



PRESIDENT'S MALARIA INITIATIVE



Suriname Vector Control Needs Assessment Report

Integrated Vector Management (IVM) Task Order 2

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SURINAME VCNA REPORT

(Draft)

Executive Summary

A vector control needs assessment (VCNA) was conducted in Paramaribo, Suriname from August 6 to August 10, 2012. This report is based primarily on the results of a three-day workshop to conduct the vector control needs assessment, which was attended by representatives from the Bureau of Public Health (*Bureau Openbare Gezondheidszorg* -BOG), the Ministry of Health, the Global Fund, representatives from the National Registry of Pesticides and the National Laboratory for Quality Control of Insecticides. It was noted that Suriname has achieved a great success in malaria control, reducing the number of malaria cases by more than 88% (>95% reduction among stable communities living in the interior of the country) with a significant reduction of the malaria-related mortality. Suriname has expanded access to malaria diagnosis and free-effective treatment in remote areas where most vulnerable populations live, especially amongst the illegal gold miners called “garimpeiros”. Vector control activities for malaria have been limited to LLIN distribution through the Global Fund malaria project and entomological surveillance is conducted at three sentinel sites.

With the goal of furthering malaria control and eventual elimination, the Ministry of Health prepared a comprehensive 5-year Strategic Plan for Malaria Control and Elimination in 2011. The plan focuses on the intensification of activities including case management, Integrated Vector Management (IVM) and Health System Integration. The strategy document provides an excellent review of the past and present malaria situation and informs the present VCNA document.

The need to support vector control staff training and activities in IVM was highlighted during the needs assessment to support not only malaria activities, but to prevent and control other vector borne diseases and threats within the region, such as dengue and Chikungunya viruses. The training and support of vector control staff in key areas of IVM, such as entomological surveillance, database management; geo-referencing of information, insecticide application, pesticide safety, field evaluation of pesticides and insecticide resistance testing, is needed. In

addition, greater support is necessary for the selection, procurement and quality control of insecticides used for the control of vector-borne diseases. It is important to note that dengue has recently started causing mortality in Suriname, with 3 deaths reported in 2010, 8 in 2011 and 4 deaths in 2012 as of Epi week 36. The need for cross-trained personnel to respond to any vector control situation cannot be overemphasized.

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1.0 Introduction

Suriname is part of the Amazon Malaria Initiative (AMI), which is a seven-country regional program that began in 2001 and whose objective is that “*Malaria control programs in the Amazon Basin sub-region substantially incorporate selected best practices.*” AMI vector control partners (Centers for Disease Control and Prevention, Pan-American Health Organization, and RTI International) are working to improve vector control and entomological monitoring in the region of the Americas by performing vector control needs assessments (VCNAs) to review existing vector control and entomological monitoring and surveillance strategies and operations, identifying challenges and opportunities to improve current efforts. More specifically, the VCNA process:

- (i) Assisted each country in reviewing opportunities and needs for implementing the AMI vector control strategic orientation document and identifying viable options for addressing them. Particular emphasis was placed upon needs to achieve the short-term objectives of the AMI 3-year work plan.
- (ii) Enabled the integration of the discrete, on-going activities of AMI partners into the broader context of national and AMI priorities
- (iii) Provided a sound basis for developing specific activities to be included in the joint work plan, based on country needs.

Based on the VCNA, specific national plans of action will be developed and countries will be supported, as much as possible, to implement the plans during the subsequent years.

The number of malaria cases in Suriname has decreased by 88% (>95% reduction among stable communities living in the interior of the country) and there have been drastic reductions in malaria-related mortality. Therefore, emphasis for malaria control and eventual elimination is on expanded case management and integrated vector management (IVM), which draws on a more comprehensive and multi-disease vector control approach and emphasizes the need for sound entomological information on local vectors of human diseases for evidence-based decision making.

In Suriname there are currently no active malaria vector control operations being conducted by the Ministry of Health (MOH). Indoor residual spraying (IRS) was curtailed in 2006 following just two rounds and the MOH no longer considers it a viable malaria vector control strategy. Current efforts are limited to the distribution of long lasting insecticidal nets (LLINs) through Global Fund malaria project. It is recognized that funding from the Global Fund for LLINs is likely to end, which will lead to reductions in LLIN procurement. In this context, it is important that the growing national focus on dengue is seen as an opportunity to ensure that national competencies for malaria vector control are maintained to prevent the re-emergence of the disease. The decision by Suriname to adopt IVM therefore provides multi-disease vector control opportunities, which will enable adequate ongoing national capacity strengthening relevant to malaria vector control. AMI will need to leverage this opportunity and focus on supporting entomological surveillance, which, together with prompt and effective treatment of cases, form the first line of defense against the re-emergence of malaria.

1.1 Health system structure

The Ministry of Health (MOH) is responsible for health system management (availability, accessibility and affordability of health care). In relation to this, the MOH is responsible for planning, policy development, evaluation, coordination, and the setting of standards in the health system. According to the state resolution of 1991, the Ministry of Public Health in Suriname has a dual task of guaranteeing: a) availability and access to quality of health care, and b) quality of training in healthcare.

The MOH is responsible for supervising healthcare providers according to norms and standards. The core-institutions are the Central Office of the Ministry of Health, the Bureau of Public Health (*Bureau Openbare Gezondheidszorg*-BOG), and the Inspectorate. The Central Office and Inspectorate are responsible for planning, setting standards, and inspection and monitoring at the central (national) level. The BOG is responsible for the monitoring of program development and public health issues, as well as policy development. The Headquarter of MOH includes the Medical, Nursing, and Pharmacological Inspectorates; the Legal Department; the Planning Department; and a General Administrative Department.

BOG is a part of the Ministry of Public Health, which is responsible for monitoring the social and environmental hygiene aspects of health care. BOG is subdivided in three sub-directorates: the sub directorate Public Health Control, the sub directorate Program Development, and the sub directorate Administrative Services. At the operational level, the health care providers include the government subsidized primary health care organizations, the Regional Health Service (*Regionale Gezondheids Dienst - RGD*), which covers the coastal area and the Medical Mission (*Medische Zending – MZ or MM*), which covers the population living in the interior part of the country.

The majority of general practitioners are in private practice, serving people that are covered by the State Health Insurance (SZF), private companies, private insurance, or patients who pay out-of-pocket. Specialists provide inpatient and outpatient care in the local hospitals and health centers. Many non-governmental organizations are recognized by the government to provide specific health care services. RGD provides health care services to citizens along the coastal area of Suriname through 43 health centers called Polyclinics and 10 mobile health team located in villages.

All hospitals are located in the coastal area. There are four hospitals in Paramaribo, of which two are private, and there is one psychiatric hospital. Another hospital in the district of Nickerie has been strengthened through an International Development Bank project. The private Diakonassen Hospital, through an agreement with the MZ, provides hospital care to patients from the interior. Ambulatory and inpatient services are provided by all hospitals. All existing five hospitals offer an array of specialist outpatient services. There are two emergency medical care units, located in the Academic Hospital in Paramaribo and the Nickerie Hospital in Nickerie District. The Military Hospital functions as an ambulatory facility for army personnel and their families.

1.2 Human resources

Some of the primary challenges to human resources for vector-borne disease control are:

- Retention of health professionals and insufficient financial resources
- Poor human resource management
- Poor quality of staff training

Many physicians have graduated from the Anton de Kom University of Suriname, Faculty for Medical Sciences. An inventory of physicians revealed that by May 2008, 334 medical doctors (general practitioners, or GPs) are working in the private and public health sectors as well as 847 Nurses and 120 specialists. Physicians must obtain further education outside of Suriname for specialization. Due to lack of further specialized education in medicine and public health, there is a national shortage of qualified medical specialists and senior level public health practitioners. Specialists are providing care via outpatient clinics and hospital clinics. The RGD operates a total of 43 clinics in all 8 coastal districts, staffed by 52 physicians, 58 registered nurses, 64 nurse aids and 12 midwives. The medical assistants of the Medical Mission follow a 3-year course which is accredited by the Ministry of Health. These medical assistants (total of 70) serve at the health centers of the Medical Mission in the interior. A significant proportion of healthcare professionals have left the public sector over the past few years. Wages and working conditions in the private sector are much improved over the public sector, making it difficult for MOH to recruit and retain skilled health professionals to guide policy development and implement disease control programs.

1.3 Health Financing

In 2006, the total health expenditure per capita was \$390, approximately 6.2% of the GDP (per capita Gross Domestic Product). The government spent about 42.6% on health care, the private sector around 42% (company cost coverage and households out-of-pocket health expenditures), and the remaining 14% comes from external sources (donors). Of the total health expenditures 55% goes to secondary care (public and private hospitals, medical specialists, hospitals lab and x-ray services, hospital drugs), 34% goes to preventive and primary care (BOG, RGD, MZ, private GPs, others), while the remaining 11% goes to other aspects (administration, training, etc.). Major international and bilateral partners supporting Suriname's health sector are the Government of the Netherlands, Brazil, USA, France and Belgium, PAHO, UNICEF and Inter-American Development Bank (IDB).

1.4 Malaria Situation Analysis

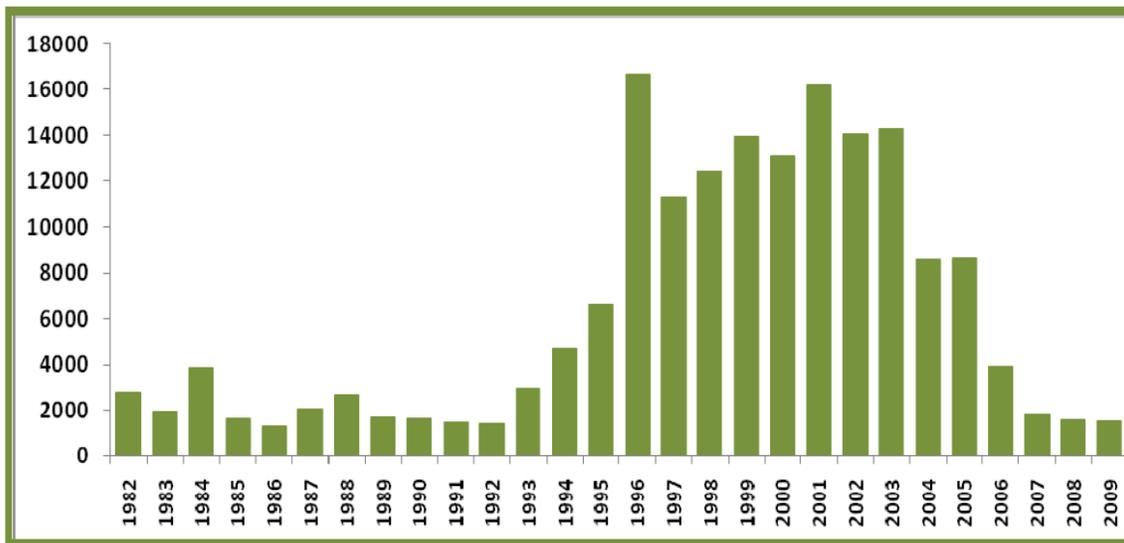
Malaria in Suriname has historically been a public health problem: Suriname had one of the highest incidence rates in the Americas and the highest proportion of *Plasmodium falciparum*

malaria. However, in recent years Suriname has reported a large reduction in malaria transmission. Currently, about 11% of the population is at risk of contracting malaria.

Malaria is endemic throughout the country, with exception of the coastal areas, which eliminated malaria few decades ago. Transmission of malaria is low with an increased number of cases after the two rainy seasons. The principal vector is *Anopheles darlingi*, although recent entomological surveillance identified other vectors that could also play a role in the transmission: *An. marajoara* and *An. nuñeztovari*.

Confirmed malaria cases dropped from 13,132 to 1,509 between 2000 and 2009, representing an 89% reduction (Figure 1). The percentage of cases due to *P. falciparum* has decreased drastically, while those caused by *P. vivax* has declined more gradually, as shown in Figure 2. The over-all proportion of *P. falciparum* malaria cases also decreased from 84% in 2000 to <43% in 2009 (Figure 3). Confirmed malaria cases dropped from 13,132 to 1,509 between 2000 and 2009, about 89% reduction. About 50% of the population at risk is tested parasitologically for malaria every year.

Figure 1. Number of malaria cases in Suriname, 1982-2009



Source: WHO Malaria Report 2005, MOH 2010.

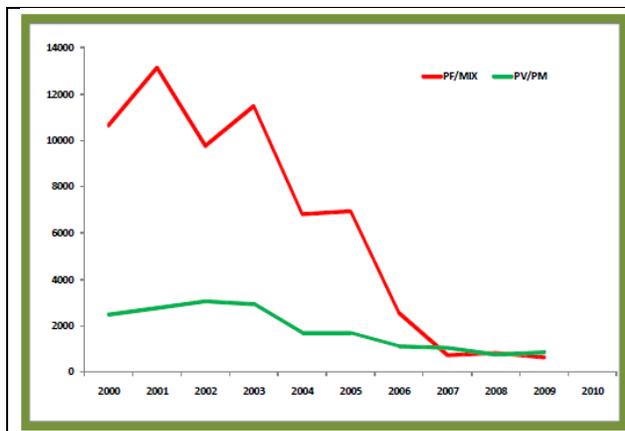


Fig. 2. Number of confirmed malaria cases by species, Suriname 2000-2009

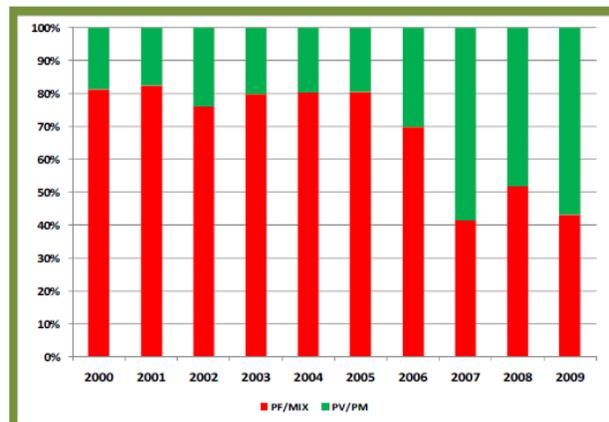
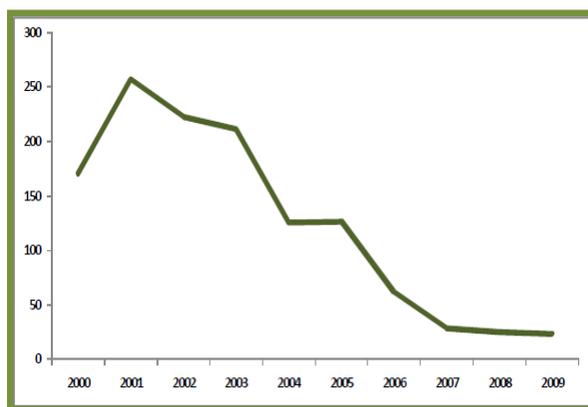


Figure 3. Trends in percentage of malaria cases by species, Suriname 2000- 2009

Malaria is an important public health problem in Suriname’s interior, where the natural habitats of the vector, *Anopheles darlingi*, are found. Malaria has been historically reported in the communities located along the Marojwine, Tapanahony and Saramacca Rivers, and small rivers in remote mining areas at Benzdorp area and the Brokopondo Lake.

The annual parasite incidence (API) per 1,000 population was at 170 in 2000 and dropped to 24 in 2009 (Figure 5).



*Per 1,000 population at risk/year

Fig. 5 Annual Parasite Index in Suriname, 200-2009

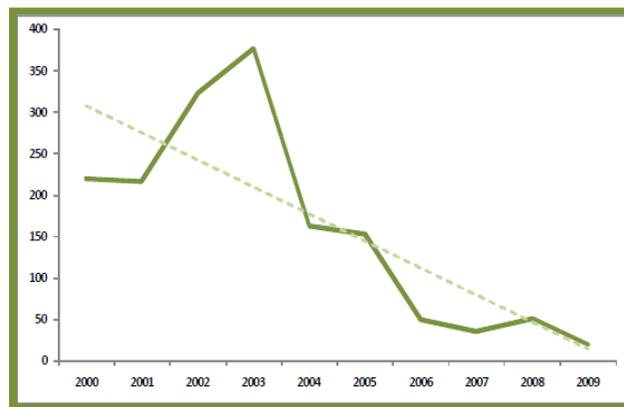


Fig 6. Trends in Malaria-related hospital admissions in Suriname, 2000-2009

The percentage of annual hospital admissions of malaria cases ranged from 1-3 % between 2000 until 2009. From a high of 323 in 2002, admissions had fallen to 19 in 2009 (Figure 6). Malaria deaths have been low in Suriname, a common feature of malaria in the Americas. There were 24

deaths due to malaria reported in 2000 and this dropped down zero in 2006. No malaria-confirmed deaths have been reported between 2006 and 2009 (Figure 7).

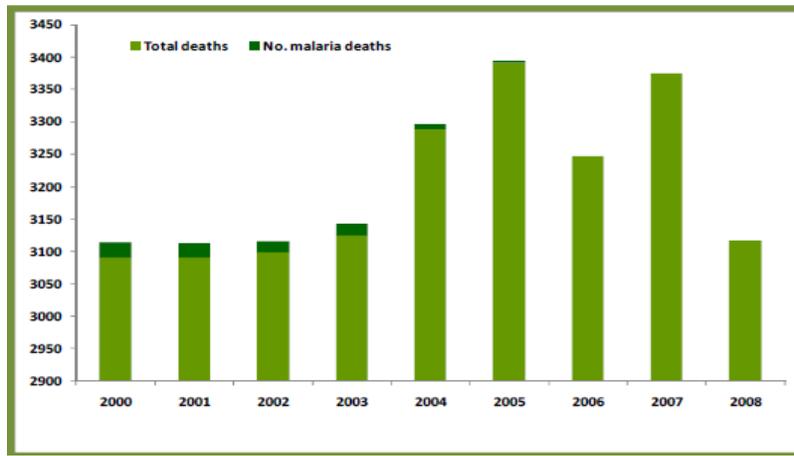


Fig. 7. Trends in Malaria-related deaths in Suriname in 2000-2008

Malaria in Suriname has been significantly controlled with remaining hot spots located along the East border areas neighboring French Guyana. In those areas, population movements and mining activities are risk factors adding to the epidemiological host-parasite-environment triad of malaria transmission. Gold mining activities by gold miners “garimpeiros” and frequent border crossings by the population have contributed to the increase of malaria. Gold mining activities have spread to new areas in the interior as well, leading to the emergence of malaria in regions where previous transmission seldom occurred. Figure 8 shows malaria hot spots identified along the border areas of Suriname with French Guyana in 2009.

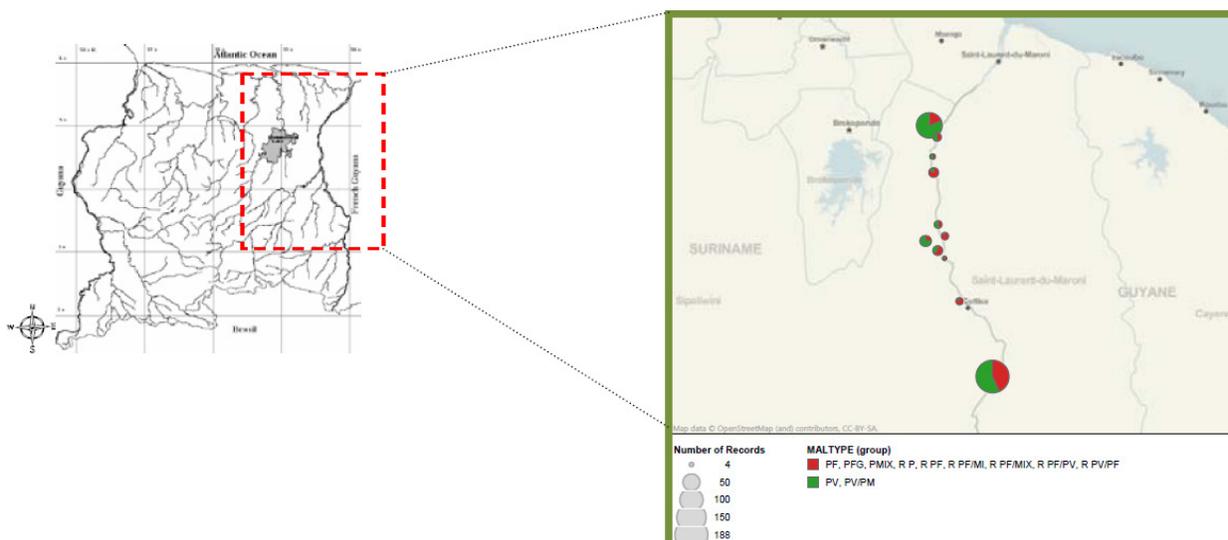


Fig. 8. Malaria hot spots along the Suriname-French Guyana border, 2009

An example of population movement along the Marojwine River is shown in Figure 9 and Figure 10 shows a gold illegal mining in Southern Suriname.



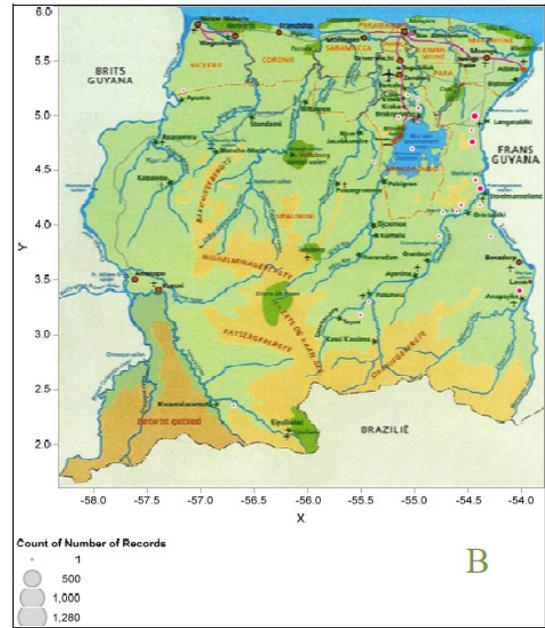
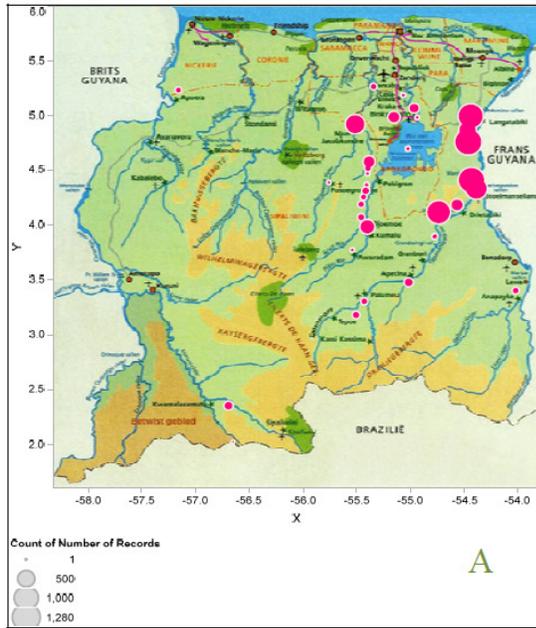
Fig. 9. Population movements along the Majowijne River border with French Guyana



Fig. 10 Illegal gold mining activities in Suriname

Suriname has shrunk the malaria map between 2000 and 2009 (Figure 11). The geographical distribution of cases showed a significant reduction of malaria cases in Central, Northwest and Southwest parts of the country. Also the distribution of *P. falciparum* malaria changed between 2004 and 2009. Changes in the distribution of malaria from 2004 coincided with the introduction of ACT (Section 1.5.1), and was further impacted with the scale-up of LLINs in 2006.

Fig. 11 Malaria map in Suriname 2000 (A) and 2009 (B).



1.4.1 *Plasmodium falciparum* resistance to antimalarial drugs

Antimalarial drug resistance is a major public health problem which hinders the control of malaria. The measurement of drug resistance in malaria is complex, as four different tools are used: (i) therapeutic drug efficacy studies measure clinical and parasitological efficacy and are the primary source to inform the treatment policy of the national malaria control program (NMCP); (ii) *in vitro* studies measure the intrinsic sensitivity of parasites to antimalarial drugs; (iii) molecular marker studies identify genetic mutations and subsequently confirm the presence of mutations in blood parasites; and (iv) pharmacokinetic studies characterize drug absorption and drug action in the body (WHO Malaria Report 2010). In Suriname, efficacy studies and molecular markers have been the methods most commonly used in the last five years. The extensive deployment of antimalarial drugs, in the past sixty years, has provided a tremendous selection pressure on human malaria parasites to evolve mechanisms of resistance. The emergence of resistance, particularly in *P. falciparum*, has been a major contributor to the global resurgence of malaria in the last three decades.

Suriname joined RAVREDA (Amazon Network for Monitoring Antimalarial Drug Resistance) in 2002 as a member of the Amazon basin initiative to assess the efficacy of the first-line therapies for malaria and review national policy based on evidences. This network was mainly funded by the USAID under the Amazon Malaria Initiative (AMI). During the first trimester of

2003, the National Malaria Board changed the first-line treatment policy from Quinine to the combination treatment artesunate+mefloquine (ASU+MQ), resulting in increased efficacy and patient adherence to treatment. Based on drug efficacy trials undertaken for RAVREDA/AMI, in 2003 the National Malaria Board adopted the use of Artemether-lumefantrine (AL) (Coartem®) as a first-line treatment for uncomplicated falciparum malaria. AL was fully implemented in all health facilities by mid-2004 and primaquine (PQ) single dose was added by 2007. The policy recommendation for severe malaria was also updated in 2008 adding intravenous (IV) artesunate (AS) into the antimalarial armamentarium.

1.4.2 National Malaria Program

The Ministry of Health (MOH) in Suriname is responsible for all actions related to malaria. For technical advice in prevention, diagnosis, treatment and vector control, the Ministry of Health relies on the Malaria Board, which is a National Advisory Technical Group. The Malaria Board has representatives from the Ministry of Health, Regional Health Services, the armed forces, Ministry of Interior, the University of Suriname, PAHO, the Medical Mission and political advisors. Policy-making processes are carried out by this group, as well as overseeing ongoing malaria activities nationwide. In 1958 the BOG created a special division dedicated to malaria control, which is called the Anti-Malaria Campaign (AMC). The AMC gathers malaria data from some health care providers in the country, and is responsible for monitoring malaria transmission and detection of local epidemics.

1.4.3 Malaria Information System

A malaria information system in Suriname was established in 1955. This is the backbone of the surveillance system nationwide. The BOG's AMC diagnoses malaria cases from hospitals, the blood bank and patients seeking diagnosis and treatment in the city (not covered by any other public health service). Other centers in the coastal area report to AMC: hospitals, RGD polyclinics and some private laboratories. Malaria data from the interior are collected by health facilities from Medical Mission. Malaria weekly reports are sent for all health facilities in the primary care system in the interior since more than 15 years. The objective of the weekly malaria notification system is the detection of malaria epidemics. Monthly reports are sent to headquarter offices in Paramaribo and collated at BOG.

1.5 Malaria Control Interventions

The MOH in Suriname reviews its national malaria protocol frequently based on scientific evidence. The approaches used in malaria control in the last five years have been a mix of inputs based on day-to-day intelligence surveillance, detailed analysis of the malaria micro epidemiology and available technical expertise. Baseline entomological studies were conducted in three key sentinel sites in the interior of the country, during 2004 and 2005, to identify resident mosquito species, determine their behavior including breeding site preferences, and susceptibility to vector control insecticides. Baseline malaria stratification was also conducted using the geographical distribution of malaria cases in 2004 (overall and by species) by notification unit. Three strata in five areas were defined for implementation. Table 1 shows the mix of malaria control interventions in deployed in 2006.

Table 1. Malaria intervention implemented in Suriname by stratum, 2006

Stratum	Area	Region	Combination interventions
1	1	Marowijne-Tapanahony	IRS, ACT+P, ACD, PCD, BCC/IEC, ITNs/LLINs, EDRS, MSD, Re
	2	Amerindians	PCD, BCC/IEC, ITNs/LLINs, EDRS, Re
2	3	Brokopondo-Saramacca-Upper Suriname-West	PCD, BCC/IEC, ITNs/LLINs, EDRS, Re
	4	Paramaribo	PCD, BCC/IEC, EDRS
3	5	Gold miners	PCD, ACT+P, ACD, BCC/IEC, ITNs/LLINs, EDRS, MSD

PCD= passive case detection; ACT= Artemisinin-based combination therapy; IRS=indoor residual spraying with insecticide; ACD= active case detection; P=Primaquine; BCC=behavioral change communication; IEC= information, education and communication; ITNs=insecticide treated nets; LLINs=Long Lasting Nets; EDRS= epidemic detection and response system; MSD=malaria service deliveries; Re= impregnation kit (KOTAB® 1-2-3)

The following sections summarize the malaria case management and transmission prevention strategies that are deployed in Suriname.

1.5.1 Case Management Diagnosis

For malaria diagnosis 19 out of the 57 health centers in stable communities have trained microscopists. The remaining centers rely on the use of rapid diagnostic tests, the results of which are crosschecked by microscopy analyses of blood slides in Paramaribo. *P. falciparum* multidrug resistant strains evolved in 2000. RAVREDA/AMI has been providing support in managing antimalarial drug resistance, strengthening drugs adherence and supported efficacy trials and its changes into national malaria treatment policies (see section 1.4.1). The *falciparum* malaria treatment regime was changed to artemisinin-based combination therapy (ACT) in 2004,

which resulted in about 40% reduction of malaria cases between 2004 and 2005. Chloroquine (CQ) still effective in malaria infections cause by *P. vivax* and *P. malariae*. Primaquine (PQ) is indicated to all malaria infections, as a gametocidal drug in *falciparum* malaria and also as anti-relapse in *vivax* cases. The policy of Medical Mission is to provide free treatment for all malaria infections. In remote areas, MSDs also provides treatment to everybody diagnosed with malaria.

1.5.2 Long-lasting insecticidal nets

Mosquito nets have been used in Suriname since the 1950s, however no details on the coverage of the implementation of this strategy were found. Conventional mosquito nets have been widely available in the market sector in Suriname. In 1996, a bednet project was initiated by PAHO/WHO, which later taken over by Medical Mission. In 2006, a free national strategy to distribute free long-lasting insecticidal nets (LLINs) began, which aimed to cover all the population at risk in the interior of the country. The distribution was supported by the Global Fund under a Round 4 grant. One LLIN per person (Permanet® 2.0, Vestergaard Frandsen, Denmark) was given to those living in the interior of Suriname. An extra LLIN was delivered to any pregnant women during post-partum. Different types of nets were distributed in the country based on sleeping practices and/or preferences: LLINs for the East, Central, and West of the country and hammock nets for those in the South. A total of 69,997 nets have been distributed since 2006 with coverage rate exceeding 99% in stable communities living in target areas (WHO, 2010). Under Global Fund Round 7 grant, in 2010 Suriname distributed more than 13,000 LLINs to high risk groups in remote areas, mainly gold mining areas where malaria transmission occurs. Impregnation kits were organized by a social scientist with support of women group organizations.

1.5.3 Indoor Residual Spraying

Indoor Residual Spraying (IRS) was implemented only in stratum 1 (Table 1), which concentrated 70% of the malaria cases in the country. Overall coverage of IRS was less than 70% with numerous logistical difficulties. Only two rounds of IRS were implemented in the country in 2006. Suriname no longer recommends IRS as a strategy for malaria control.

1.6 Public Information and Education

An aggressive media campaign was launched in 2006 including televised public service announcements, commercials, interviews, flyers, posters and outreach programs at the

community level. Five televised public service announcements were aired more than 800 times each during 2006 and 2007. DVDs containing those malaria televised public service announcements were reproduced and provided free of charge to communities with no access to television, but with availability of DVD players in the village.

2.0 SWOT Analysis of Vector Control in Suriname

In preparation for the development of the Malaria Control and Elimination Strategic Plan, a SWOT analysis was conducted for vector control which suggests areas that need support in order to be effective in vector control of malaria (Figure 12). Similar discussions were held during the three day VCNA workshop to consider strategic areas in dengue control that require support.

<p>Strengths</p> <ul style="list-style-type: none"> ▪ Government commitment to malaria vector control program ▪ Technical decision to stop IRS nationwide in 2006 ▪ Country participating in RAVREDA/AMI in vector control activities related to monitoring insecticide resistance and surveillance ▪ Strong sentinel site entomological surveillance ▪ Excellent experience working with women groups organizations at the local level in LLINs distribution, re-impregnation and IRS ▪ High coverage of LLINs in stable communities in the interior (>98%) 	<p>Weaknesses</p> <ul style="list-style-type: none"> ▪ No geographical reconnaissance done in all endemic regions ▪ Staff at regional and district levels to support scale up to universal coverage ▪ Limited resources for new national distribution of LLINs ▪ Lack of human resources for a well functioning vector control program ▪ Vector control activities mainly coordinated by GFATM malaria grants rather than central level ▪ Lack of vector control guidelines and manuals ▪ Lack of malaria epidemiologist at the central level ▪ Limited information of the use and washing patterns of LLINs among gold miners in remote areas
<p>Opportunities</p> <ul style="list-style-type: none"> ▪ Government commitment to support national malaria control program and vector control ▪ Collaboration and support from international partners ▪ Potential increase in vector control personnel at all levels through proposed increase in malaria specific personnel ▪ Proposed new structure & staff establishment in the AMC ▪ Availability of donor funding to maintain high coverage of vector control interventions 	<p>Threats</p> <ul style="list-style-type: none"> ▪ Natural disasters such as floods are risk factors for access with vector control interventions ▪ Limited resources to fund main commodities (i.e. LLINs, RDTs) and the logistical cost to reach remote areas ▪ Increase in population movements will affect monitoring of interventions, especially in border areas

Fig. 12: SWOT Analysis on Vector control

2.1 Opportunities to improve vector control

The current focus of the country is on capacity strengthening for dengue vector control, given the regular occurrence of cases (Table 2). The need for a strategic plan for dengue vector control has been identified by country stakeholders. If developed within a national context of integrated vector management development, the strategic plan would provide a great opportunity to ensure that national capacity for malaria vector control is strengthened and positioned as a frontline defense against the reemergence of the diseases. In particular, efforts to improve entomological surveillance and monitoring, better manage insecticide resistance, improve on judicious use of

insecticides and assure the quality of procured insecticides, are all critical to preventing the resurgence of malaria in Suriname. AMI will need to leverage opportunities under the umbrella of IVM.

A 3-day meeting of vector control stakeholders was organized as part of the VCNA process. The meeting identified priority actions to improve the management of vector control, improve entomological surveillance and monitoring, and manage insecticide resistance in local mosquito vectors. The priority actions are presented by Annexes 1 to 3 of this report.

Year and Week	Clinical Cases	Confirmed Cases
2012, week 28	663	148
2011, week 52	409	145
2010, week 52	113	113
2009, week 40	120	28
2008, week 44	28	28
2007, week 52	41	-
2006, week 52	285	-
2005, week 52	2,853	-
2004, week 52	375	7
2003, week 52	285	1

Table 2: Dengue in Suriname 2003 – 2012
 (Source: www.new.paho.org accessed 26 September 2012)

2.1.1 Improving the Human Resource Capacity of the Bureau of Public Health

Until 2011 the Bureau of Public Health (BOG) had only three vector control staff members who were responsible for dengue prevention. After 2011, 40 new inspectors were trained to conduct vector control activities. The Environmental Unit now has 100 staff members that are divided over different units. The number of staff members for vector control will be increased to 15 within a short period of time. These staff are trained as Environmental Inspectors and are stratified into three categories:

1. Basic Environmental Inspectors
2. Controllers
3. Supervisors (responsible for managing the units)

Each category requires a specific training. In the past year, 40 Environmental Inspectors were trained through a one-year course, including a six-month practical training. One of the subjects of the training was vector control. It is proposed that more intensive vector surveillance and control training should be conducted to permit this workforce to effectively conduct entomological surveillance, disease risk stratification, vector control activities and field evaluation of vector control activities.

There is no functioning insectary in all of Suriname. The BOG has an entomology laboratory with six microscopes.

Priority actions to improve the management of vector control in Suriname are presented by Annex 1.

2.1.2 Enhancing Vector Surveillance and Monitoring

Constraints to entomological surveillance include:

- Absence of a national entomological surveillance and monitoring plan for malaria or dengue
- Lack of routine budget and dependency on funded projects and research
- Ad hoc surveillance activities based on project of research, with reporting usually depending on project/research requirements
- Absence of a centralized system for systematic storage, review and distributed of information.
- Inadequate knowledge on the primary vectors of malaria and particularly, on the suspected primary vector *Anopheles darlingi*.
- Lack of in-country training opportunities on entomology and vector control

Priority actions to improve surveillance and vector monitoring in Suriname are presented by Annex 2.

2.1.3 Improving Judicious Use of Insecticides

Quality Control of Insecticides and labeling of pesticides: At present the laboratory for conducting quality control of pesticides is not capable of conducting the required quality control tests on pesticides being used in the program. Some pesticides that are being used have expired and need to be tested and recertified or replaced. It was observed that the pesticides that were recently purchased were labeled for use in Agriculture and for other means and had no instructions for use in vector control. Support for pesticide procurement, quality control and application is required and has been requested.

Enhancing performance of insecticide applicators: The BOG has six portable thermal swing foggers, three truck mounted thermal foggers, eight Hudson sprayers, 40 plastic sprayers for Bti (Vectobac 12AS SC formulation), and three backpack sprayers for Bti (corn cob formulation).

At present there is no process or procedure in place to routinely evaluate the application and residual efficacy of insecticides applied in the field for vector control. This is especially important for the use of larvicides, which are assumed to have a specific duration of effectiveness and applications are made based upon that assumption. This is also required for the use of adulticides to ensure that the insecticide is effective and is being applied correctly.

Technicians applying pesticides in the public domain for the control of vectors of human diseases should receive a certified training course in pesticide application and safe use in order to ensure proper application and precautions are taken to protect the public.

Priority actions to improve pesticide application and judicious use in Suriname are presented by Annex 3.

2.2 Operational Research for Vector Control

Opportunities to use local and international universities for operational research to support vector control activities must be encouraged. One small scale trial was observed with a student conducting a research project on the longevity of effectiveness of insecticides used in the dengue control program under semi-field conditions. More activities of this type, including those

relevant to malaria, need to be encouraged to support the national program and to encourage future researchers to be involved in solving local problems.

2.3 Promotion of Community Involvement in Source Reduction of Domestically Occurring Dengue Vectors

Considering the staff and program limitations for controlling *Aedes aegypti*, it is important to involve the community in regular routine vector control source reduction activities. Training of personnel or specific entities within the Ministry of Health in the area of Communication for Behavioral Impact (COMBI) is recommended by WHO to involve homeowners and residents in elimination of standing water that may produce mosquitoes. At present these activities are not being used.

The following is a list of recommended priority actions in the areas of (i) Program Management, (ii) Entomological Surveillance and Control and (iii) Insecticides and Resistance that were developed in a three day VCNA workshop of key country stakeholders in Suriname.

Annex 1: Priority Actions for Program Management

In order to improve the effectiveness and efficiency of the vector surveillance and control program the following actions are recommended to take into consideration:

	PROGRAM MANAGEMENT PRIORITY ACTIONS	ADDITIONAL REMARKS
1.	Develop a Strategic Plan for control of the vector-borne diseases (inter-epidemic phases) and promote the implementation of Integrated Vector Management as recommended by the PAHO Directing Council 2008 (CE 142.R9).	
2.	The recommendations and conclusions of Integrated Dengue Management Strategy that was prepared in Martinique in 2009 should be reviewed and considered for implementation.	The IDMS is a subsector of the Integrated Vector Control Management.
3.	Conduct a workshop in Suriname to implement Integrated Management Strategy for Dengue.	If deemed appropriate this workshop can be held in Suriname
4.	Support the development of a regional Technical Country Collaboration (TCC) with Guyana, French Guyana, Brazil and, if possible, Venezuela in order to coordinate activities and exchange information.	<ul style="list-style-type: none"> ▪ Guyana also has dengue even though they don't report the cases. PAHO has a website where the incidence of cases in Guyana can be checked. ▪ PAHO will have to deal directly with the French Government, because French Guyana is not a PAHO member. They can however be invited as observers.
5.	Improve the communication, coordination and collaboration between Environmental Inspection (BOG), the Entomology Department (BOG), Epidemiology Department of BOG and the Malaria Program (MOH) in the conduct of entomological surveillance and control activities.	<ul style="list-style-type: none"> ▪ A mechanism should be in place (through regular meetings or emails) to coordinate the activities
6.	Establish routine evaluation of program activities (surveillance, insecticide applications, public health messages, IEC, use of evidence for decision making etc.)	<ul style="list-style-type: none"> ▪ A mechanism for evaluation should be put in place to determine the effectiveness
7.	Strengthening of the MOH Public Relations Department (including BOG <i>Gezondheidsvoorlichting en -Opvoeding</i> and BOG PR Departments) for improved production and evaluation of IEC messages (develop protocol for production and distribution of messages to communities; employ/train health communicators; conduct training course in COMBI	

	PROGRAM MANAGEMENT PRIORITY ACTIONS	ADDITIONAL REMARKS
	(Communication for Behavioral Impact)	
8.	Support the development and documentation of intra- and inter-sectorial lines of reporting and communication (quarterly reports, annual reports).	<ul style="list-style-type: none"> ▪ The objective is to increase the communication between the departments to facilitate the control activities (Perhaps a webpage can be used for this sort of inter-departmental information). ▪ A form could be developed that can be used that is very to the point. ▪ Perhaps the process of filling out the forms can be automated with the information that is already available. ▪ It's recommended to hold a workshop with all stakeholders to develop a common format. It is essential to have an adequate information flow from the hospitals to MOH and vice versa.
9.	Promote and facilitate timely and pro-active case reporting for health posts, hospitals and private sector (labs) based on clinical confirmation, to BOG Epidemiology Dept. (standardized electronic formats) in order to implement timely response to vector borne diseases cases	<ul style="list-style-type: none"> ▪ Reporting can be done more quickly and response time will probably also much be faster.
10.	Strengthening of the Epidemiology Department for improved analysis, reporting, and establishing of maps and stratification of disease risk.	
11.	Promote the review and enforcement of legislation with regards to vector control	
12.	Encourage involvement of University/Medical Scientific Institute (MWI) students in Vector Control Program activities through the development of short-term student projects that will generate and analyse up-to-date information.	<ul style="list-style-type: none"> ▪ Initiatives should be taken to get more people to conduct small-scale research since this is a very cost-effective way of generating quality information. ▪ The benefit is that when students are involved, they might eventually come to work with one of the units. ▪ It is recommended in this regard to send notes out abroad that Suriname is open to students on certain topics. Universities often cover the costs of such projects and it is a good way to obtain international expertise.
13.	Promote the establishment of a managed sanitary landfill to handle large solid waste (tires, cars, refrigerators).	<ul style="list-style-type: none"> ▪ There currently is a landfill, but it is not managed.

	PROGRAM MANAGEMENT PRIORITY ACTIONS	ADDITIONAL REMARKS
14.	Promote annual or bi-annual Clean-up Campaigns (Ministry of Public Works) before the rainy season.	<ul style="list-style-type: none"> ▪ It is recommended to execute such a campaign before a dengue epidemic. There are already countries initiating these activities; however no evaluation of the effectiveness has been conducted to date. ▪ It is important to get the community involved and raise awareness about dengue
15.	Evaluate and discuss the issue of decentralization vs. centralization of Vector Surveillance and Control Activities.	
16	Promote the development of a budgeting process that facilitates purchases within the Vector Control Program in order to facilitate planning and evaluation of cost effectiveness.	<ul style="list-style-type: none"> ▪ This will address, among other things, to the current red tape to procurement approvals.

Annex 2: Priority Actions for Entomological Surveillance and Control

In order to improve the quality and capacity of personnel to conduct entomological surveillance and vector control, the following actions are recommended to be taken into consideration:

	SURVEILLANCE AND CONTROL PRIORITY ACTIONS	ADDITIONAL REMARKS
1	Upgrade Vector Control and entomology personnel by providing targeted training in pesticide application, safety and monitoring and evaluation of control activities, entomological surveillance and resistance monitoring. Environmental inspectors should also receive this training to enable them to respond in epidemic situations. (Suggestion: provide personnel with weekly information-session trainings on a relevant topic.)	It is recommended to provide short seminars on a weekly basis instead of lengthy courses to improve knowledge in specific areas.
2	Revise the job descriptions and training requirements for the entomology team and environmental inspectors to conform to the new proposed IVM strategy (keeping in mind the multi-tasking)	<ul style="list-style-type: none"> ▪ It is recommended to train people and provide them with skills that will enable the unit to use them for multiple tasks. ▪ A complication might be that additional tasks and training might lead to demands for higher salaries. However, the objective is to train personnel to have sufficient skills readily available when needed, for example, in case of an epidemic. But personnel are not necessarily required to use their skills outside of these emergency situations.
3.	Establish a functional routine entomological monitoring system which continuously generates information on risk priorities (stratification, seasonality), resistance, efficiency etc.	
4.	Develop and implement the necessary SOPs for entomological surveillance and vector control with periodic evaluation and revision.	<ul style="list-style-type: none"> ▪ The SOPs are currently inadequate and in need of strengthening and revision (for field work). ▪ There are manuals available that can be adapted to the local situation, so Suriname certainly does not have to start from scratch.
5.	Prepare for the eventual termination of the MOH Malaria Program (Global Fund) activities and transfer of responsibilities to BOG (which should include the transfer of the activities of MOH Malaria Program to roles and responsibilities of VC program)	The Global Fund financing for the Malaria Program will end shortly (2014) and a smooth transition needs to be ensured.
6.	Develop, document (adopt/adapt international practices/documents) and integrate Monitoring and	Obtain documents that will assist the execution of this activity and show how

	SURVEILLANCE AND CONTROL PRIORITY ACTIONS	ADDITIONAL REMARKS
	Evaluation in Vector Control Program [Entomology (bio-essays), cost-efficiency etc.]	similar activities are conducted in other countries.
7	Develop sampling systems to streamline entomological surveillance (focus on priority areas and do frequent sampling there; i.e. LIRa system in Brazil)	To sample periodically you need a sampling system in place to determine how to make the program more efficient
8	Digitalize, analyse and report information on the VC program (including the development).	People are already collecting information and now this information should be analysed.
9	Geo-reference all field-data; develop mapping unit at BOG, acquire relevant equipment, software, have people trained in making the maps (IDEAs; work with Tableau or Google Maps; UNICEF can provide maps/Tulane University support).	<ul style="list-style-type: none"> ▪ Other countries are already doing this and it is a matter of adapting these products. By using the systems the control program would be much more effective and responsive to field conditions. ▪ The Medical Mission and Malaria Program are currently mapping malaria cases and have a system for this. ▪ It's recommended to also look within the different departments to determine whether there are already systems used for this purpose.
10	Provide computers, software and trained personnel for mapping and data entry.	
11	In order to be pro-active and improve response to epidemics, promote the improvement of infrastructure, transportation, equipment and materials based on reorganization/development of VC control program and strategic plans	There is a need for resources to realize the necessary improvement.

Annex 3: Priority Actions for Insecticides and Resistance

In order to detect, predict and respond to the development of insecticide resistance and ensure insecticide effectiveness, the following actions are recommended to take into consideration:

	INSECTICIDES AND RESISTANCE PRIORITY ACTIONS	ADDITIONAL REMARKS
1.	Develop short courses for certification and licensing system for pesticide applicators. (short courses could be provided/supported by NATIN “Community College” or Poly Technic College)	<ul style="list-style-type: none"> ▪ Pesticide applicators need a very high level of training to know how to apply insecticide etc. Many countries have rules and regulations for private companies but not for departments within the government where workers use pesticides. It is important to establish limited levels of certification. ▪ It was recommended to involve NATIN or the University in providing the certification. ▪ A risk is that workers will leave their job at the government and start their own company. It is therefore recommended to limit the licensing, for example, only give a certification for mosquito control.
2.	Develop Resistance Management and routine monitoring for insecticide resistance using WHO and IRAC (Insecticide Resistance Action Committee) guidelines.	<ul style="list-style-type: none"> ▪ It is important to monitor the insecticides that are purchased and used to see how they function in the field and know the resistance status before it fails. ▪ It is also important to establish baseline data. ▪ IRAC supports many field activities for insecticide resistance and they have papers available. They are only interested in monitoring and managing resistance.
3.	Promote the use of evidence-based selection of insecticide (based upon WHOPES recommendations, field evaluation, quality control and efficiency. The insecticides purchased for the VC program should be WHOPES/EPA approved.	<ul style="list-style-type: none"> ▪ Refer to new publication of WHOPES on this issue. WHOPES provides recommended steps in the purchase and use of insecticides. ▪ It should be noted that when WHOPES evaluates and recommends a product, it is a product from a specific producer. (with a specific toxicological profile)
4.	Insecticides used by the MOH need to be fully labelled (including detailed instructions for use against mosquitoes) in Dutch	Including mixing instructions, rates of application, safety, first aid etc.
5	Develop database for pesticide management [record origin, manufacturer, importer, storage (warehouse management) use, and geographical data].	This is necessary in order to manage a life cycle of a pesticide.

	INSECTICIDES AND RESISTANCE PRIORITY ACTIONS	ADDITIONAL REMARKS
6.	Establish record keeping (logbook and database) for equipment use (name of applicator, date of application, location of application, insecticide uses, amount insecticide applied and maintenance records).	This information can be used when you want to buy new equipment. A similar system has already been adapted in Brazil.
7.	Implement enforcement of appropriate PPE use and replacement with record keeping of	If there are health problems you are able to look into a correlation with PPE use.
8	Ensure quality control of pesticides and application equipment (new WHOPES procurement guidelines, WHOPES specifications for equipment).	It is recommended to visit the American Mosquito Control Association meeting to obtain information before purchasing equipment. All manufacturers will be present at this meeting and Suriname can go there to get familiarized with the different products. This will prevent being dependent on only one vendor.
9.	Implement routine biological monitoring of applicators health and family members. Occupational hygiene and pesticide emergencies training and procedures.	<ul style="list-style-type: none"> ▪ This is especially important for some of the pesticides that are used. There should be a separate building where people can, for instance, shower before they go home. ▪ Biological monitoring is important and used to monitor human health. ▪ It might be useful to conduct a study with regard to the use of insecticides and safety.
10.	Support for chemical laboratory of BOG to do quality control of pesticides and linkage of the laboratory with international QC laboratories is required.	
11.	Apply “best practices” for pesticide use and disposal of empty containers and expired products.	