the first round of spray and September 2012 for the second round of spraying.

TRAINING OF TRAINERS (TOT) TRAINING

The TOT training was held for five days between February 28 and March 3, 2012 at the KTC training center in Monrovia in preparation for the first spray cycle. The training, which included both theoretical and practical sessions, was co-facilitated by officers from the NMCP (the Head of the IEC/BCC Unit & IRS Coordinators), the EPA and MoA. A total of 85 participants (80% male) attended the TOT training; among them were 46 spray operator supervisors, 18 warehouse clerks, 3 pump technicians, and 18 mobilizer supervisors. Topics covered during the TOT training were:

- Introduction to IRS.
- Hudson spray pump handling, use, assembly and maintenance.
- Insecticide use, handling, and safety.
- Environmental compliance.

The first day of training involved all participants because the topics covered were useful to all those involved in the IRS campaign. In subsequent training days, the group was split into two. The first group dealt with spraying operations and was designed for spray operator supervisors, store keepers and pump technicians. The topics included:

- Spray techniques.
- Spray supervision.
- Logistics management.
- Performance monitoring, M&E and data management.

The second group was for those involved in IEC/BCC mobilization and was designed for community mobilizer supervisors. The majority of the trainees had previous IRS experience, and thus, the training mainly served as a refresher course. During the second spray cycle that was conducted in areas sprayed with a carbamate, the TOT training was not conducted again because the facilitators had previous experience gained during the first cycle training and also had experience working on the IRS program.

SPRAY OPERATOR (SOP) TRAINING

During the first spray cycle, the spray operator training was conducted for all staff working on the 2012 IRS campaign in the 14 districts. The training was conducted for 3 days for those with previous IRS experience and there was an additional day for selected spray operators with no previous experience in IRS. Graduates of the TOT training conducted the spray operator training with the support of Abt staff, and facilitators from the NMCP and CHTs. The training had both theoretical and practical sessions.

Training at the district level involved a total of 619 spray operators (84% male) (**Annex 3**). In addition to spray operators, 78 washers (24% male), 72 security guards (100% male), 42 drivers (100% male), and 15 conveyors (93% male) received training on IRS protection measures against poisoning and prevention of environmental contamination by insecticides. During the second spray cycle in carbamate areas, a total of 137 spray operators (76% male) from the two districts Mamba Kaba and Careysburg) were trained in spraying technique. The training was facilitated by Abt, NMCP and CHT staff, and lasted three days **(Annex 4).**

A general medical examination was performed on all trainees by the District Health Officer in each district to assess their capability to perform IRS activities. All of the trainees were found to be physically fit to undertake the IRS campaign. In addition, all female spray operators and washers were tested for pregnancy. None were found to be pregnant, and therefore, all of them were allowed to work on the IRS program.

IEC MOBILIZER TRAINING

The majority of mobilizers were community health volunteers with strong visibility and extensive experience in health awareness campaigns in the community. The selected community mobilizers received a refresher training, which was conducted in each of the regions. In coordination with Abt and NMCP IEC/BCC officers, all mobilizer supervisors who attended the TOT training facilitated the refresher trainings. The training modules that were covered included:

- Introduction to IRS
- Communication basics and strategies
- Community entry approaches
- Overview of malaria parasite, transmission and control
- Data collection and reporting
- IRS messages (i.e., household preparation, handling of animals during spraying, safety measures and steps to take in case of exposure to insecticide)

A total of 386 mobilizers (80% male) from 14 districts were trained to conduct house-to-house mobilization during the first spray cycle of the IRS campaign. In the second spray cycle, 56 community mobilizers (68% male) were trained. The training was facilitated by Abt, NMCP and CHTs. The training took 2 days (**Annex 5**).

STOREKEEPER TRAINING

The storekeeper training was conducted at the KTC Centre in Monrovia for 18 storekeepers (44% male). The storekeepers' responsibility was to oversee operations in the 3 central warehouses and 9 sub-warehouses. The training included the following topics and was facilitated by the Abt Procurement/Logistics Coordinator:

- Proper storage procedures for insecticides and other IRS commodities.
- Inventory control.
- Material handling and transportation.
- Introduction and use of logistics management tools.

DATA ENTRY CLERK TRAINING

Five data entry clerks (80% male) were recruited and trained at the AIRS Liberia project office in Monrovia in preparation for first spray cycle data entry. However, as data from the field started streaming in, a workload assessment was done and it showed there was a need to increase the number of data entry clerks. An additional 7 clerks (86% male) were hired and trained to enable the program to meet the reporting deadlines to the client and partners and ensure quality data entry. The data clerk training module covered the following topics:

- Navigation of the AIRS Microsoft Access database.
- Introduction to data collection tools.
- Protocol for raising issues to the Database and M&E Managers
- Data quality control and assurance procedures.

On-the- job training and support to data entry clerks was provided by the Database and M&E Mangers and the Client Technology Center, located at Abt home office in Bethesda, MD. During the second cycle of spraying, five data clerks were selected from among the 12. The selection was based on their ability to meet the required number of entries per day with a minimal data entry error rate.

POISON MANAGEMENT TRAINING

A one-day poison management training workshop was conducted in October at the central warehouse facility in Schefflin, Margibi County. Several officers in charge of health care facilities, physician assistants, and drug dispensers from various health facilities in Careysburg and Mamba Kaba attended the training. Abt, NMCP trainers in malaria case management and the District Health Officers facilitated the workshop. The objective of the training was to acquaint clinicians with the skills to manage and treat poisoning related to insecticide exposure. Clinicians and drug dispensers were informed of the recommended drugs for managing carbamate or pyrethroid poisoning. The workshop also dealt with acute exposure symptoms and treatment from the field in case of an accident.

A total of 16 health care providers (50% male) attended the training workshop on poison management and the topics covered during the workshop were:

- Mitigation measures for residential exposure
- Measures to ensure safe pesticide transport
- Pregnancy testing
- Mitigating SOP's exposure
- Pesticide exposure and treatment
- Diagnosis and treatment of pesticide poisoning
- First aid and decontamination

A summary of all staff trained in IRS delivery throughout the project year, disaggregated by staff role, gender and spray round is provided in **Tables 4** and **5**.

MONITORING AND EVALUATION TRAINING

Early in 2012, the Abt home office held an internal Abt regional training for M&E and Operations Mangers in Tamale, Ghana. Both the AIRS Liberia M&E Manager and Operations Manager attended the training. The training involved both theoretical and practical sessions where the M&E tools were developed and standardized for the AIRS program to ensure high-quality and consistent data collection and recording. Tools were customized to country-specific situations.

Additionally, monitoring and evaluation curricula for TOT training for spray operators and mobilizers was developed and shared among the M&E Managers. The topics covered in this training included:

- Defining and understanding key definitions, like “household” and “eligible structure”
- Completing the data collection tools and the IRS card
- Roles and responsibilities of M&E and Database Managers
- Importance of accurate data documentation, data flow and data security protocols

The AIRS Liberia M&E and Database Managers later trained spray operators and community mobilizers on the topics mentioned above to ensure a high quality, cost-effective and efficient IRS campaign. Data entry clerks were also trained on how to use the AIRS Microsoft Access database for data entry and how to identify, correct or report errors. A total of 12 data entry clerks were contracted for spray round one and five were contracted for spray round two. Data clerks were selected on the basis of data entry speed and accuracy to ensure data were entered correctly and promptly to meet client reporting deadlines.

2.8 ENVIRONMENTAL COMPLIANCE

Prior to IRS operations, the Abt Environmental Compliance Officer, in close collaboration with the NMCP, carried out environmental compliance assessments and evaluated warehouses, stores and soak pits in the 14 districts for the first cycle and the 2 districts for the second cycle.

The following activities were conducted before the commencement of spray operations:

- An assessment of insecticide storage facilities and soak pits to establish compliance with relevant local and international environmental compliance laws and standards during spray operations.
- An environmental compliance monitoring plan and checklists for the insecticide storage facilities and soak pits were developed, as well as accidental contamination safety responses during spray operations.
- All soak pits were constructed and/or repaired to meet international standards.
- All degrading materials in the soak pits were well arranged according to prescribed dimensions.
- All warehouses were renovated and repaired to meet international standards prescribed for spray operations.
- Monitoring systems to track used insecticide sachets were established, and all storekeepers and washers were trained on the proper management of both storage facilities and soak pits.

ENVIRONMENTAL ASSESSMENT

In keeping with USAID’s environmental compliance procedures, Title 22 Code of the National Regulations Part 216 is a broad document with details on environmental impact assessment procedures. They are intended to enforce the requirements of the National Environmental Policy Act of 1970, as amended (NEPA). Title 22 CFR 216 applies to all USAID programs, projects, activities and substantive amendments. A supplemental Environmental Assessment (SEA) was carried out in 2009, in order to take into account environmental measures and mitigations which must be considered before embarking on the IRS program in Liberia.

The assessment was carried out by RTI in close supervision and consultation with the Environment Protection Agency (EPA) and was approved by the USAID Environmental Mission Officer in November 2009. This SEA is valid for 3 years from the date of approval. As a requirement, a Pre-

Spray Inspection Report (PSIR) and a Letter Report were submitted to the USAID Global Health Environmental Officer (GHEO). The approval of the PSIR and Letter Report by USAID was official approval to commence spraying activities in all areas targeted for the IRS campaign for 2012.

2.9 IEC ACTIVITIES AND COMMUNITY MOBILIZATION

Community mobilization is considered to be one of the core components of IRS. During the 2012 campaign, the IEC Coordinator worked closely with the NMCP, CHTs, and local authorities to raise awareness and seek support from local leaders and communities. The IEC Coordinator also worked with the Malaria Focal Persons, mobilizers, town announcers and spray operator team leaders from each of the 14 districts designated for spraying to conduct community mobilization campaigns.

In the first spray cycle, a total of 340 mobilizers (78% male) and 46 team leaders/supervisors (91% male) (**Table 4**) were involved in carrying out mobilization and sensitization of communities in all the 14 districts of the 5 counties. The mobilization and sensitization exercise lasted for 83 days. Mobilizers were required to inform households about the purpose and benefits of the IRS program and what was the role of the house owners before, during and immediately after spraying of the house. The mobilizers also collected data related to the eligible structures to be sprayed. Mobilizers used the pre-defined IEC/BCC Mobilization Form to collect data on households and structures. In addition, they handed out new IRS cards and retrieved IRS cards from previous spray rounds. The mobilizer documented the head of the household name and mobilization date and signed the IRS cards. Households were cautioned about the need to keep the cards in a safe and accessible part of the house. Mobilizers also distributed IEC materials, in the form of IRS brochures, to the communities.

Similar mobilization activities continued in the second spray cycle starting from the first week of October 2012, targeting Careysburg and Mamba Kaba districts only. Review and advocacy meetings were held with key stakeholders, and the key issues discussed included the acceptability of IRS and misconceptions concerning IRS, for instance claims that IRS increased mosquito populations. In addition, the recruitment criteria of mobilizers and spray operators and the code of conduct of hired staff were discussed at review meetings. After the review meetings, community leaders became more involved in the IRS program and the level of cooperation between the IRS program and communities improved, leading to many people accepting IRS, and in turn, spray coverage also improved.

Besides review meetings with community leaders, the communities were sensitized and mobilized to accept IRS through other means, which included house-to house visitation, radio talk shows and IRS advertisements on local radio stations. The mobilizers were also given refresher training to improve their skills in community mobilization for the IRS program. Also there was a change in strategy whereby mobilizers accompanied the spray operators to the communities that they had sensitized on the previous day.

Comment [F5]: Was this just for the second spray cycle? How did this change in strategy wor out?

Comment [ET6]: This strategy worked very w in the 2nd spray cycle, particularly the campaign conducted in Careysburg. Unlike Mamba Kaba, community leaders in Careysburg were very supportive of the IRS campaign.

IEC CHALLENGES

Despite the successes that were achieved during IRS mobilization, there were still a few challenges that were encountered. For instance, in areas where mobilizer recruitment was done solely by DHO (e.g., Mamba Kaba district), people engaged in other full time professions like teaching and health care provision were recruited. This affected the mobilization process because those recruited were not fully involved in mobilization since they had other duties to perform. This resulted in poor mobilization at the initial stages; however, after consultations, this was resolved by replacing them with those without full time employment.

Another challenge faced was related to other malaria control programs. Certain communities in Mamba Kaba district did not receive LLINs during the mass distribution campaign that was conducted by the NCMP and other partners. When IRS operations entered into such communities, it received resistance from the communities because they alleged discrimination in LLIN distribution, and therefore, would not allow IRS to be conducted in their communities. However, a meeting was held to discuss this issue and it was resolved.

IEC LESSONS LEARNED

The program observed that the recruitment of mobilizers and other staff involved in IRS could not be solely left to community leaders and DHO but should involve other stakeholders and the implementing partner to avoid discrimination and hiring of people already engaged elsewhere. Meeting with stakeholders and community leaders was very crucial in the harmonious operation of IRS activities. Also, closer supervision of sprayer operators is required to make sure that the mixing of insecticides was done properly and accurately.

IEC RECOMMENDATIONS

- Recruitment of mobilizers should be all-inclusive, involving Abt IEC/BCC officer, NMCP, community leaders and DHO.
- Because radio dramas and shows are successful in highlighting IRS benefits and dispels IRS misconceptions, these shows should be made a priority and key method for relaying the IRS message and IRS information via local radio stations in IRS target communities.

3. SPRAY ACTIVITIES

3.1 SPRAY OPERATIONS

After several months of preparation the actual spraying activity started in four counties on March 23rd 2012 in the public sector. The spraying took approximately 10 weeks and was concluded on June 30th 2012. Spraying was also conducted in the private sector through a public-private partnership from the 5th to the 30th of June. In the first spray cycle, over 1,200 seasonal field staff, which included 622 spray operators and 380 community mobilizers, including team leaders, were involved (**Table 4a**). In the second spray cycle, 110 spray operators were hired to spray in the two carbamate districts. Spraying commenced on October 3rd. A summary of the number and type of seasonal staff hired for the campaign is provided below (**Table 4b**).

Spraying in the public sector included a total of 102 teams, each comprised of five spray operators. On average, it took 26 days to complete spraying in one site. The duration of operations varied with the size of the site and access to remote communities. For example, it took 18 days to complete spraying in Panta district in Bong County and it took 34 days to complete spraying in Mamba Kaba district located in Margibi County (**Table 5a**). It took 28 and 31 days to complete the operation in Careysburg and Mamba Kaba (respectively) during the second spray cycle (**Table 5b**). The hiring process for seasonal staff was based on equity and effort was made to have gender balance as much as possible. Below are **Tables 6a** and **6b** showing the number of hired staff by district, spray cycle, and gender.

The spray operations were monitored by Abt staff, the NMCP, MOH and local officials from the communities. As part of capacity building in IRS implementation, government officers from NMCP, CHT and DHO served as IRS supervisors in various districts. There was a close working relationship and supervision between the Abt home office and field office in Liberia. The Director of Operations from the Abt home office visited Liberia during the first week of spray operations. The visit led to interaction between spray teams and the Director of Operations, and it improved the implementation of spray operations.

In spite of the challenges of bad road conditions and frequent breakdown of some of the hired vehicles, the movement of spray operators and other staff went uninterrupted. In total, 15 trucks and 25 Toyota Land Cruiser 4x4 vehicles were hired to support the IRS campaign for the first spray cycle. The allocation of vehicles varied depending on the terrain and road conditions in the area of operation. Most of 4x4 vehicles were allocated to support operational areas with poor roads such as District #2, District #3C, Fuamah and Mamba Kaba, or hard to reach communities located in other operational sites.

Table 4a: Number of Seasonal Spray Staff by District of Operation for the 1st spray cycle

Districts	Spray Operators	Team Leaders	Supervisors	Mobilizers	TL Mobilizers	Washers	Storekeepers	Dispatchers	Conveyors	Logistics Assistants	Security Guards	Cleaners	Pump technicians
Careysburg	40	8	2	25	4	4	1		0	0	3	0	0
Mambahn Kaba	55	11	3	30	3	4	1	1	0	1	3	1	1
Fuamah	41	7	3	20	3	16	2		3	0	12	0	0
Kokoyah	30	6	2	25	2	4	2	1	0	1	6	0	0
Kpaai	30	6	2	15	2	4	2		0	0	3	0	1
Panta	25	5	2	9	2	4	1		0	0	4	0	0
District 1	65	13	4	55	8	9	2		5	0	9	0	0
District 2	51	10	3	30	4	4	1	1	0	1	3	1	1
District 2B	35	7	2	20	3	9	1		4	0	10	0	0
District 3A &B	30	6	2	20	3	5	1		0	0	3	0	0
District 3C	23	4	2	10	2	7	1		3	0	9	0	0
District 4	25	5	3	20	3	4	1		0	0	3	0	0
Neekeen	70	14	4	55	7	4	2		0	0	4	0	0
Total	**520**	**102**	**34**	**334**	**46**	**78**	**18**	**3**	**15**	**3**	**72**	**2**	**3**

Table 4b: Number of Seasonal Spray Staff by District of Operation for the 2nd spray cycle

Districts	Spray Operators	Team Leaders	Supervisors	Mobilizers	TL Mobilizers	Washers	Storekeepers	Dispatchers	Conveyors	Logistics Assistants	Security Guards	Cleaners	Pump technicians
Careysburg	45	9	2	24	3	4	0	0	0	1	3	0	1
Mamba Kaba	65	13	3	28	3	5	1	0	0	2	3	1	1
Total	**110**	**22**	**5**	**52**	**6**	**9**	**1**	**0**	**0**	**3**	**6**	**1**	**2**

Table 5a: Number of spray teams, spray start dates & number of days of spraying, for first spray cycle

County	Districts	Type of Insecticide Used	Start date	Days of Operation	Number of spray teams
Montserrado	Careysburg	Carbamate	March 23, 2012	30	8
Margibi	Mamba Kaba	Carbamate	March 27, 2012	34	11
Bong	Fuamah	Pyrethroid	May 4, 2012	26	7
	Kokoyah	Pyrethroid	March 26, 2012	20	6
	Kpaai	Pyrethroid	April 23, 2012	22	6
	Panta	Pyrethroid	May 7, 2012	18	5
Grand Bassa	Neekeen	Pyrethroid	March 24, 2012	31	14
	District 1/Worr	Pyrethroid	March 24, 2012	27	13
	District 2	Pyrethroid	March 23, 2012	23	10
	District 2B	Pyrethroid	May 4, 2012	23	7
	District 3A &B	Pyrethroid	March 23, 2012	34	6
	District 3C	Pyrethroid	May 7, 2012	24	4
	District 4	Pyrethroid	March 23, 2012	25	5
Total					**102**

Table 5b: Number of spray teams, spray start dates & number of days of spraying, for second spray cycle

County	Districts	Type of Insecticide Used	Start date	Days of Operation	Number of spray teams
Montserrado	Careysburg	Carbamate	3-Oct-12	28	9
Margibi	Mamba Kaba	Carbamate	3-Oct-12	31	13
Total					22

Table 6a: Number of Seasonal District Staff by Gender, for first spray cycle

Position	Males	Females	Total

Spray Operators	434	86	520
Team Leaders	83	19	102
Supervisors	31	3	34
Field logisticians	2	1	3
Storekeepers	10	8	18
Store dispatchers	3	0	3
Conveyors	14	1	15
Pump Service Technicians	3	0	3
Washers	19	59	78
Cleaners/Janitors	3	0	3
Security Guards	72	0	72
Mobilizers	263	71	334
Mobilizers team leaders	42	4	46
Data Clerks	10	2	12
Total	**989**	**254**	**1243**

Table 6b: Number of Seasonal District Staff by Gender, for second spray cycle

Position	Males	Females	Total
Spray Operators	89	21	110
Team Leaders	11	11	22
Supervisors	5	0	5
Field logisticians	1	2	3
Storekeepers	0	0	0
Store dispatchers	1	0	1
Conveyors	0	0	0
Pump Service Technicians	2	0	2
Washers	2	7	9
Cleaners/Janitors	1	0	1
Security Guards	6	0	6
Mobilizers	36	16	52
Mobilizers team leaders	2	2	4
Supervisor mobilizer	2	0	2
Data Clerks	0	0	0
Total	158	59	217

Spray operations were smooth with no disruptions. There were fears that excessive rainfall would interfere with “hard to reach” areas where roads are impassable in the rainy season, but this was averted by spraying those areas before the onset of the rainy season.

Overall, the communities were generally receptive to the spray teams and appreciative of the IRS campaign. Daily spray operation activities commenced at 8AM and ended at 2PM. Spray data was collected by the spray operators, collated and verified by their team leaders, and then deposited at the stores. The supervisors then picked up the forms from the stores, checked them, and returned them to the Monrovia office. Delivery of data forms from each field site to the Monrovia office was

done at least twice a week. In some areas, particularly in hard to reach communities, there was a lag in time to collect the data forms and delivery to Monrovia took much longer.

In order to monitor the progress of spraying, the supervisors were required to send a daily summary of structures found and sprayed, population protected, and number of spray operators who worked, including information on insecticide usage. This summary data was sent as mobile text messages to the COP and Operations Manager. The daily summary data was valuable in determining the progress of the IRS campaign, and the information was used to strategically plan supervision visits. It also enabled the operations team to identifying sites that required more support.

3.2 PUBLIC PRIVATE PARTNERSHIP

The IRS public private sector partnership initiative involved Arcelor Mittal Liberia (AML), a mining company operating in Liberia. Spraying was conducted in two concession sites, AML Buchannan in Grand Bassa county and AML Yekepa in Nimba country. AIRS Liberia provided training, insecticides and Hudson spray tanks, whereas AML provided spray operators and paid the cost of spraying. The progress of spraying was extremely slow because AML allocated very few spray operators (only 5) and there were many absentee house owners because the majority of people work in the mines and they start their day shift very early (5AM) in the morning. Therefore, spray operators could not get access to the houses. Also, the spraying operations in the AML sites coincided with the departure of the Health Care Prevention Manager who was instrumental in coordinating the IRS activities with the mining company. Despite these problems, a total of 848 structures were sprayed in the concession areas, protecting a population of 5,916 people of which 13% (753) and 2% (100) were children under 5 years and pregnant women, respectively.

3.3 IEC ACTIVITIES AND COMMUNITY MOBILIZATION

Successful mobilization plays a key role in the success of an IRS spray campaign. Door-to-door mobilization was conducted to deliver messages concerning IRS. The messages informed the communities on when and how households should prepare for IRS. A day preceding spraying day, mobilizers visited the target communities to mobilize for IRS. On the day of IRS, a mobilizer directed and led the spray operators to mobilized communities for spraying. Mobilizers were assigned to spray teams and reported to the team leaders. The IEC Officer kept in touch with the team leaders to monitor the mobilizers' performance and progress. Prior to the commencement of mobilization, town announcers were sent to the communities and also radio talk shows were held to announce the spray schedule, promote compliance, and address any misconceptions or questions related to IRS. Mobilizers also distributed various IRS promotional materials, such as posters, brochures and T-shirts (**Table 7**).

Table 7: IEC materials distributed in intervention sites for 1st spray cycle

County	Posters	Brochures	T-shirts
Margibi	16,000	7,000	80
Montserrado	4,000	5,000	59
Fuamah	3,000	5,000	50
Bong	2,388	2,000	21
Grand Bassa	24,000	39,000	273
Sub - total	**49,388**	**58,000**	**483**
Margibi	6,000	4,500	
Montserrado	2,000	5,500	
Sub-total	**8,000**	**10,000**	

Several advocacy meetings were held in various communities that targeted the attention of local leadership and residents. The meetings were used as an entry point into the communities to notify and educate communities about the IRS campaign **Tables 8a** and **8b** show number of advocacy meetings and radio talk shows held during first and second spray cycles, respectively. The meetings were co-facilitated by Abt and NMCP staff.

Table 8a: Community mobilization campaign activities to raise awareness of IRS, 1st spray cycle

County	Location	Advocacy meetings	Radio talk shows
Margibi	Mamba Kaba	2	5
Montserrado	Careysburg	1	1
Grand Bassa	District 1 / Worr	2	0
	District 2	1	0
	District 3A & B & C	2	2
	District 4	1	0
	Neekreen/Buchanan	1	4
Bong	Fuamah	2	1
	Panta	1	0
	Kpaii	1	1
	Kokoyah	1	0
TOTAL		**15**	**14**

Table 8b: Community mobilization campaign activities to raise awareness of IRS, 2nd spray cycle

County	Location	Advocacy meetings	Radio talk shows
Margibi	Mamba Kaba	5*	4
Montserrado	Careysburg	3*	0
TOTAL		8	4

**Apart from official meetings with local leaders, at least 10 and 26 informal meetings were held in Mamba Kaba and Careysburg respectively, between IRS coordinators and town / community leaders prior to each spray day.*

Activities related to community mobilization were supervised by the Abt IEC/BCC Officer, NMCP staff, and CHT communication officers. Communication officers organized and participated in radio talk shows and facilitated discussions at community meetings involving local leaders to discuss and clarify any issues related to the IRS campaign. As communication officers interacted with the community, success stories and community testimonies on the effectiveness of IEC/BCC activities were documented.

3.4 LOGISTICS AND STOCK MANAGEMENT

Inventory control cards (ICC) were used for stock keeping and record tracking, and every item had a card associated with it. The cards are kept in the central warehouse and regional stores. At the regional stores, records of materials issued and received were recorded on the ICC with details of transactions and quantities involved. Weekly stock verification was conducted by the store keepers to ensure that the physical stock matched the records and to identify items that needed to be ordered from central warehouse.

All commodities at the central warehouses, such as PPE, were assigned a special identification number. Spray operators were also assigned identification numbers and whenever materials were handed out, the numbers were matched, such that SOP 1 was given PPE 1. Insecticides boxes in the stores were labeled with their intended destination. A dispatch note (quadruplicate copies) was used during the distribution process from the warehouse, which included a signed copy as proof of delivery to the operational site warehouse. The quantities of each item received were entered on the ICC.

An insecticide tracking form was used to track the stock of insecticide in every warehouse and the stores. The cards recorded information on the number of sachets issued to spray teams and the number of empty and full sachets returned after the day's work. Store keepers managed this process on a daily basis and alerted IRS program staff when discrepancies were observed. In addition, the store keepers prepared and submitted a comprehensive bi-weekly stock report to the Abt Logistics & Procurement Coordinator. The procurement reports were used to generate aggregated utilization data and helped to determine the quantity needed to order. The reports were important for planning insecticide distribution and provided the status of inventory items, as well as security across the warehouses.

3.5 ENVIRONMENTAL COMPLIANCE SUPERVISION

The IRS program must adhere to environmental standards and regulations, so the AIRS project worked closely with local EPA officials throughout the spray period. The environmental compliance inspections were conducted jointly by Abt and EPA to evaluate mitigation measures put in place during spray operations. These compliance inspections achieved the following objectives:

- Created a baseline of current compliance activities for the purpose of evaluating improvement in future IRS programs.
- Observed IRS activities in progress to determine and document whether the intervention was in full compliance with USAID requirements included in the approved SEA.
- Determined, in consultation with EPA officials, the training and support required to improve and ensure future compliance with the SEA.

- Ensured adherence to relevant international rules and regulations, including USAID regulations.
- Ensured accurate record keeping and daily collection of empty sachets.
- Ensured that progressive rinsing methods were used in all spray sites and ensured that leftover insecticide solution was re-used for spraying the next day to prevent environmental contamination.
- Ensured that SOPs, washers, team leaders and supervisors were knowledgeable of the correct way to handle and apply insecticides.
- Ensured that all persons involved in the spraying campaign used PPE at all times.

Inspection results showed that there was satisfactory environmental compliance. Environmental mitigation measures put in place were at the required standards and the EPA certified the spraying to proceed. There were no adverse events that occurred during the first and second spray cycles. After each spray cycle, the Abt ECO, in collaboration with NMCP and EPA, made sure that all the waste material generated during the IRS campaign was collected and safely disposed of. Below are **Tables 9a and 9b**, which provide details of all waste generated during the first and second spray cycles, respectively.

Table 9a: Details of waste generated during IRS campaign for 1st spray cycle

Type of waste	Amount of waste	Number of bags	Weight per bag (kg)	Total weight (kg)
Empty sachets	101833	46	20	920
Nose masks	12577	12	18.75	225
Hand gloves	800	4	30	120
Backpacks		23	16	345
Cardboard	100			
First aid kits	5	1		0.5
Total	**115315**	**86**	**84**	**1610**

Table 9b: Details of waste generated during IRS campaign for 2nd spray cycle

Type of waste	Amount of waste	Number of bags	Weight per bag (kg)	Total weight (kg)
Empty sachets	28754	18	15	270
Nose masks	7875	7	12	84
Hand gloves	587	3	25	75
Backpacks	262	5	13	65
Cardboard	170			
Total	**37648**	**86**	**84**	**494**

3.6 Development of new Supplementary Environmental Assessment (SEA)

Abt hired an Environmental Consultant to work with the ECO to update the existing SEA for Liberia. The consultant, together with the ECO, worked closely and in collaboration with EPA, MoA and

NMCP officials to update the SEA. The process involved not only meetings and inputs by experts, but also field trips by the team to assess and inspect IRS operations and to get input from other IRS program stakeholders, such as IRS beneficiaries who reside in IRS districts and local authorities. The consultant also inspected the soak pits and storage facilities and witnessed real-time progressive rinsing as it was conducted by the spray operators to assess their knowledge and operational skills. Field trips, besides inspections, also involved interviews to assess the community acceptance and assessment of the IRS program. A health official in Bong County noted that malaria cases dropped after the spraying was conducted. The Liberia environmental compliance team and local partners also conducted several field inspection trips. **Table 10** below shows the locations visited and the period of inspection during the IRS campaign.

Table 10: Environmental Compliance inspection visits conducted for the 1st and 2nd spray cycles

Spray cycles	Location	Pre-spray inspection	Mid spray inspection	End of spray inspection
First	Mamba Kaba	March 5,2012	May 3,2012	June 20,1012
	Careysburg	March 5,2012	May 3,2012	June 20,2012
	District 1 / Worr	March 7,2012	May 1,2012	June 20,2012
	District 2	March 7,2012	May 1,2012	June 19,2012
	District 3A&B&C	March 8,2012	May 2,2012	June 19,2012
	District 4	March 8,2012	May 2,2012	June 19,2012
	Neekreen/Buchanan	March 8,2012	May 1,2012	June 19,2012
	Fuamah	March 10,2012	May 2,2012	June 20,2012
	Panta(garmue)	March 12,2012	May 3,2012	June 21, 2012
	Kpaii (Zowienta)	March 12,2012	May 3,2012	June 21,2012
	Kokoyah	March 12,2012	May 3,2012	June 21, 2012
Second	Mamba Kaba	Sept 26,2012	Oct 27,2012	November 16,2012
	Careysburg	Sept 26,2012	Oct 27,2012	November 16,2012

4. POST-SPRAY ACTIVITIES

4.1 CLOSING IRS OPERATIONS

IRS operations for the first spray cycle officially ended on June 30, 2012. The end-of-spray review meetings (post spray conferences) were held during the first and second week of August 2012. Participants at the meetings included: NMCP, CHT, and selected members from the beneficiary communities (District Commissioners, Superintendents, Clan Chiefs, and Youth and Women leaders). The review meetings documented challenges encountered during the spray operations and lessons learned, as well as recommendations on how to improve implementation during the next spray cycle. The review meetings were used as a forum to discuss and provide feedback on the following topics:

- Recruitment of spray operators and mobilizers, re-training and motivation of spray teams
- Effective mobilization of the communities
- Quality of spraying and data collection

- Preventing pilferage of IRS materials and the role of community leaders
- Effectiveness of the spray campaign and positive feedback

Overall the feedback from the community during the review meetings was that the IRS campaign was received favorably because it contributed to malaria control efforts and it also providesd employment opportunities and a source of income for the local community. Community participants reported an immediate impact of IRS including the death of mosquitoes and other insects, and one house reported a snake was dislodged from the house after the spray. Participants felt that the awareness campaign was helpful because many misconceptions that the community had on IRS were clarified, thus increasing the community's understanding and acceptance of IRS. The community leaders from the Kokoyah district in Bong appreciated the opportunity to provide their feedback on the IRS campaign since it was the first time they attended a meeting organized by the implementing partner to hear the views from the beneficiaries. The community leaders were reminded that community support is important for the overall success of the IRS campaign and that the MOHSW and AIRS Liberia project staff would work closely with local authorities when they enter a community. The local authorities served as host and security for the program.

There was consensus that spray operators should be recruited from within the communities and local authorities or the Ministry of Internal Affairs should facilitate the process. However, the selection of spray operators should be guided by criteria required by the program. Spray operators should be literate and preferably with previous experience in IRS, and be physically fit to endure spraying operations. Community mobilizers should be recruited among the CHV who support health promotion activities through their CHT.

Overall, the awareness campaign and strategy used to disseminate health education related to IRS was received favorably by community members. Community mobilization through house-to -house awareness campaigns, radio broadcasts, and advocacy meetings with communities were considered the most effective ways to raise awareness and disseminate information on IRS activities.

Allegations related to insecticide pilferage were raised in the meetings held in Fuamah, Kokoyah and Careysburg. Overall, the community leaders agreed that such allegations on misuse of insecticide are not good for the program. Several suggestions were put forward to insure proper use of insecticide: community leaders should become good ambassadors of the IRS campaign and should help to monitor spraying activities, and spray operators should sign a code of good conduct. In addition, local authorities and the community at large should be vigilant and monitor spray operators to ensure proper insecticide use. If there is evidence that someone misused insecticide, they should be apprehended to aid prosecution of those found misusing insecticide.

4.2 LOGISTICS

Prior to end of the spray campaign, the Logistics & Procurement Coordinator embarked on re-orientation of the store keepers on what should be done at the end of spray operation, as well as commodity retrieval mechanisms. The store keepers were all provided with clearance forms which listed project materials with quantities issued to each field staff during the spray period. On the last day of operations, staff that returned all of their materials (especially those which are intended for reuse) were cleared for final payments by the store keepers and team leader or supervisor. All of the retrieved project items from the various operational stores were transported to the central warehouse in Schefflin.

Table 11: List of materials used during the first and second spray cycles

Item	Unit	Quantity Before the Campaign	Quantity Used	Remaining Stock after Campaign
First spray cycle				
Insecticide FENDONA	sachets	20,365	20,365	0
Insecticide FICAM	sachets	43,544	18,983	4786
Insecticide K-Othrine	sachets	55,069	46,313	8,756
Spray Cans (10 liters Hudson)	Pcs	230	230	230
Spray Cans (8 liters Hudson)	Pcs	130	130	130
Canisters (Hudson)	pcs	100	0	100
Overalls	Pcs	1,604	1,495	1,495
Rain Boots	Pairs	622	622	622
Nose Masks	Pcs	25,628	14,953	10,675
Hand gloves	pairs	2,032	940	1,092
Backpacks	pcs	655	612	37
First Aid Kits	Kits	100	99	1
Vitamin ''E'' Cream	pcs	201	185	16
Pregnancy Tests	pcs	200	200	0
Second spray cycle				
Rain Boots	Pairs	622	601	450
Nose Masks	Pcs	10,675	6185	4,490
Hand gloves	pairs	1,092	407	685
Backpacks	pcs	337	299	38
First Aid Kits	Kits	101	43	58
Vitamin ''E'' Cream	pcs	316	65	251
Pregnancy Tests	pcs	100	60	40

4.3 DEMOBILIZATION AND WASTE DISPOSAL

Retrieved materials transported and stored in the Schefflin warehouse included Hudson pumps, PPEs, used insecticide sachets, unused sachets, and other commodities. Barrels and buckets used for progressive rinsing and washing were also collected and stored during the demobilization exercise. Solid waste from the campaign, including packaging materials, empty insecticide sachets, torn gloves and used disposable nose masks, were packaged in black bin liners, and stored in the central warehouse awaiting incineration. The Environmental Compliance Officer supervised the retrieval of materials used by spray operators that were contaminated with insecticides (empty sachets, hand gloves and nose masks) to ensure that all environmental compliance procedures were followed. A post spray environmental compliance assessment was also completed and documented. All IRS waste was disposed at the facility managed by UNMIL Property Disposal Unit located at Star Base in Monrovia.

5. ENTOMOLOGY

The IRS program worked closely with the Vector Control Unit (VCU) of the NMCP and the Liberian Institute for Biomedical Research (LIBR) to conduct entomological monitoring for IRS program. The entomological indicators that were monitored included: identification of local malaria vectors; vector indoor resting densities; vector feeding behavior and feeding time; insecticide resistance and quality of spraying. The entomological activities were executed by Abt and the VCU of NMCP. Data collection tools were developed by Abt in collaboration with PMI.

5.1 STUDY SITES

Entomological monitoring was conducted in three south central counties (i.e., Grand Bassa, Margibi and Montserrado) and one north central county (i.e., Bong). Six sentinel sites were selected for monitoring entomological indicators for the IRS program. Among the six selected sites, four (i.e., Doemah, Bokay, Frank town and Palala) were sprayed, while two sites, Firestone Division 43 in Mamba Kaba District, Margibi County and Jiniepita in Jorkolleh District Bong County were not sprayed (**see Map**). Doemah in Mamba Kaba District, Margibi County was sprayed with bendiocarb (Ficam) on the 27th of April 2012. Bokay in District # one, Grand Bassa County was sprayed with pyrethroid (Fendona/K-Othrine) on the 26th of April 2012. Frank town in Careysburg District, Montserrado County was sprayed with bendiocarb on the 26th of April 2012, and Palala in Kpaai District, Bong County was sprayed with pyrethroid (K-Othrine) on the 27th April 2012.

Comment [F7]: Are these indicated on the ma below? I only see 4 PSC sites on the map.

Comment [Nd8]: The map is produced by the EMP project so we would need to request that the update it.

The monitoring of vector densities was conducted during both pre- and post-spray periods. The pre-spray surveillance was conducted in March 2012 and the post spray surveillance was conducted in June and September 2012. The pre-spray surveillance was conducted in three sentinel sites (Doemah, Bokay and Red Hill) while post spray surveillance was conducted in six sentinel sites (Firestone, Doemah, Frank town, Bokay, Palala and Jiniepita). However, due to significant ecological variation between Red Hill and other sites, using it as a sentinel site was discontinued and it was not further sampled. It was replaced by two control sites, Firestone 43 and Jiniepita.

5.2 VECTOR DISTRIBUTION, INDOOR DENSITY AND SEASONAL VARIATION

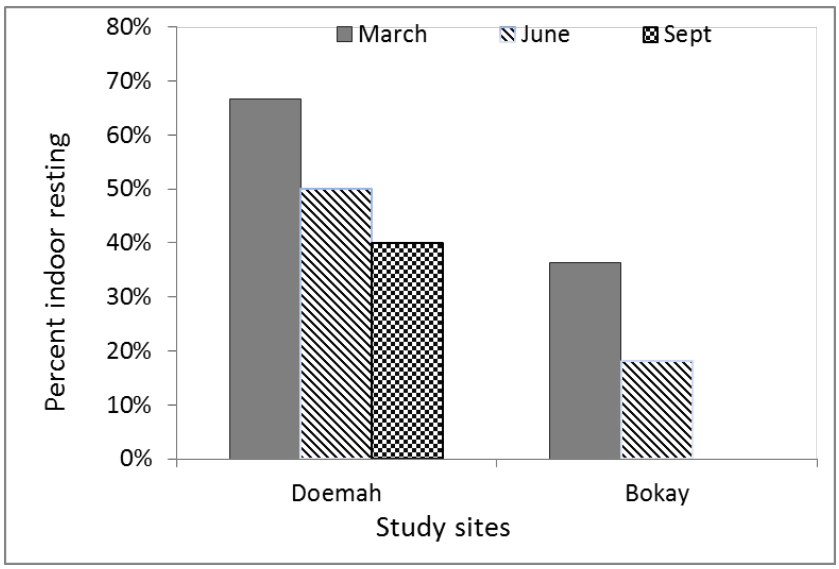
Indoor resting densities were monitored during pre- and post-spray periods. The pre-spray surveillance was conducted in March in three study sites (i.e., Doemah, Bokay and Red Hill); however, Red Hill was not sampled any further in the subsequent surveys due to significant ecological variation in comparison to the other two rural sites. Red Hill is a peri-urban area lying on the outskirts of Monrovia and all of the mosquitoes that were captured resting inside in March were *Culex*. The post-spray indoor resting density monitoring was conducted after the completion of the first spray cycle in June and September in six study sites (4 intervention sites and 2 control sites).

The distribution of indoor resting vectors was determined by sampling 10 randomly selected houses at each site using pyrethrum spray catch (PSC) between 6AM and 9AM. The distribution of houses with indoor resting malaria vectors in two sites that were sampled in both pre- and post-spray period is shown in **Figure 1** below. The distribution of houses with indoor resting vectors was higher in the pre-spray period than post-spray period in Doemah and Bokay Towns. In Doemah 66.7% of

sampled houses had vectors resting indoor and in Bokay 36.4% of houses had indoor resting vectors in pre-spray surveillance.

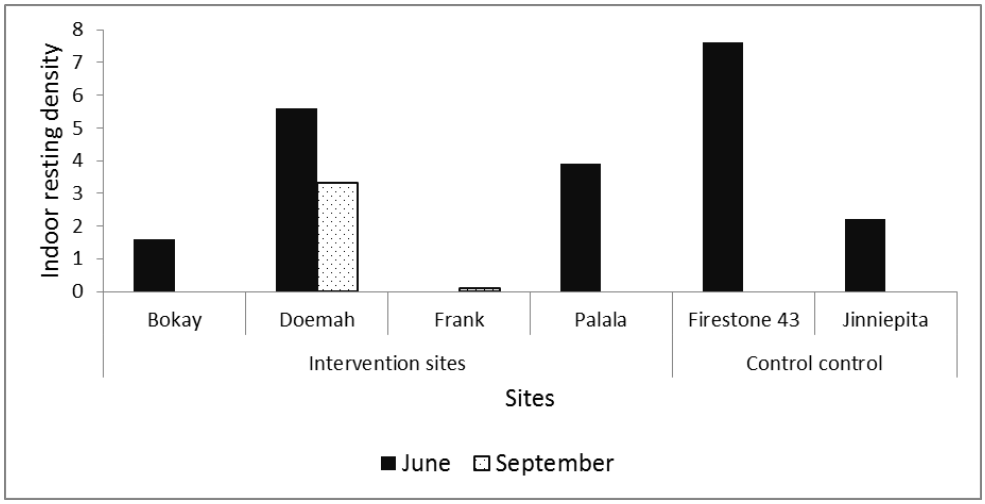
The post-spray sampling was conducted twice after the first spray cycle, and in Doemah the distribution of houses with vectors decreased 1.3 fold to 50% in June and 1.7 fold to 40% in September. In Bokay it was 18.8% in June and 0% September. The results show a reduction in the number of houses positive for indoor resting vectors after IRS. The observed difference could also suggest a seasonal variation in indoor densities; however, more data points are required for seasonal variation to be determined. Efforts will be made in the second year of spray to monitor monthly indoor resting densities in the sentinel sites that will be selected.

Figure 1: Distribution of houses positive for indoor resting vectors during the pre- spray (March) and post-spray (June and Sept) periods in two sites



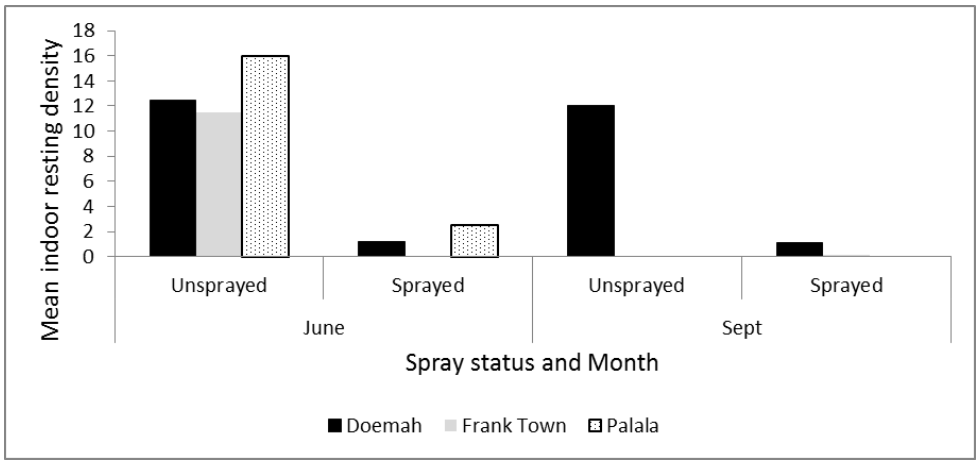
The post-spray indoor resting densities were also compared between intervention and control sites. Using PSCs 10 houses were randomly selected and sampled in 4 intervention sites and 2 control sites in June and September respectively. Indoor resting densities varied significantly between the intervention and control sites (**Figure 2**). Significant variation was observed between June and September, but this variation could not be explained by the effect of IRS alone because similar variation was also observed in the control sites. The variations could be related to seasonal variations in rainfall patterns. In the next spray year efforts will be made to conduct monthly indoor density monitoring and to establish rainfall patterns, which determine the availability of breeding habitats. Measures have been put in place to have at least 2 technicians from the NMCP permanently attached to AIRS program to conduct timely monitoring of all indicators.

Figure 2: *An. gambiae* s.l. indoor resting densities in intervention and control sites of IRS program



During the post-spray indoor resting density monitoring, unsprayed houses were occasionally sampled in circumstances that the sprayed houses were not accessible when house owners were absent. To assess the effect of spraying, the sampled unsprayed houses in the intervention areas were separated from sprayed houses and the indoor resting densities compared. **Figure 3** below shows the variation in the indoor resting densities in sprayed and unsprayed houses in 3 intervention sites. A significant variation was observed between sprayed and unsprayed houses. In Doemah unsprayed houses had a mean density of 12.5 vectors per house, in Frank town unsprayed houses had a mean density of 11.5 vectors per house, and in Palala unsprayed houses had a mean density of 16 vectors per house. The sprayed houses had indoor resting densities that ranged from 2.5 – 0.1 vectors per house in the three intervention sites. This observation could suggest that the populations sleeping in sprayed houses were protected and had a lower risk of malaria infection compared to those sleeping in unsprayed houses in the intervention sites. This information is important and should be shared among the IRS operations team and communities to improve awareness and also increase the acceptability of IRS by the communities.

Figure 3: Variation of *An. gambiae* s.l. in sprayed and non-sprayed houses in intervention areas



5.3 MONITORING VECTOR BITING CYCLE AND FEEDING BEHAVIOR

The human landing collections (HLCs) were conducted in six sites between 6PM and 6AM. The collection involved 4 collectors from the NMCP supervised by the Abt Technical Manager. Two collectors were stationed outdoors while the other two collectors were stationed indoors and they switched positions after every hour. The HLCs were used to determine the vector preferred feeding locations and pattern/cycle in the intervention and control sites. The HLCs were conducted in June after the first spray cycle and in October just before the commencement of the second spray cycle. In both June and October, a total of 124 *An. gambiae* s.l. were captured in the six study sites for 8 nights seeking to bite human baits outdoors and 73 vectors were captured during the same periods seeking to bite human baits indoors. **Table 12** below summarizes the hourly outdoor and indoor mean biting rates in the 6 sites. Two of the intervention sites (Doemah and Frank town), which were sprayed using bendiocarb, had the highest outdoor host seeking vectors compared to the indoor seeking vectors. There was no significant variation in the indoor and outdoor host seeking vectors in pyrethroid sprayed areas (Bokay and Palala) and the control sites. In bendiocarb sprayed sites the outdoor seeking vectors were 6-fold more than of those seeking indoor.

Table 12: Mean hourly outdoor and indoor biting rate of *An. gambiae* s.l. in six sites

Outdoor				**Indoor**	
Site	Human baits	Total vectors captured	Mean hourly biting rate	Total vectors captured	Mean hourly biting rate
Bokay	2	6	3.0	4	2.0
Firestone 43	4	29	7.3	17	4.3
Frank town	4	25	6.3	4	1.0
Jiniepita	2	10	5.0	8	4.0
Palala	2	12	6.0	12	6.0
Doemah	2	42	21.0	28	14.0
Total		124		73	

The results presented in **Table 12** suggest that in bendiocarb sprayed areas, vectors sought to bite human baits more outdoors than they attempted to bite human baits stationed indoors. This observation could suggest that vectors in areas sprayed with an effective insecticide would develop behaviors that limit the contact with sprayed walls. The development of such phenomenon among local vectors could still sustain malaria transmission in sprayed areas. Lack of significant variation in indoor and outdoor host seeking vectors in pyrethroid sprayed areas could suggest vectors were resistant and had become more tolerant to the repellency effect of pyrethroid insecticides. The HLCs were also used to determine the vector feeding pattern/cycle both indoors and outdoors. **Figures 4** and **5** below show the feeding patterns of vectors indoors and outdoors respectively. The feeding patterns show that the peak feeding occurs between 11PM and 3AM when most people are indoors and asleep.

Figure 4: The biting cycle of indoor host seeking *An. gambiae* s.l. in control and intervention sites

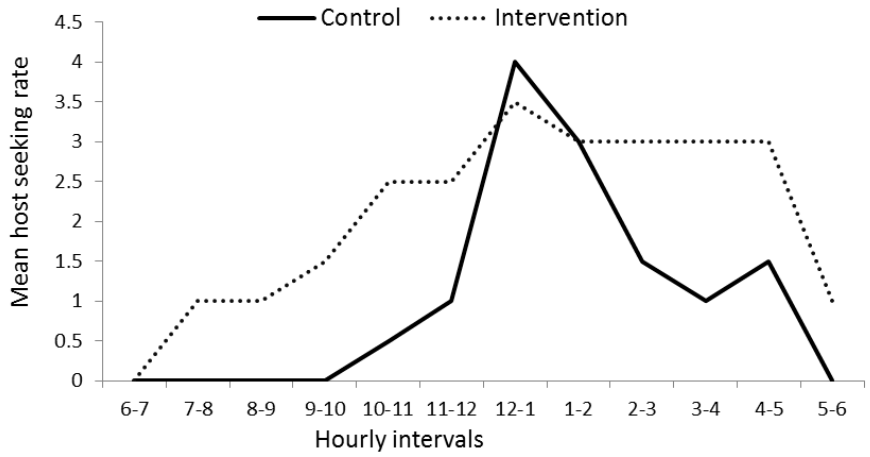
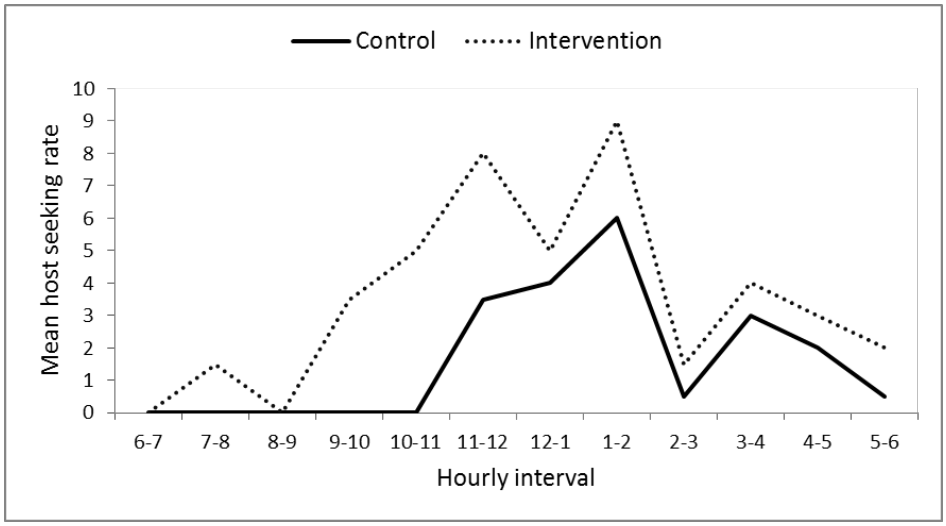


Figure 5: The biting cycle of outdoor hosting seeking *An. gambiae* s.l. in control and intervention sites



5.4 VECTOR SUSCEPTIBILITY AND RESIDUAL EFFICACY

CONE BIOASSAY

Cone wall bioassays to assess the quality of spraying and decay rate of insecticides were conducted in the four intervention areas between 10 days and two months post-spraying. Both wild caught indoor resting adults and those reared from field-collected larvae were used in the bioassays. The wild caught *Anopheles gambiae* mosquitoes were collected by indoor resting hand catches in Firestone Division 43 (control site). Larvae were collected in breeding habitats in Margibi County (Schefflin, Doemah Town and Robert's International Airport), then transported to the insectary at LIBR and reared to adult stages. Briefly, cone bioassays were conducted by exposing 10 to 15 adult female mosquitoes, aged 2 to 5 days, confined in WHO conical transparent chambers to either sprayed (test exposure) or unsprayed (control exposure) wall surfaces for 30 minutes. After expiry of exposure time (30 min), the knocked down mosquitoes were counted and recorded, then transferred to holding paper cups. The mosquitoes were then provided with 10% sugar solution soaked in cotton wool and after 24 hours holding period dead mosquitoes counted and recorded.

After the first spray cycle, cone bioassays were conducted in all four intervention sites; two sprayed with bendiocarb and two sprayed with pyrethroid. But after the second spray cycle in the 2 bendiocarb sites, the cone bioassay was conducted only in one site due to lack of sufficient mosquitoes to conduct experiments. The cone bioassay test mortalities in Doemah and Franktown were above 90% after the first spray cycle, which, according to WHO standards, suggests good quality spraying and that mosquitoes are susceptible to the insecticide applied. After the second spray cycle, similar results were observed in carbamate sprayed areas suggesting mosquitoes were susceptible to bendiocarb and also suggesting a good quality of spraying (**Table 12)**.

The mortality rates in Bokay in Grand Bassa and Palala in Bong were below 20%. These results suggested that exposed mosquitoes were either resistant to pyrethroids or quality of spraying was not up to standard. However, interpreting these results should be with caution because mosquitoes used in cone bioassays in these two areas were collected from Margibi County. This was necessitated because of the close proximity of larval breeding sites in Margibi County to the LIBR insectary compared to either Bong or Grand Bassa. It was much easier to collect and rear a large number of mosquitoes from Margibi than from Bong or Grand Bassa because of long distances between the two counties and the insectary. Therefore, the mosquitoes from Margibi were used in all cone bioassays. Using mosquitoes from Margibi, which had been sprayed with bendiocarb due to previously observed resistance to pyrethroids in this area, could explain the low mortality rates in cone bioassays in Grand Bassa and Bong counties. Lack of a susceptible strain to assess the quality of spraying was a challenge. Nevertheless, suspected poor quality of spraying to the observed low mortality rates could not be ruled out. Therefore the Operation department increased supervision of spray operators to ensure standard spray procedures were followed and enforced.

If measures were put in place to have a functional insectary for mosquito rearing, this would have mitigated the challenges encountered in year one of IRS. With a functional insectary, even indoor resting mosquitoes can be collected from far away counties then allowed to lay eggs in the insectary and the F1 generation could be used for experiments (wall bioassay and susceptibility studies). The use of larval samples required several trips shuttling between the insectary and the field, and in the case where the field is far, this is not possible in absence of a field insectary, as it was here.

Table 13: Cone bioassay 24-hour mortality rates of *An. gambiae* s.l. after exposure for 30 minutes on sprayed walls

District	Study site	Insecticide sprayed	Spray date	Bioassay date	Days post spray	Total tested	Dead after 24hr	% test mortality	Total control	Dead control	% control mortality
Mamba Kaba	Doemah	Bendiocarb	27/04/2012	7/5/2012	10	99	95	95.96	20	2	10.00
District one	Bokay	K-Othrine	26/04/2012	12/5/2012	18	154	16	10.39	30	1	3.33
Careysburg	Frank town	Bendiocarb	26/04/2012	26/06/2012	60	97	90	92.78	10	0	0.00
Kpaai	Palala	K-Othrine	26/04/2012	29/06/2012	60	109	6	5.50	10	0	0.00
District one	Bokay	K-Othrine	26/04/2012	25/06/2012	60	101	1	0.99	10	0	0.00
Mambahn Kaba	Doemah	Bendiocarb	26/04/2012	3/7/2012	60	105	71	67.62	10	0	0.00
Careysburg	Frank town	Bendiocarb	18/10/2012	5/11/2012	17	74	72	97.30	10	0	0.00

SUSCEPTIBILITY STUDIES

The scaling up of IRS programs in most African countries has exposed malaria vectors to selection pressure for insecticide resistance that is more intense and consistent. The intense insecticide pressure could favor the spread of genes conferring resistance in vector populations. It is important, therefore, that IRS programs are monitored to ensure that applied insecticides are efficacious and the mosquitoes are responding to the programs in an expected manner. The monitoring of susceptibility of vectors to three classes of insecticides was conducted for the Liberia IRS program to evaluate resistance levels, efficacy and provide evidence that could inform the IRS task Force decision in the selection of insecticide for next year's IRS campaign.

The World Health Organization (WHO) tube test was used to assess the susceptibility of local vectors in the four IRS counties. The susceptibility studies were conducted in May, August, September and November in year one of the AIRS program. Mosquitoes used for susceptibility studies were female *An. gambiae* s.l. aged 2 – 5 days, and samples were collected from larval breeding habitats in four IRS counties. The larval stages were reared at the LIBR insectary and in other makeshift "insectaries" in the field. Between 20 and 25 female mosquitoes were exposed to the insecticide-impregnated filter papers in the WHO test tubes, for 60 – 90 minutes. Each experiment was run alongside a control sample. In Margibi, a total of 260 samples were tested against deltamethrin and the observed mortality rates for the test samples ranged from 29.4% - 84%, an indication that *An. gambiae* s.l. were resistant to deltamethrin. Additionally, in Margibi, 220 samples were tested against cypermethrin and the observed mortality rate was 78.3%, also indicating resistance. In Montserrado 157 samples were tested against deltamethrin, and the observed mortality was 31% - 60.4%, again indicating resistance. Furthermore, in Montserrado 100 mosquitoes were exposed to cypermethrin, and 53% mortality was observed, also an indication of resistance. Mosquitoes from Grand Bassa showed 12% mortality against deltamethrin, and from Bong 92 mosquitoes exposed to deltamethrin showed a mortality rate of 58% (**Table 14**). These results indicate that *An. gambiae* s.l. in the four IRS counties were resistant to pyrethroid insecticides.

Comment [F9]: Do you mean alphacypermethrin?

Comment [Nd10]: We actually did test cypermethrin, not alphacypermethrin.

Comment [F11]: Alphacypermethrin?

Comment [Nd12]: Same as above.

Susceptibility studies were also conducted on two organophosphate insecticides (fenitrothion and pirimiphos-methyl). In Bong county 143 mosquitoes were tested against fenitrothion and observed mortality was 93.7%, and in Margibi mortality against fenitrothion was 97.3%. Susceptibility studies against pirimiphos-methyl were conducted on 81 mosquitoes from Bong and 91 mosquitoes from Margibi, respectively. Both studies showed that mosquitoes were susceptible to pirimiphos-methyl because the observed morality in both cases was 100%. Also studies also showed that mosquitoes from Margibi were susceptible to bendiocarb because the observed morality was 100% (**Table 14**). The results showed that *An. gambiae* s.l. were susceptible to pirimiphos-methyl and bendiocarb. For fenitrothion, results showed an indication of emerging resistance. It is recommended that more studies be conducted on fenitrothion with samples from all the IRS counties to establish the resistance and susceptibility levels of this insecticide in local mosquito populations.

INTERPRETATION OF SUSCEPTIBILITY FINDINGS

Data presented here are from susceptibility studies conducted using local mosquitoes from four IRS counties. Results strongly suggest that local *An. gambiae* s.l., which is the main malaria vector in the counties, are resistant to insecticides belonging to the pyrethroid class. Results also show that the main malaria vectors are susceptible to bendiocarb and pirimiphos-methyl, but there is an indication of resistance in local vectors against fenitrothion. There has been over dependence on pyrethroid insecticides in malaria control programs since pyrethroid insecticides are the only class of insecticides used in WHOPES-recommended nets. The widespread use of LLINs in Liberia could be a contributory factor to the increased resistance against pyrethroid insecticides.

RECOMMENDATIONS

There is an urgent requirement to immediately implement insecticide resistance management in the IRS program following evidence that local mosquito populations are resistant to pyrethroid insecticides. A rotation management strategy is recommended and the IRS Task Force should consider selecting pirimiphos-methyl as a preferred insecticide for year 2 of AIRS IRS. Pirimiphos-methyl belongs to the organophosphate class of insecticides, which have a different mode of action against mosquitoes from that of pyrethroids. Replacing pyrethroids will ease selection pressure and may make the mosquitoes susceptible to pyrethroids again for use in future control programs. The carbamate bendiocarb could be another option, but the short residual efficacy of bendiocarb would require twice-yearly spraying. The recommended pirimiphos-methyl is Actellic CS, which has a longer effective period of 9 months and would only need to be applied once per year.

Table 14: A summary of susceptibility tests results conducted in the Year 1 of AIRS IRS program

Date	County	District	Site	Insecticide tested	Number exposed	# dead after 24 hrs	% test mortality	Total in control	% control mortality
May-12	Margibi	Mamba Kaba	Schefflin, Doemah, RIA, Cotton Tree	Deltamethrin	100	84	82.2*	100	10
May-12	Margibi	Mamba Kaba	Schefflin, Doemah, RIA, Cotton Tree	Cypermethrin	220	177	78.3*	220	10
May-12	Montserrado	Careysburg	Findel, Mount Barclay	Deltamethrin	73	47	60.4*	60	10
Aug-12	Montserrado	Careysburg	Findel, Mount Barclay	Deltamethrin	84	26	29.2	80	2.5
Aug-12	Margibi	Mamba Kaba	Schefflin, Doemah, RIA, Cotton Tree	Deltamethrin	160	47	29.4	140	0
Aug-12	Grand Bassa	District # One	Owen Groove, Neegeewein	Deltamethrin	25	3	12.0	20	0
Sep-12	Margibi	Mamba Kaba	Schefflin, Doemah, RIA, Cotton Tree	Bendiocarb	44	44	100.0	20	0
Sep-12	Montserrado	Careysburg	Findel, Mount Barclay	Cypermethrin	100	53	53.0	60	0
Oct-12	Bong	Kpaai and Kokoya	Palala, Kpaai, Botota, Zoenta	Fenitrothion	143	134	93.5	40	2.5
Oct-12	Margibi	Mamba Kaba	Doemah	Fenitrothion	40	39	97.5	10	0
Nov-12	Margibi	Mamba Kaba	Cotton Tree	Pirimiphos-methyl	91	91	100	15	0
Nov-12	Bong	Jorkolleh	Gbarnga	Deltamethrin	68	40	58.8	20	0
Nov-12	Bong	Kpaai	Palala, Tomato Camp, Green Hill	Deltamethrin	101	52	51.2	20	0
Nov-12	Bong	Kpaai	Palala, Tomato Camp, Green Hill	Pirimiphos-methyl	81	81	100	14	0

*Abbot formula corrected mortality

Comment [ET13]: Yes corrected mortality if 29.2%

Comment [F14]: Would corrected mortality be 29.2%?

Comment [ET15]: Yes, corrected mortality if 93.5%

Comment [F16]: Would corrected mortality be 93.5%

5.5 MOLECULAR ANALYSES

A subset of mosquitoes from larval collections from three counties, Margibi, Bong and Montserrado, identified morphologically to be *An. gambiae* s.l. were sent to CDC Atlanta for *An. gambiae* sibling species identification by molecular analyses using polymerase chain reaction (PCR). There were 16 samples from Margibi, 43 from Bong, and 24 from Montserrado. Analysis showed that all samples that resulted in an amplification product were *An. gambiae* s.s. (**Table 15**). These results therefore confirm that the main malaria vector in the IRS counties is *An. gambiae* s.s. However, it should be pointed out that during larval sampling the breeding habitats that were mainly prospected had characteristics suitable for *An. gambiae* mosquitoes, efforts will be made to prospect and sample other breeding sites so that other anopheline species present can be identified. This will be made possible with the supplemental enhanced entomology activities that will run concurrently as part of the AIRS program.

Table 15: Molecular species identification on subset of mosquitoes in three IRS counties

Site	Number of samples analyzed	*An. gambiae* S form	*An. gambiae* M form	Unidentified
Margibi	16	1	14	1
Bong	33	19	10	17
Montserrado	24	0	14	10

5.6 ENTOMOLOGICAL TRAINING

One of the IRS program objectives is to develop local capacity in IRS implementation and monitoring. During the entomological monitoring of the IRS program, Abt worked in close collaboration with NMCP vector control technicians and coordinators to monitor indoor resting densities, to conduct HLCs, cone bioassays and susceptibility studies. This close working relationship enhanced the NMCP's capacity to conduct fieldwork and do monitoring of insecticide resistance. In addition to the fieldwork, a one day workshop was organized by CDC and Abt, in collaboration with NMCP, to train NMCP and CHT technicians in the CDC bottle bioassay technique for susceptibility testing. The training was facilitated by a representative from the CDC (Dr. Hoel) and the Abt Technical Manager. The workshop covered an overview of the WHO susceptibility tube test, of which most trainees were familiar with, and a practical session on the CDC bottle bioassay. A total of 14 trainees attended the workshop and the list of workshop trainees is provided in **Table 16** below.

Table 16: The entomology training workshop on CDC bottle bioassay trainee list

Name	Position	Organization
Blamo Sieh	Vector Control Technician	NMCP
S. Mark Chesson	Vector Control Technician	NMCP
George Dehnue	Vector Control Technician	NMCP
James Lamah	Vector Control Technician	NMCP
Agnes Nador	Vector Control Technician	NMCP
Kortoson Pellewwen	Vector Control Technician	NMCP
Wollo Jetor	Vector Control Technician	NMCP
F.K Dares sr.	Vector Control Technician	CHT
Benjamin Sollo	Vector Control Technician	CHT

Chrispin Williams	Vector Control Technician	NMCP
Wilfred Jorto	Vector Control Technician	CHT
Bismark Wleh	Vector Control Technician	CHT
Gracella Cooper	Vector Control Technician	NMCP

6. MONITORING AND EVALUATION

6.1 APPROACH AND KEY OBJECTIVES

The implementation of the AIRS Project in Liberia adopted the lessons learned from other countries, as well as those learned from the previous IRS implementer in Liberia:

- To emphasize accuracy of both the data collection and the data entry process through comprehensive trainings and supervision at all levels
- To streamline and standardize data flow to minimize errors and facilitate timely reporting
- To ensure IRS data security and storage for future reference through establishment and enforcement of proper protocols
- To build capacity for implementation of a high quality IRS operation

6.2 DATA FLOW

The data flow process begins with the primary data collectors (i.e. mobilizers and spray operators), and then data are reviewed and transmitted to team leaders/supervisors and regional coordinators, who in return transfer the data to the data entry center for the Database and M&E Managers and data entry clerks.

The data flow is divided into two parts as given below:

1. Mobilizers visit communities to provide education and information of the upcoming IRS campaign via door-to-door sensitization. They provide one IRS card to each household with at least one eligible structure and collect demographic information on the IEC/BCC Mobilization Form. Next the mobilizers submit the completed data forms to the supervisors who, in turn, review and forward the data forms to IRS Regional Coordinators for verification before submitting the data forms to the data center for review by the Database and M&E Managers and entry into the database by data clerks. The IRS Cards issued to residents serve as a reference document for spray operators during the spray campaign since they contain the IRS Structure Serial number.

2. Spray operators (SOPs) are the primary data collectors of spray data that is recorded on the Daily Spray Operator Form. Completed spray forms are verified and approved daily by each team leader and submitted to their respective supervisors for further verification. Subsequently, spray forms are delivered to Regional Coordinators for verification and then are delivered to the data center. Data forms are reviewed by both the Database and M&E Managers and finally given to the data clerks for a final review and entry into the database.

6.3 SUPERVISION AND DATA QUALITY CONTROL

As noted in Section 6.2, each Mobilizer Form and Daily Spray Operator Form is verified by respective team leaders and supervisors for arithmetic accuracy, data consistency and integrity before being forwarded to the Regional Coordinator who delivers the data forms to the Database and M&E Managers for further verification. When a data error was identified in the submitted forms, the M&E Manager either communicated with the Regional Coordinator or visited the field staff to resolve the issue and reinforce the proper data collection methods.

Additionally, two types of random spot checks were conducted to ensure data quality: (1) team leaders and supervisors conducted field checks on a sample of spray forms where they crosschecked data on the spray forms with residents in sprayed structures; and (2) the M&E and Database Managers performed random checks on a sample of forms to ensure the data on the spray forms were consistent with data entered in the database.

6.4 REPORTING

During both spray campaigns, weekly spray progress reports were prepared and submitted to PMI. The reports included data on five core AIRS indicators to track spray activity and spray operators performance.

The first spray round was completed successfully with a spray coverage of 98% representing 96,901 eligible structures sprayed out of 99,236 eligible structures found. A total of 869,707 people were protected of which 47,786 were pregnant women (5.5%) and 145,845 were children <5 years old (16.8%) (**Table 17a)**. A total of 83,146 mosquito nets were available in the target communities in the five counties, where 23,454 pregnant women and 43,224 children <5 years had reported sleeping under a net the previous night (**Table 17a**).

The second spray cycle was conducted in only two districts that had been sprayed with carbamates during the first spray cycle. Six weekly spray reports were submitted to PMI. In total, 21,152 eligible structures were sprayed out of 21,564 eligible structures found (**Table 17b**) indicating a spray coverage of 98%. During the same spray cycle, a total population of 196,279 was protected, including 7,875 (4%) pregnant women and 28,860 (15%) children <5 years old. Of the total 13,540 mosquito nets reported available in the target communities, 2,857 pregnant women and 7,081 children under 5 years old reported sleeping under a net the previous night.

The number of insecticide sachets used in the first spray cycle to spray 96,901 structures was 81,691 sachets, averaging 1.2 structures per sachet of insecticide. Each spray operator used an average of 6.6 sachets of insecticide per day. The average spray performance for all districts was approximately 8 structures per spray operator per day, with 6.5 for Mamba Kaba, 9.4 in District # 4 and 11.6 for Yekepa (**Table 18a**). In the second spray cycle, 19,705 insecticide sachets were used to spray 21,152 structures, yielding an average of 1.1 structures sprayed per sachet. Spray operators sprayed on average 7.2 structures a day (**Table 18b**).

Comment [ET17]: This has been updated.

Comment [F18]: This is an incomplete though

Table 17a: Spray coverage and population protected by district, 1st spray cycle

County	District	Structures Found	Structures Sprayed	% Structure Sprayed	Population Protected	Population Not Protected	% Population Protected	Pregnant Women in Sprayed Structures	Children <5 in Sprayed Structures	Mosquito Nets		
										Total Available	Pregnant women sleeping under nets	Children <5 sleeping under nets
Montserrado	Careysburg	9,411	9,103	97	75,875	2,028	97	3,687	11,917	5,288	1,814	2,951
Margibi	Mamba Kaba	12,575	12,441	99	106,987	558	99	5,394	14,538	21,147	3,617	8,611
Grand Bassa	Compound #1/ Worr	17,377	16,714	96	143,842	5,863	96	7,996	24,180	5,522	2,124	3,101
	District # 2	11,369	10,788	95	83,304	4,356	95	5,954	15,014	6,404	2,287	3,564
	District # 3 a&b	11,044	10,936	99	106,825	666	99	6,709	21,341	14,702	4,948	8,902
	District # 3 c	1,525	1,522	100	13,569	34	100	1,094	2,716	2,591	775	1,348
	District # 4	5,472	5,432	99	47,179	284	99	2,554	7,664	2,255	793	1,251
	Neekreen/ Buchanan/ Commonwealth	10,219	10,141	99	107,540	809	99	5,447	15,741	7,036	2,025	3,787
Bong	Fuamah	6,553	6,410	98	52,408	602	99	2,901	9,483	5,395	1,655	2,841
	Kokoyah	4,247	4,201	99	36,360	343	99	1,783	7,412	2,087	724	1,371
	Kpaai	5,299	5,097	96	55,970	145	100	2,444	9,159	6,435	1,421	2,999
	Panta	3,297	3,268	99	33,932	243	99	1,723	5,927	3,854	1,217	2,178
Nimba AML	Yekepa AML	848	848	100	5,916	-	100	100	753	430	54	320
	Total	**99,236**	**96,901**	**98**	**869,707**	**15,931**	**98**	**47,786**	**145,845**	**83,146**	**23,454**	**43,224**

Table 17b: Spray coverage and population protected by district, 2nd spray cycle

Comment [ET19]: This table has been updated

County	District	Structures Found	Structures Sprayed	% Structure Sprayed	Population Protected	Population Not Protected	% Population Protected	Pregnant Women in Sprayed Structures	Children <5 in Sprayed Structures	Mosquito Nets		
										Total Available	Pregnant women sleeping under nets	Children <5 sleeping under nets
Margibi	Mamba Kaba	11,595	11,540	>99	116,268	486	99.6	4,394	17,766	10,923	1,860	5,594
Montserrado	Careysburg	9,969	9,612	96	80,011	2,676	96.8	3,481	11,094	2,617	997	1,487
	Total	**21,564**	**21,152**	**98**	**196,279**	**3,162**	**98.4**	**7,875**	**28,860**	**13,540**	**2,857**	**7,081**

Table 18a: Insecticide consumption & performance of spray operators in 1st spray cycle

		Insecticide consumption			Spray Performance		
Districts	Structures Sprayed	Sachets Issued	Sachets used	Lost / damaged	Structures / Sachet	Structure / SOP	Sachets / SOP
Careysburg	9,103	9,000	8,842	0	1.03	7.9	7.6
Mamba Kaba	12,441	11,740	10,643	0	1.17	6.5	5.5
Compound # 1/Worr	16,714	11,745	11,471	0	1.46	8.6	5.9
District # 2	10,788	10,352	9,604	0	1.12	7.2	6.4
District # 3 a&b	10,936	10,383	10,316	0	1.06	8.4	7.9
District # 3 c	1,522	1,240	1,240	0	1.23	7.2	5.9
District # 4	5,432	3,883	3,830	0	1.42	9.4	6.6
Neekreen/Buchanan/ Commonwealth	10,141	8,368	8,247	0	1.23	6.9	5.6
Fuamah	6,410	6,097	5,908	0	1.08	6.5	6
Kokoyah	4,201	3,444	3,440	0	1.22	7.7	6.3
Kpaai	5,097	4,446	4,426	0	1.15	7.8	6.7
Panta	3,268	3,165	3,155	0	1.04	8	7.8
Yekepa AML	848	1,024	569	0	1.49	11.6	7.8
Total	96,901	84,887	81,691	0	1.2	7.9	6.6

Table 18b: Insecticide consumption & performance of spray operators, 2nd spray cycle

		Insecticide consumption			**Spray Performance**		
Districts	Structures Sprayed	Sachets Issued	Sachets Used	Lost / Damaged	Structures per Sachet	Structures per SOP per day	Sachets per SOP per day
Careysburg	9,612	9,470	8,901	5	1.1	8.0	7.4
Mamba Kaba	11,540	12,191	10,804	9	1.1	6.4	6.0
Grand Total	**21,152**	**21,661**	**19,705**	**2**	**1.1**	**7.2**	**6.7**

Figures 6a and **6b** below show the time series spray progress for the first and second spray cycles, respectively. Both figures compare progress based on the number of eligible structures found in 2011.

Figure 6a: Spray progress for the 13-week campaign, 1st spray cycle

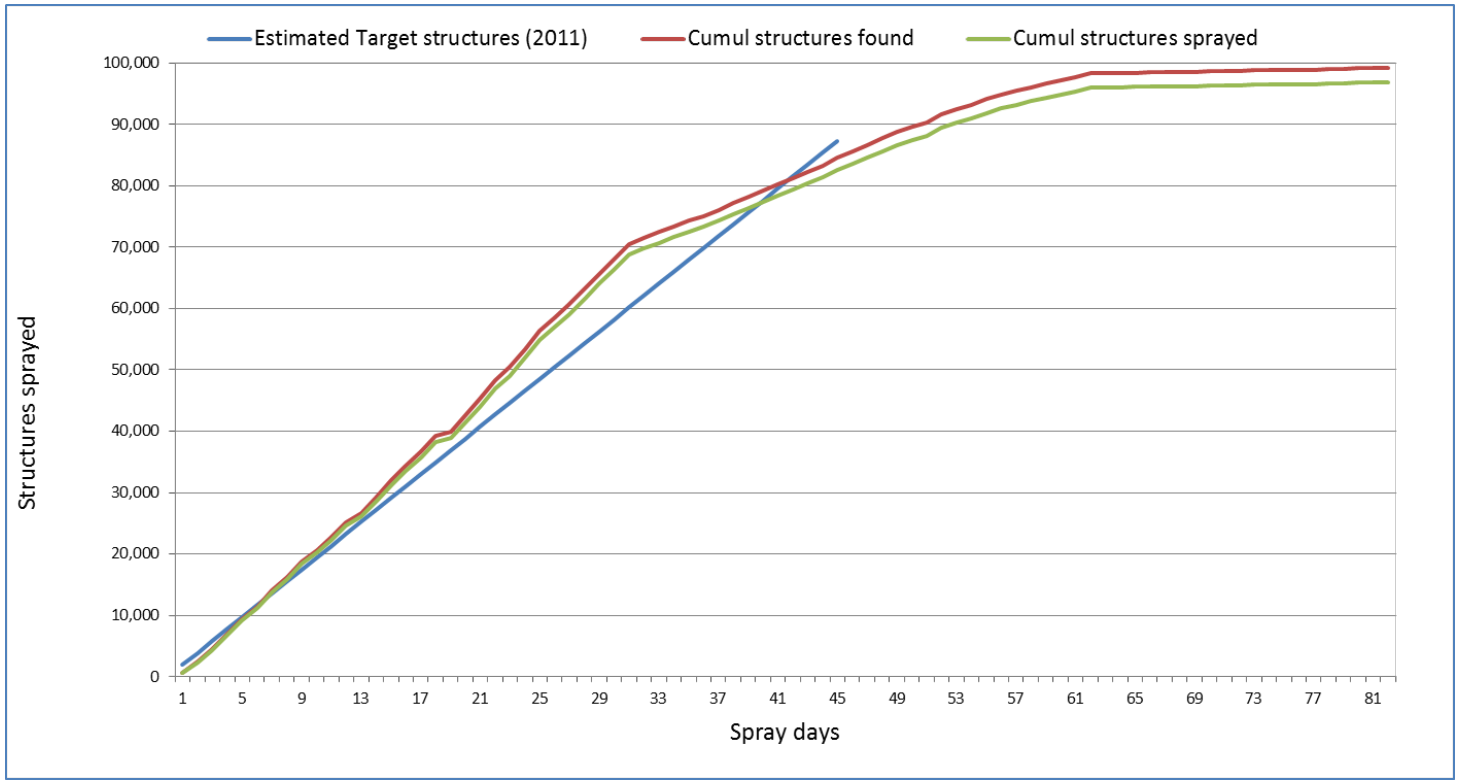
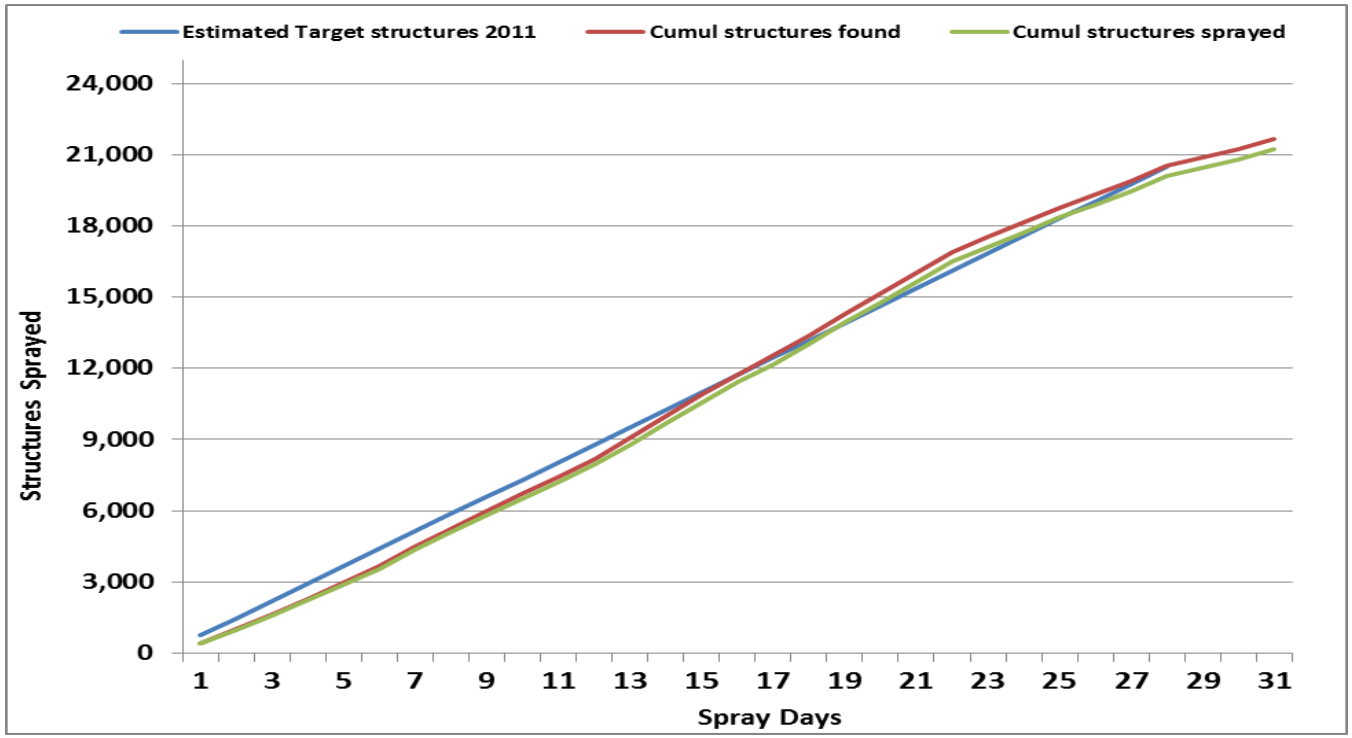


Figure 6b: Spray progress for the 5-week campaign, 2nd spray cycle



7. FINANCE AND PAYMENT STRATEGIES

Adequate and timely financial planning is an essential component of IRS malaria programs. Successful IRS implementation requires teamwork involving experienced technical experts and operational teams to develop good operational and budget planning, as well as the timely availability of funds to ensure smooth operations.

The Liberia Finance & Administration unit and home office worked closely with the technical and operational teams to budget for the project according to the work plan and to determine monthly financial needs and prevent cash flow bottlenecks. Given the remoteness of some of the Liberian communities and the absence of banking facilitates in these communities, coupled with the interest of ensuring transparency and accountability, the project established a system wherein the field workers were paid at the end of each contracted period. The finance team organized an on-the-spot paying system in the presence of the local officials in the various communities. On payday, each field staff produced the contract he/she signed with the project and their identity was verified onsite by the supervisor.

The finance department paid a total of US$ 375,057 as wages to spray operators, mobilizers, washers and security personnel. The wage payment was 25.6% of total FY 2012 budget. In addition 3.12% of the budget, which amounted to US$ 45,732, was used to facilitate training workshops for all people trained by AIRS. Another US$ 307,407 was used for renting vehicles for the IRS program, and it amounted to 20.95% of the budget. Honorarium payments to NMCP and EPA staff involved in field inspection and supervision was US$ 8510, while per diem and meals and incidentals allowances to Abt staff was US$ 11, 824.25. Abt also paid taxes to the government, which included staff income tax US$ 31,143.33, employee social security amounting to US$ 5,190.41, and employer social security totaling US$ 8,762.63.

As of the end of the 2012 spray campaign, the Abt Associates Liberia field office has a total of 17 employees, of which 89% are Liberian nationals. Recently, the Monitoring and Evaluation Manager resigned due to poor health condition that could not allow him to execute his duties.

Comment [Nd20]: This has been corrected.

Comment [F21]: Perhaps say as of a certain date? As of the end of the 2012 spray campaign?

8. CHALLENGES, LESSONS LEARNED AND RECOMMENDATIONS

The following are challenges, lessons learned, and recommendations, which were identified by the AIRS project team throughout the process of spray implementation:

8.1 CHALLENGES

1. **AIRS Project Database deployment:** The AIRS Project database was deployed a few days after mobilization by the mobilizers started. This did not give much time for familiarization and rigorous testing to inform repairs that would make for smooth use of the database. This resulted in having to do some manual counting in order to provide tentative reports. One of the challenges was the inability to track structure details disaggregated by districts. Remedial measures taken included: an increase in field supervision, sharing information on the M&E problem with staff members so that they could solve these problems when encountered in the field, and re-training of field staff whenever problems were detected during supervision.
2. **Entomology:** Lack of a functional insectary to rear mosquitoes was a big challenge for conducting timely experiments to assess the quality of spraying and insecticide decay rates on sprayed walls. To conduct wall bioassays in four IRS intervention sites, large numbers of mosquitoes were required, but the microclimate conditions in the insectary were not conducive for adult mosquito survival.
3. **Insufficient preparatory phase for entomological baseline data collection**: Pre-spray data collection should have been done at least one or two months before the start of spraying, but it was conducted 3 weeks before the start of spraying. This did not give sufficient time for determining which mosquito collection methods were efficient and suitable for the Liberian setting. Previously, only three sentinel sites had been picked and one site was not suitable at all for entomological monitoring of the malaria situation. This meant that no meaningful data were acquired from that site; all was due to limited time to plan for entomological monitoring for IRS.
4. **Bad road network and poor infrastructures:** Reaching some communities proved to be challenging, particularly those in Bong County where rivers needed to be crossed by canoe. The poor road network was a challenge during operations, particularly in Grand Bassa and Bong Counties. In order to reach certain operation sites long distances needed to be traveled, at times going through other districts. This was particularly pronounced in Faumah, Bong County and Compound, District #3c in Grand Bassa. In several districts the program could not secure a standard house to be used for a warehouse, so the project renovated storage facilities. The local vehicle rental companies own old and heavily used vehicles. Some of these vehicles were unreliable leading to frequent breakdowns in the field.
5. **Field workers welfare and payment modalities:** The field workers were of the opinion that their daily remuneration should be increased from 10.00USD. This occasionally affected their motivation for work. The project was forced to pay field workers in cash because of limited

banking facilities and the lack of alternative means of delivering finances to rural operational sites in rural areas. All necessary precautions were taken to minimize risk associated with cash payment and to confirm the identity of field staff receiving payments.

6. **PPE concern:** Inadequate numbers of overalls and boots caused some spray operators to wait for other operators to complete their task before the commencement of their daily task. Some of the overused PPE were ineffective, posing as a risk to spray operators. In order to alleviate the problem, 800 overalls (transferred from the IVM project managed by RTI) and 360 pairs of boots were bought to support the IRS campaign for FY 2012.
7. **Training period:** The project's strategy was to recruit field employees with previous experience in IRS who were then re-trained for 3 days. The NMCP complained the days allocated to training at the district level were insufficient, especially for those with no prior IRS experience. During the re-training exercise, all potential field staff with no prior experience in IRS were identified and given an extra day of couching to bring them up to speed.
8. **Poor community compliance in some areas:** The head of households in certain communities were reluctant to move their property outside even when mobilizers and spray operators were willing to assist. Some refused spraying because they thought Abt was responsible to also distribute mosquito nets. The communication units of Abt and NMCP intervened by holding meetings with community leaders and aired radio broadcast to clarify the situation, and eventually the problem was solved.
9. **Low capacity of seasonal workers:** Overall, the capacity of seasonal workers was low due to the high illiteracy level in Liberia, which is a result of 14 years of civil war. As most of the IRS field workers are supposed to come from within the communities, it was difficult to get people with the required background to work on the project. This also became a political issue as most of the community leaders and local authorities insist on having people from their own communities working for the project.
10. **Private sector initiative:** Arcelor Mittal (AML) is the only private company that participated in the first cycle of the IRS campaign on a cost-sharing basis. The spray campaign at AML took longer than expected because the company allocated very few spray operators (five). It took 20 days to spray only 881 structures.
11. **Finance & administration staffing:** Since our Finance and Administration Manager was not compliant with finance procedures and impeded the timeliness of activities during spray operations preparation, the project was forced to release him, bring in a staff member from Bethesda to fill in, and re-hire.

8.2 LESSONS LEARNED

1. **M&E**: The finalization of all the requisite tools (data collection, database) in advance of the commencement of spray activities is important. Clear data movement protocols and requisite logistics should be in place to ensure smooth entry and timely reporting. Late deployment of the database lead to a rushed approach to data entry and collection, thereby leading to unforeseen complications when using an untested database.
2. **Supervision**: Effective supervision is strategic to IRS implementation irrespective of the level of experiences, training, and knowledge level of the teams.
3. **Agreements**: Finalization of MOU, structure definition and other documents required to guide IRS implementation are critical to the success of operation.

8.3 RECOMMENDATIONS

1. **Timing of operations**: Spraying should begin earlier before the rainy period, and activities should start from the inaccessible communities.
2. **Supervision and monitoring**: Rigorous supervision and monitoring of operations, as well as M&E activities, should be routine, especially at the beginning of a spray cycle and during the entire spray period. Whenever problems are discovered then onsite training should be provided.
3. **Insectary**: Measures to improve the insectary facilities at LIBR were instituted. This included the installation of a battery-powered back-up system. Despite this investment, the LIBR insectary is not yet fully functional and the long distance to reach the facility is a big concern. It is recommended that a new mobile insectary be created which should be located close to the NMCP/ Abt offices for easy access and maintenance. A fully functional insectary equipped with temperature control equipment is needed in order to be able to establish and maintain a mosquito colony required for quality assurance and resistance monitoring, as well as training of entomologists.
4. **Entomology staffing:** In order to maintain a mosquito colony, insectary technicians need to be recruited and stationed at the insectary facility. Abt's Technical manager will continue mentoring and conducting on the job training of VCU/NMCP staff to improve competence in various entomological techniques.
5. **Monitoring project performance**: Timely submission of field reports, field worker timecards and data summary is important to monitor progress of spray activities. In addition, timely payment of field workers is important.
6. **Human resources**: Given high illiteracy in Liberia, there is a need to continue training to build capacity of field staff at all levels of IRS operations. This also means supervision and monitoring of field activities should be enhanced. IRS training curriculum for field staff should include an examination to assess background knowledge, critical thinking skills, and ability to perform simple arithmetic. Recommendation of field workers should come from community leaders, but selection should be based on the recruitment criteria of the project.

ANNEXES

Annex 1: Summary of susceptibility test data conducted under RTI (2011)

			Lambdacyhalothrin		Bendiocarb		Fenitrothion	
	County	**replicate**	**# Anopheles exposed**	**% corrected mortality**	**# Anopheles exposed**	**% corrected mortality**	**# Anopheles exposed**	**% corrected mortality**
Tests were conducted in May 2011	**G Bassa**	Replicat e 1	20	90	21	94.5	21	95.5
		Replicate 2	20	89	20	94.5	20	100
		% Mean mortality	**90**		**95**		**98**	
		Status	**P**		**P**		**S**	
	Margibi	Replicate 1	24	92	20	100	22	100
		Replicate 2	21	90	20	100	23	100
		Replicate 3	21	90	20	100		
		Replicate 4	21	100				
		% Mean mortality	**93**		**100**		**100**	
		Status	**P**		**S**		**S**	
	Monsterrado	Replicate 1	19	89	20	100	20	100
		Replicate 2	20	85	19	100	25	100
		Replicate 3	25	86	21	95	26	100
		Replicate 4	24	89	25	100	25	100
		% Mean mortality	87		**99**		**100**	
		Status	**P**		**S**		**S**	
Tests were	**Bong**	Replicate 1	20	77	22	79	19	100
		Replicate 2	24	86	18	87		

conducted in Sept 2011		Replicate 3	21	84	20	88		
		% Mean mortality	82		85		100	
		Status	**P**		**P**		**S**	
	Nimba	Replicate 1	20	88	20	100		
		Replicate 2	21	89	20	100		
		% Mean mortality	**89**		**100**			
		Status	**P**		**S**			

P (yellow) – Possibility of resistance; **S (green)** – Susceptible

Annex 2: Wall Bioassay tests data conducted under RTI (September 2011)

Site	Insecticide used	Date IRS	Wall substrate	Period post IRS	Corrected Average % Mortality
Monsterrado; Caresburg	Bendiocarb	09-May-11	Mud	4½ Months	66.67
		09-May-11	Mud	4½ months	70.00
		09-May-11	Mud	4½ months	68.89
		09-May-11	Mud	4½ months	73.33
G-Bassa Eye to Eye	Deltamethrin	5-April-11	Concrete	5 months	76.67
		5-April-11	Mud	5months	77.37
		5-April-11	Mud	5 months	90.00
		2-April-11	Mud	5 months	84.52
		2-April-11	Mud	5months	80.66
Margibi county, Mamba kaba District; Schieflin	Alphacypermethrin	27-Apr-11	mat	5 months	73.13
		27-Apr-11	Concrete	5 months	80.54
		27-Apr-11	mat	5 months	70.00
		27-Apr-11	mat	5 months	74.00
Margibi county, Mamba kaba District; Charlesville	Alphacypermethrin	27-Apr-11	Concrete	5 months	80.00
		27-Apr-11	mat	5months	74.00
		27-Apr-11	Concrete	5months	80.00
Bong, Wolota District; Swahta Village	Bendiocarb	23-Sep-11	Mud	1 day	100
		23-Sep-11	Mud	1day	100
		23-Sep-11	Cement	1 day	96.3
		23-Sep-11	Mud	1 day	96.30
Bong, Kpai District; Yopea Village	Bendiocarb	27-Sep-11	Mud	1 day	100
		27-Sep-11	Mud	1 day	100
		27-Sep-11	Mud	1 day	100
		27-Sep-11	Mud	1 day	100

Annex 3: IRS Trainees, by role and gender for the first spray cycle

Persons Trained	Training on IRS Delivery						Other Trainings							
	Training of Trainers		Spraying Operations		Data Capture		IEC/BCC Mobilization		Overalls Washing & General cleaning		Security		Transport Security	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Mobilizers	17	1												
Supervisors	40	6												
Spray Operator			518	101										
Data entry clerk					10	2								
Store keepers	8	10												
Pump Technicians	3	0												
IEC Mobilizers							265	75						
Team Leader							42	4						
Supervisor														
Washers									19	59				
Janitors									3					
Security											72	0		
Drivers													42	0
Dispatchers													3	
Conveyors													14	1
TOTAL M/F	**68**	**17**	**518**	**101**	**10**	**2**	**307**	**79**	**22**	**59**	**72**	**0**	**59**	**1**
TOTAL	**1315**													

Annex 4: IRS Trainees, by role and gender for the second spray cycle

Persons Trained	Training on IRS Delivery						Other Trainings							
	Training of Trainers		Spraying Operations		Data Capture		IEC/BCC Mobilization		Overalls Washing & General cleaning		Security		Transport Security	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Mobilizers														
Supervisors														
Spray Operator			104	33										
Data entry clerk														
Store keepers														
Pump Technicians														
IEC Mobilizers							36	16						
Team Leader							2	2						
Supervisor														
Washers									2	7				
Janitors									1	0				
Security													3	0
Drivers													11	0
Dispatchers														
Clinician – poison management			8	8										
TOTAL M/F			**112**	**41**			**38**	**18**	**3**	**7**	**0**	**0**	**14**	**0**
TOTAL	**233**													

Annex 5: Environmental Compliance field assessment and maintenance of warehouses and soak pits

District	Site Location	Facilities (Warehouse/Health Center/etc)	Site Refurbished (soak pit, warehouse, fencing, etc)
First spray cycle			
Panta	Garmu	Warehouse/Health center	Crush rocks added and soak pit fenced
Kpaai	Zowienta	Warehouse/Health center	Crush rocks added and soak pit fenced
Fuamah	Hindi	Warehouse/Health center	Site reconditioned, crush rocks added and soak pit fenced
Careysburg	Careysburg	Warehouse/Health center	Fenced soak pit, water wells serviced and crush rocks added
Kokoya	Botota	Warehouse/ Health center	Fenced soak pit
Mamba Kaba	Scheffellin	Warehouse / Health center	Site reconditioned, crush rocks added, water wells serviced, store room windows fixed, and soak pit fenced. Gates are in tact
District 3a&b	Compound 3	Warehouse/ health facility	Crush rocks added and soak pit fenced
Compound 4	Compound 4	warehouse	Crush rocks added and soak pit fenced
Commonwealth	Nekreen	warehouse	Crush rocks added and soak pit fenced
Compound 2	St. John	Warehouse/ Health center	Crush rocks added and soak pit fenced
Compound 2	Camwood	Warehouse/ health facility	Crush rocks added and soak pit fenced
District 1	Compound # 1	Warehouse	Crush rocks added and soak pit fenced
District # 3c	Gardour's town	Warehouse/ health facility	Crush rocks added and soak pit fenced
Worr District	Jacob Larteh's town	Warehouse/ health facility	Crush rocks added and soak pit fenced
Second spray cycle			
Mamba Kaba	Schefflin warehouse	Warehouse/health facility	Crushed rocks added and soak pit fenced, water-well serviced
Careysburg	Careysburg warehouse	Warehouse/health facility	Crushed rocks added and soak pit fenced, water-well serviced

Annex 6: Minutes from IRS Task Force Meeting

IRS TASK FORCE MEETING
WEDNESDDAY, NOVEMBER 2, 2011
CONFERENCE ROOM OF THE NMCP- MOH SW, LIBERIA
10:20 AM – 12:00 NOON

Mrs. Jessie E. Duncan, Assistant Minister for Preventive Services, Deputy CMO and Chair of the IRS Task Force chaired the meeting.

AGENDA
- (Need to modify???)
- Only to add introduction (comment by Mr. Fahnbulleh – MOA)
- Self-introduction was done by each person

Chair: take 5 minutes to go through the minutes of the meeting
Matters arising from the minutes: page 2 – unethical to continue with DL study and continuation (not only spraying)
- Nets used : permanent

Action point:
- How do we strengthen entomological monitoring, what has been done, what will be done (for NMCP to give update in next meeting)

Page 3; why was DDT included? It was placed as an option for discussion
Page 4: Bifenthrin has been banned so why is it listed? This is WHO's latest list of insecticides
Page: scope of work of Jacob Williams – he was only to do IRS strategic plan

Power point presentation by Martin Netsa (RTI)
- As the target increases maybe the whole of Nimba & Bong can be sprayed
- Bioassays: we have people capable of doing bioassays
- We need a resistance management plan
- The same structures are being followed on for 4 ½ months
- Are maps available where bioassays were done?
- We will map the areas; didn't have GPS
- LISGIS will be the best option to do mapping of areas where we have worked. They are partners with the NMCP
- The cadre of people trained? From NMCP, they are coordinators, also people from the county government
- For the recommendation regarding capacity building what roles can we ship to NMCP for the upcoming campaign? Why rural areas (considering the cost)
- The health facilities are far apart
- The IEC/BCC unit of the NMCP has been fully involved

Fahnbulleh: volunteer workforce – do you have the adequate number of volunteers. Do you have the information on the mosquito population in the 15 counties; in implementation you should work with concerned agencies in monitoring your activities
- The volunteers per district list we have
- The residual effect on the volunteers? We have a medical committee that can look
- NMCP should provide the information on the malaria prevalence in the intervention areas
- Have been working with EPA to check on the chemicals

PPP Abt Associates:
- One of the indicators missing
- Any risk management plan? USAID contracted them and there is a risk management plan

Preliminary reports:
The preliminary report from the entomologist of RTI, Mrs. Rodaly Muthoni was read and explained by Gracella Cooper of NMCP. Also included was the analysis of the results by the CDC chemical experts.
Dr. Jones: in his own opinion we should use DDT
MOA: Looking at result – possibility of resistance (87%) compared to 90% susceptibility what consideration should you take in regard to the use of the chemical
- More areas could be sprayed but the cost is huge

- Going for a pyrethroid we can spray more houses
- Decision of task force: Margibi & Montserrado – Carbamates; Nimba, Bassa & Bong – pyrethroids

AOB

- EPA only 1 entity to work with; suggest: the 3 entities MoH, MoA & EPA work closely in monitoring the implementation
- Evaluation of the IRS activities for 3 years. Let Filiberto tell us if it's necessary or not. It's possible to do an evaluation of the spraying quality. It's not possible to measure the impact on the population because other methods have been used such as LLINs, drugs, etc.
- The only case where only IRS is used and no other interventions
- Working with HMIS to see where IRS was done and decrease in malaria cases from clinics

Sarah: is the evaluation for RTI or decrease in malaria?
PMI already doing that (Dr. Jones)
Should the same organization doing the IRS be doing the bioassay? It should be done independently

Martin: NMCP capacity has been built to do bioassay; insectary needs to be fully equipped
2 or 3 persons need to be placed on the payroll to take full responsibility of the insectary

- Call for adjournment
- Vote of thanks by Dr. Jones
- Closing prayer
- Meeting adjourned at 12:00 noon

ATTENDANCE

#	NAME	ORG	POSITION	CELL#	E-MAIL
1.	Augustus B. G. Fahnbulleh	MoA	Director	0886-439982	augustusfahnbulleh@ymail.com
2.	Bethany Tomala	Abt	FCA	0776-329750	Bethany-tomala@abtassoc.com
3.	Wes Negussie	Abt	FCA	0776-329751	Wes-negussie@abtassoc.com
4.	U. Wollo Jetoh	NMCP	V.C. Officer	0886-591599	uwollojetoh@yahoo.com
5.	Sarah Hoibak	MENTOR	Acting CD	0880-992048	sarah@mentor-initiative.net
6.	Caroline Maxwell	MENTOR	Study Coordinator	0880-258594	Caroline.maxi@gmail.com
7.	Wilfred T. Gortor	DEOH/MOH SW	Coordinator	0886-966408 / 0777-061979	Sayegortor54@yahoo.com
8.	Levi Hinneh	NMCP	Research Officer	0886-564071	Dlevi30@gmail.com
9.	Kortoson Pellewuwan	NMCP	Supervisor	0886-561249	Kortoson20505@yahoo.com
10.	Francis K. Davies	NMCP	Advisor	0886-494804	
11.	Martin Netsa	RTI	COP	0777-484084	mnetsa@nb.rti.org
12.	Noe Rakotondrajaona	USAID/PMI	Malaria Advisor	0777-292558	nrakotondrajaona@usaid.gov
13.	Filiberto Hernandez	CDC	Rep/Advisor	0777-524733	Etv0@cdc.gov
14.	Isaac Hinneh	LAC	Sanitation Officer	0777-442344	
15.	Jonathan Enders	NMCP	M & E	0886-558220	
16.	Jessie E. Duncan	MOHSW	Health Services	0886-517797	
17.	Ruth W. Ricks	NMCP	Finance	0886-552073	
18.	Gracella W. Cooper	NMCP	Coordinator	0886-383872/ 0777-229516	Gracella1982@gmail.com
19.	Joel J. Jones	NMCP	Program Manager	0886-528010	jjonesdr@yahoo.com
20.	Eve B. Yeargar	NMCP	Data Clerk	0886-426092	
21.	Gloria A. Guezo	NMCP	Secretary	0880707352	Guezoglo1978@yahoo.com

Annex 7. Summary of Radio Talk shows / programs broadcasted during the IRS campaign

Date 2012	County / District	Radio Station/ Frequency/ Duration	Affiliation of Participants	Comments
First	**Spray cycle**			
March 27	Grand Bassa / District #3	LAC Radio 92.5 45 minutes	IEC Coordinator NMCP IEC, Officer Abt Associates	Callers complained of inconvenience of carrying things in and out, SOPs spraying over diluted insecticide, IRS bringing more mosquitoes; a single caller called to praise the IRS team
March 26	Grand Bassa / Buchanan/	Radio Gbezon 106.3 1 hour	IEC Coordinator NMCP IEC, Officer Abt Associates	Callers said IRS brings more mosquitoes in the house
March 26	Grand Bassa / Buchanan/	Radio Dukpa 89.1 1 hour	IEC Coordinator NMCP, IEC Officer Abt Associates	
April 27	Grand Bassa / District #3/	LAC Radio 92.1 1 hour	IRS Coordinator NMCP,IECBCC Officer Abt Associates, Sop supervisor	
April 27	Grand Bassa / Buchanan/	Radio Gbezon 106.3 1 hour	IRS Coordinator NMCP,IECBCC Officer Abt Associates, Sop supervisor	
April 27	Grand Bassa / Buchanan	Radio Dukpa 89.1 1 hour	IRS Coordinator NMCP,IECBCC Officer Abt Associates, Sop supervisor	
March 21	Margibi / Kakata /	Atlantic Radio 1 hour	DHO Mamba Kaba, IEC Officer Abt Associates	
March 21	Margibi / Kakata /	Radio Kakata 104.6 1 hour	DHO Mamba Kaba, IEC Officer Abt Associates	

	Margibi / Firestone / March 28	Radio Firestone 89.5 1 hour	IEC/BCC Officer Abt Associates	

Date 2012	County / District	Radio Station/ Frequency/ Duration	Affiliation of Participants	Comments
March 29	Margibi / Firestone /	Eagle FM 101.1 1 hour	IEC/BCC Officer Abt Associates, SP supervisor, Mobilizer supervisor	Callers asked why they did not receive mosquito nets, and if they still need to sleep under LLIN after their houses had been sprayed.
	Margibi / Firestone	Eagle FM 89.5 1 hour x 7days		IEC Officer wrote a radio announcement clarifying issues on LLIN distribution in Cotton Tree and Dolo Town which the station read for a week
March 22	Bong / Suakoko	Radio Gbarnga 96.5 1 hour	Malaria Focal person Bong County, IEC Officer Abt Associates	Callers wondered why we were spraying only a few districts and not the whole of Bong County.
May 3	Bong / Kpaii	Palala Radio 104.1 1 hour	IRS Coordinator NMCP Mobilizer supervisor, IEC/BCC Officer Abt Associates	
May 5	Bong / Fuamah	Bog Mines Community Radio 1 hour	IRS Coordinator NMCP Mobilizer supervisor, IEC/BCC Officer Abt Associates	

County / District / Date	Radio Station/ Frequency/ Duration	Participants	Comments
Second	**Spray Cycle**		
Careysburg			Careysburg responded very well to the spray and the house to house mobilization seemed to handle our mobilization so well that we did not see the need for a radio broadcast.
Mamba Kaba October 12	Radio Peace FM 96.5	Joseph Saah, Margibi County DHO	Two persons called to commend the IRS campaign and that the spray was killing other insects and mosquitoes. We addressed concerns like the insecticide bringing more mosquitoes in the house after spray predominantly in the talk show. We addressed the issue of people having to carry things in and out before and after spray.
October 13	Radio Firestone 89.5 1 hour X 7days of repeat broadcast	Joseph Saah Margibi County DHO Abt's IEC/BCC Officer	People called to express gratitude about the spray which they praised as killing other insects and mosquitoes. We addressed the issue of people having to carry things in and out before and after spray.
October 15	Stone FM1 105.5 1 hour X 7days of repeat broadcast	Joseph Saah Margibi County DHO, Salmon Joe, Mobilizer supervisor Thomas Jeffrey, Abt's IEC/BCC Officer	About three persons called to say the spray was good and killing other insects and mosquitoes. Many Firestone residents asked why we were not spraying Firestone concessional areas. We were even met outside the studio. We also addressed the issue of people having to carry things in and out before and after spray.by a crowd concerning this issue. They also asked about LLINs and the DHO told them the MOH would address the issue soon
October 20	Eagle FM101.1 1 hour X 7days of repeat broadcast(in Bassa dialect)	Mobilizer supervisor Mobilizer team leader (a broadcaster at the radio station)	The mobilizer supervisor (Salmon Joe and Rev. Kweller-a mobilizer/broadcaster at Eagle FM) discussed IRS in Bassa and addressed question on carrying things in and out, spray bringing lots of mosquitoes and refusal.