Annual report 2017
Towards Malaria Elimination: Test, Treat and Track
Foreword

According to the World Health Organization\(^1\) in 2016, 91 countries reported a total of 216 million cases of malaria, an increase of 5 million cases over 2015. Malaria case incidence decreased globally since 2010, but currently the rate of decline has stalled and even reversed in some regions. In the Americas four countries (Nicaragua, Panama, Peru and Venezuela) saw increases in 2016 compared to 2010. Malaria transmission, however, is focalized in many countries, with Brazil and Venezuela accounting for 65% of the reported cases.

The good news is that nine countries in the Americas reported zero local *P. falciparum* (malaria tropica) cases for more than 3 years. Countries projected to eliminate malaria by 2020 are Argentina, Belize, Costa Rica, Ecuador, El Salvador, Mexico, Paraguay and Suriname. Malaria in Suriname is still decreasing, bringing elimination within reach. Pressure from import malaria, however, increased over the past year and availability of international funds for malaria intervention are reducing, especially when moving from the current Global Fund\(^2\) grant to the new “continuation grant” for elimination, which is planned to start in April 2018.

This close to the finish line for malaria elimination Suriname cannot afford to lose focus. The first Strategic Direction of the National Elimination Strategy 2018-2022 says that the nation (government, political leaders, all stakeholders in health, all partners and the general public) should take ownership of this goal. Already the country is reaping the benefits from over a decade of near malaria elimination. Businesses are thriving in the Interior of the country. Villages are experiencing economic growth as a result of a healthy population engaging in the increasing availability of labor related to tourism, and forestry and mining activities. Our government is getting a significant return of investment from these endeavors.

With this in mind, for the benefit of the population in the Interior of Suriname and to further enable local and national economic development, I urge everyone in Suriname to consider his or her role and responsibility toward reaching the national malaria elimination goal.

Malaria Elimination in Suriname by 2020, make it your goal as well!

Dr. H. Hiwat
Coordinator Ministry of Health Malaria Program

www.malariasuriname.com

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1 World Malaria Report 2017, World Health Organization
2 Global Fund to fight Aids, Tuberculosis and Malaria. https://www.theglobalfund.org
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1. Introduction

Suriname was responsible for the highest concentration of *Plasmodium falciparum* malaria in the Americas prior to 2006. Malaria was a problem in the interior of the country, especially in the Maroon and Amerindian village communities, located along the main rivers. Since 2006 the country experienced a significant decrease in malaria incidence, reaching near elimination levels by 2009\(^3\). Transmission still occurs in the remote forested gold mining areas, with the mobile migrant miner population now being most at risk. The country is currently listed by the World Health Organization (WHO) among the countries with the potential to eliminate malaria by 2020\(^4\).

A recent publication by Van Eer et al.\(^5\) provides a great overview on what changes with regard to malaria have occurred between 2000 and 2015 in the stable village population of the Interior. The enormous decrease in malaria was especially a result of a decrease in *P. falciparum* malaria which at that time encompassed over 80% of the national cases (figure 1).

![Figure 1: Number of *Plasmodium falciparum* (Pf) and *Plasmodium vivax* (Pv) cases between 2000 and 2015 by ethnicity in the stable population in Suriname (data Medical Mission)\(^5\)](image)

Not only the number of cases, but also the severity of the infections decreased. Infections with gametocytes were no longer recorded in patients since 2012. In addition zero children under 5 years of age were recorded with malaria since 2013. The relative importance of import malaria increased significantly between 2006 and 2015 (figure 2).
The import malaria in Suriname is mostly due to mobile migrant miners traveling between Suriname and French Guiana. An upcoming publication by Hiwat et al shows that on national level over 90% of the imported cases between 2004 and 2016 are from French Guiana, while in 89% of these cases between 2007 and 2016 the nationality is Brazilian (figure 3).

**Figure 2:** Number of malaria cases 2000–2015 by origin of infection of the stable population in Suriname (data Medical Mission).

**Figure 3:** Contribution of countries (origin of import: between 2004 and 2016) (A) and case nationalities (between 2007 and 2016) (B) to import malaria cases in Suriname (data Malaria Program).
The high proportion of imported malaria cases from French Guiana diagnosed annually in Suriname show the regionalization of malaria in the Guyana Shield, and the impact of the mobile gold miners on regional malaria transmission dynamics. The problem in French Guiana is a largely unrecognized one, which until today has not properly been addressed by the French government. It is estimated that the official numbers reported by French Guiana authorities represent only 30% of the actual number of cases, as about two thirds are diagnosed in neighboring Suriname and Brazil (Figure 4, Musset et al 2014).

![Figure 4: Malaria cases transmitted in French Guiana 2000-2012](image)

For Suriname the continued high import from French Guiana has consequences. It threatens the achievement of the elimination goal due to the continuous risk of re-introduction and re-establishment of malaria in areas in which transmission has been interrupted. In addition it puts a high pressure on the national malaria surveillance system which is not in relation to the national burden of malaria. The need for border screening and malaria case detection in remote mining areas remains high despite the very few cases still reported in Suriname.

There is also a larger threat; due to the common practice of improper self-treatment without diagnosis by the mobile migrant communities the risk for emerging drug-resistance in the malaria parasite increases. Once resistance has been established and with a lack of alternative treatments, malaria is likely to return and cause severe epidemics in a population at risk that has largely lost its immunity.

3.4.5.6.7.8 see literature list
2. Strategy

In 2014 the National Malaria Board developed a “Five Year Malaria Plan” for Suriname (National Malaria Strategic Plan 2014-2019). This plan included the vision to eliminate malaria by 2020 by providing free access to malaria control and prevention to all in Suriname. The goal was to reduce the incidence of malaria to less than 1 case per 1000 inhabitants in every region of Suriname and in parallel prevent the reintroduction in malaria free areas. The elimination goal was deemed necessary and feasible by the Suriname government. Since then, following international guidelines the goal has been sharpened to reaching zero cases in the entire country by 2020. With this in mind, and taking into account the new guidelines for malaria elimination set forth by the World Health Organization\(^9\), it was decided to upgrade the National Strategic Plan.

Nowadays the people most at risk in Suriname are small-scale gold miners called “garimpeiros”. The majority of the cases of malaria diagnosed in Suriname are in the cross-border moving migrant, mostly Brazilian, gold-mining communities and originate from the neighboring countries; especially French Guiana (France). Concerns for Malaria surveillance, control and ultimately elimination include:

- Continued high import of malaria cases from French Guiana, especially in remote mining areas, requiring a continued high investment by the Suriname government to reach and maintain malaria elimination
- High risk of re-introduction of malaria in Suriname in areas where malaria was controlled due this import from neighboring countries.
- High risk of emergence of drug-resistance in the malaria parasite, as is currently the case in other regions worldwide
- Incorrect use of treatment and use as self-treatment among gold miners as a factor contributing to the emergence of drug-resistance in the parasite in Suriname.
- Insufficient and incorrect use of prevention tools (especially bed nets) by the high risk populations resulting in a low protection level of the risk population
- High turnover of miners in high risk areas complicating surveillance and interventions

To address these concerns in an upgraded and updated national strategic plan the Ministry of Health asked the Pan American Health Organization (PAHO) to assist in the development of a **National Malaria Elimination Plan 2018-2022** (figure 5).

Technical Assistance was provided by Dr. Rainier Escalada, of the PAHO WDC office, and a national consultant, Drs Marthelise Eersel, was commissioned to hold stakeholder meetings and write the plan, taking into account stakeholder inputs. The final digital product was launched during a national malaria conference on the 6th of October 2017.

\(^9\) See literature list
During the conference Dr. Marcos Espinal, Director of the Department of Communicable Diseases and Health Analysis at the Pan American Health Organization (PAHO), Regional Office for the Americas made a presentation stressing the importance of the elimination of malaria and explaining the return of investment that can be achieved in a malaria-free environment. Dr Espinal took the opportunity of his visit to have meetings with the Minister of Health, the Minister of Finance and the Vice-President to discuss the national malaria elimination goal.

The National Malaria Elimination Plan 2018-2022 contains the following objectives, namely to:

- Develop and sustain the required financial resources, national management capacity and structures to effectively and efficiently deliver the interventions needed to achieve and maintain elimination;
- Keep the geographical areas where malaria has been eliminated free of autochthonous transmission
- Achieve parasitological diagnostic confirmation of all cases;
- Treat freely all confirmed cases and Track and Report all patients with diagnosis;
- Enhance surveillance linking individual case reports with environmental/entomological data of the locality/focus of transmission;
- Achieve more than 90% coverage of Long Lasting Nets in selected, defined, high risk and vulnerable mobile populations of miners and to selected villages along the border of French Guyana.
- Achieve behavioral change in risk populations regarding adherence to treatment and bed net use.
To achieve these objectives six strategic directions were developed, as follows, namely to:

1. Achieve national ownership and leadership  
2. Achieve a Malaria information system adequate for the analysis, monitoring and evaluation of malaria data and planning of malaria interventions.  
3. Test, Treat and Track (T3) all cases.  
4. Provide long-lasting insecticide treated bed nets for high risk populations.  
5. Conduct the necessary operational research.  
6. Integrated health services for the vulnerable migrant populations in the mining areas.

Crosscutting areas for each strategic direction are the objectives to establish effective Information, education and Communication (IEC), and to establish regional collaboration in order to expand the elimination efforts to neighboring countries.

This Malaria Elimination Plan will guide Suriname to sustain the malaria elimination levels and contain the emergence of antimalarial drug resistance. The Plan also supports strengthening of collaboration with neighboring countries in the Guyana Shield to eliminate active foci of malaria transmission. Continued support for sustained malaria elimination in Suriname and in the Guyana Shield will be needed by donor and technical organizations, as we envision a Suriname and Guyana shield free of malaria.

Hardcopies of the National Malaria Elimination Plan 2018-2022 are now available at the Malaria Program and a translated Dutch version is currently being developed.

3. Resources

The Ministry of Health Malaria Program is a government program with donor support. The Ministry of Health provides this program with laboratory supplies, anti-malarial drugs and human resources. The largest donor of the Malaria Program is the Global Fund to fight Aids, Tuberculosis and Malaria (the Global Fund). Currently the Malaria Program is in its final phase of execution of a three-year grant (April 2015- March 2018) from the Global Fund for a total of USD 2,891,249.00 (SUR-M-MoH; Towards Malaria Elimination: Expanding Test, Track, and Treat in Mining Areas; www.theglobalfund.org).

The Global Fund grant supports key staff positions in the Malaria Program and human resources active in management of the Malaria Service Deliverer (MSD) network in the gold-mining areas in the Interior of the country. It also supports logistical and material costs for the major malaria interventions of the Malaria Program, which include the provision of health services at the Malaria Program clinic, “TropClinic”, and by the MSD network, as well as malaria screening of populations at risk in remote areas via Active Case Detection Surveys (ACDs) and bed net distribution among these populations at risk (see section on Malaria Interventions).
Part of the Global Fund support in 2017 consisted of a contribution of over USD60,000.00 for the construction of a combined office/laboratory/clinic accommodation for the Malaria Program out of grant savings. Counter-financing of USD 60,000.00 was provided by Newmont Suriname LCC, a gold mining company which owns and operates the Merian Project, a gold deposit located approximately 66 kilometers south of the town of Moengo and 30 kilometers north of the Nassau Mountains in Suriname. Newmont Suriname LCC also provided part of the (refurbished) prefab units used for the accommodation. For the design and construction oversight of the new Malaria Program facility technical assistance was obtained free-of-charge from IBT Engineering Consultants (Mr. Serge Tjin) in Paramaribo, while the plot of land upon which the building was constructed was made available by the Bedrijf Geneesmiddelen-Voorziening Suriname (BGVS).

4. Malaria Program Health Services

The main objective of the malaria program is to eliminate malaria in Suriname by 2020 and prevent re-introduction and re-establishment of malaria in all areas in which malaria transmission was successfully interrupted. The population most at risk for malaria is the so-called mobile migrant population, which are gold miners, mostly of Brazilian origin, moving between Suriname and French Guiana. This key vulnerable population is not easy to work with for malaria prevention and control. Important limitations encountered are the result of characteristics of the mobile migrant populations with regard to language and culture, mobility and turn-over, and a general perception of low priority of health versus a high priority of obtaining gold. Equally important are the limitations resulting from the remoteness and difficult accessibility of the mining areas and the gold-based economy (which makes all interventions costly), as well as the unregulated environments which result in unsafe working conditions.

The Malaria Program has a number of strategies to provide malaria health services to the target population. One important pillar of the program is TropClinic which has facilities for testing, counseling and doctor consult, as well as its own laboratory for microscopy. The clinic is run by people who are able to converse in Dutch, English, Surinamese and Portuguese. All personnel have extensive experience in working in the gold mining areas for malaria prevention and control.

Another important pillar is the Malaria Service Deliverer network. Malaria Service Deliverers or MSDs are lay persons who are working in the Surinamese mining areas and who are trained by the Malaria Program to provide diagnosis and treatment to their peers under supervision of the Malaria Program.

The network of Malaria Program MSDs covers mining areas in the Tibiti area, in Saramacca, around the Brokopondo Lake and near Brownsweg, near Snesikondre (border screening), around Lawatabiki and upstream toward Ulemari (border
screening), and around Benzdorp. In addition there is a post at Papatam-Albina to service cross-border moving population from French Guiana. For increased mobility of the MSDs the Malaria Program has a boat in the Lawatabiki area and ATVs in Benzdorp, at the south of the Brokopondo Lake and in the Saramacca area. Those areas that are at high risk for malaria transmission and are not, or insufficiently, covered by the MSD network are visited on regular basis for Active Case Detection Surveys (ACDs); another pillar strategy of the Malaria Program. During these surveys all people present in that area are asked to be diagnosed for malaria and people with a positive test result are immediately treated. The ACD surveys are often a combined effort of TropClinic technical personnel and MSDs of the area. Where necessary the ACD teams are supplemented with trained part-time personnel from Paramaribo.

Prevention is a key activity of the Malaria Program as well. Mass-distribution of impregnated bed nets in risk areas took place over 2016 and continued into 2017. The bed net campaign is linked to an awareness and community engagement building intervention by the Malaria Program outreach team.

An important part of the national strategy is the provision of integrated health services to the vulnerable migrant populations in the mining areas. In a time where malaria is almost eliminated in Suriname, and malaria prevention and diagnosis are not high on the agenda of the target population it is important to stay connected to the population by provision of health services for other priority infectious diseases such as HIV and Leishmaniasis. Using the Malaria Program facilities to provide integrated services to a population who is otherwise barely accessing regular health services is efficient and cost-reducing.

**TropClinic**

The Malaria program clinic, TropClinic, is a low-threshold facility for migrants and provides health services in the area of Malaria (prevention, diagnosis and treatment), HIV (prevention, diagnosis, counseling and referral), leishmaniasis (diagnosis and referral) and general health services related to blood pressure and blood sugar (screening, counseling and referral). In 2017 TropClinic serviced a total of 1206 clients (Table 1).

**Table 1. Number of people visiting TropClinic (Malaria Program) for Malaria and HIV testing or other health services in 2017.**

<table>
<thead>
<tr>
<th>TROPCLINIC</th>
<th>Number of people visiting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>843</td>
</tr>
<tr>
<td>HIV</td>
<td>232</td>
</tr>
<tr>
<td>Other services (blood sugar, blood pressure, Leishmaniasis etc.)</td>
<td>147</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1222</td>
</tr>
</tbody>
</table>
HIV testing services were interrupting halfway 2017 due to a national shortage of tests as a result of expired oral rapid diagnostic tests. The testing services were restarted after a refreshment training with Brazilian counterparts on the use of the oral test in December and receipt of a new donation of test (See also Capacity Building).

With moving of the Malaria Program into the new accommodation TropClinic facilities have expanded to include separate rooms for Testing, Counseling and Doctor Consultations. Also the laboratory was expanded to include a separate room for the laboratory supervisor and extra storage space (figure 6).

Figure 6: TropClinic Laboratory (left) and Testing room (right) with Lauro Melo de Souza, (Malaria Service Deliverer) awaiting clients.

MSD network

Most of the MSDs are service providers in the gold mining areas such as shopkeepers or taxi (all-terrain vehicle (ATV)) drivers. The MSDs are trained to diagnose malaria using rapid diagnostic tests (RDTs) and by making blood slides for cross-checking at a later time at central level. Treatment is done according to national guidelines. Severe and complex cases are referred to health professionals. All MSDs are overseen by so-called MSD-supervisors who spent most of their time in the Interior visiting the MSDs, working with them on data-management and stock-management, providing feedback on results and where necessary providing refreshment training.

Over 2017 the MSD have covered 33.9% (2631/7768) of the national screening effort which resulted in 296 cases of which 96.6% % were import malaria cases.

One of the main challenges in the MSD network is finding suitable people to fill this role in the mining areas. The generally low level of education of the miners and service providers in these risk areas makes this difficult. Minimum requirements include being able to read and write (make reports), having a good concept of and adherence to protocols related to health and safety, having a ‘stable position’ in a certain area and being able to stay in contact with the supervisors. Another problem is the high turnover of people, which necessitates a continuous training and re-training of MSDs.
Active Case Detection surveys
Active Case Detection surveys have taken place in areas where (stable) MSD are active, mostly by the MSD themselves. Larger ACDs were organized for areas where MSDs are not available on a regular basis or at all (figure 7). With the continuous movement of miners between areas it is of importance to keep surveillance going in these remote areas to prevent local outbreaks.
Over 2017 the ACD surveys covered 55.3% (4294/7768) of the national screening effort which resulted in 18 cases of which 72.2 % were import malaria cases.
The challenge with ACDs when comparing the intervention to the MSD network is that the costs of bringing in central level technicians from Paramaribo to do mass-screenings in these remote mining areas, which have a gold-based economy, are very high.

Figure 7: Garimpeiros screened during Active Case Detection surveys at mining areas in the Interior of Suriname.

Bed net distribution
The Malaria Program distributed most of the 37000 bed nets that were purchased in 2016 in that year. A small spill-over was left for 2017. In the third quarter of 2017 an additional 25000 long-lasting impregnated nets (LLINs) were purchased for distribution in the risk areas. The idea was to not distribute the second batch of nets as much on a mass-scale as was done in 2016, but instead combine distribution with a community engagement outreach campaign and work on replenishment of bed nets in areas were bed nets disappeared as a result of a high turn-over of miners or for instance due to loss of the nets during travel to other mining areas (in Suriname or French Guiana). The total number of nets distributed in 2017 was 6022 (figure 8). The remainder of nets that were purchased in 2017 will be distributed in a similar fashion during in 2018 and during the next Global Fund grant period.
Figure 8: Bed nets loaded upon All Terrain Vehicles for distribution in the mining areas (left); Outreach officer Cor Marengo with bed nets in the Adosian mining area (south of the Brokopondo Lake) (middle); Instruction on setup and use of bed nets by one of the Malaria Program outreach agents (right).

5. Research and Monitoring

A research project titled “Monitoring of Artemisinin Resistance and Assessment of the progress of Malaria elimination in Suriname -Introduction of molecular and serological screening-“ is being done by the Medical Scientific Institute, under coordination of Prof. M. Adhin as a sub-contract under the Global Fund grant for Malaria. The objectives of this study are:

- Introduction of molecular screening with Real-Time PET PCR for identification of single foci even with very low parasitaemia
- Assessing the emerging of Artemisin resistance through molecular characterizations and drug sensitivity studies
- Set up malaria serology in Suriname
- Introduction of serological testing to allow the country to gradually declare areas of the territory as free from malaria.

This is an ongoing study for which results will be presented at the end of March 2018.

The Malaria Program is also researching Knowledge, Attitude and Practices (KAP) in relation to malaria in malaria risk areas with local consultants. In 2017 two KAP studies were started which are still in progress and will be finished by the end of March 2018. The first KAP study focuses on mobile migrant populations at high risk in the mining areas. Those are the populations in which the Malaria Program is active with prevention and cases management activities. The second KAP is looking at the stable village population in areas which have not seen malaria in many years, and will be comparing communities which are at risk for re-introduction of malaria (for instance by having commuters to mining areas) with communities who have a low risk of these events.
Entomology surveys are being done as well. For reasons of 1) recurring cases of malaria (though part of these were relapses), 2) a known seasonal high density of Anopheles darlingi mosquitoes in the area, and 3) the presence of contractors from Guyana at the Greenheart logging company, the area of Mozeskreek in West-Suriname was visited for entomological surveys, training of MSDs, bed net distribution and awareness building in 2017. The entomological surveys were done in February (19 Anopheles darlingi, 3 Anopheles nuneztovari), April (13 An. darlingi) and September (13 An. darlingi) respectively by the Entomology Department of the Bureau of Public Health. Support was obtained from the Greenheart Company which provided accommodation for the entomology team.

Mining areas visited following reports of a malaria case or multiple malaria cases were Gonini kreek (April, no Anopheles mosquitoes encountered) and Villa Brazil (October, 1 An. nuneztovari). In addition, since no surveys had been done in the stable communities of the Upper Suriname river in a long time and as a means to get insight into transmission risk a survey was done in the village of Ladauni (August, no Anopheles mosquitoes encountered).

6. Capacity building

The Malaria Program, with support from PAHO (USAID funds) organized two trainings for its own personnel. These were 1) the Malaria Service Deliverer- Supervisor training which had a focus on the elimination goal and the new guidelines published in the “Framework for malaria elimination” by the World Health Organization, and 2) the Outreach training which aimed at providing the outreach team the necessary tools to interactively work with the populations at risk to establish community engagement for bed net use.

With support from the PAHO country office and the Dermatology Service all microscopists of the malaria were trained in making slides of skin scrapes for Leishmaniasis diagnosis. This is in line with Strategic Direction 6 of the national Malaria Elimination Plan 2018-2021 which aims to provide “Integrated health services for the vulnerable migrant populations in the mining areas”. The rationale behind this is that by providing integrated services the structures of the Malaria Program and its connection with the mobile migrant populations allows for efficient use of funds and opportunities. But equally important, by providing services for other priority infectious diseases the Malaria Program remains in contact with the target risk population for malaria, in a time when malaria is of little importance to the population itself due to near-elimination.

From May 22 to June 2, 2017, four Surinamese microscopists participated in a Malaria Microscopy Refreshment training at the Instituto Evandro Chagas in Belem (figure 9). The training was part of the ABC (Brazilian Cooperation Agency) agreement between
Suriname and Brazil. The participants were Hortence Nelson, Iwan Koffie and Valdieia Pantoja Lima (MSD field supervisors of the Malaria Program) and Urick Fortune (microscopist at the Bureau of Public Health). The training was given by Sra. Giselli Rashid and her technical assistants.

Figure 9: MSD field supervisors Iwan Koffie (left); MSD field supervisor Hortence Nelson and Bureau of Public Health microscopist Urick Fortune (right) at the Instituto Evandro Chagas in Belem, Brazil for a malaria microscopy training.

From July 17-27 a SORT IT training was organized for data managers of the Ministry of Health in Suriname. The SORT IT training was implemented by the Pan American Health Organization (PAHO Regional Office) in cooperation with the Malaria Program of the Ministry of Health in Suriname. Participants of the Ministry of Health, the Malaria Program, the National Tuberculosis Program and the Medical Mission Primary Health Care Suriname were trained, by expert facilitators from the region, in analyzing and reporting health information (figure 10). The objective of SORT IT, which is a WHO/TDR initiative, is to encourage countries to scientifically process the enormous amount of health information which is present in the national databases, and to publish the results. The data-analysis will result in visualization of trends and problems, which in turn can lead to the development of more effective and targeted strategies for disease prevention and control. De SORT IT training is divided in modules. The final module of the training took place in December 2017. After completion of the training all participating organizations will make one or more manuscripts ready for submission to a peer-reviewed scientific journal.
The Malaria Program is gradually working towards a strategy to provide its target population with integrated health care for priority infectious diseases, including HIV. Many of the nationals insights into the HIV problem within the migrant population originate from consultations of the Pan Caribbean Partnership Against HIV and Aids Project (PANCAP), which ended in 2014. In line with the PANCAP results and with its target population in mind the Malaria Program felt a need to assess the accessibility of HIV services for migrants in the gold mining areas. The ultimate goal of the study was to generate a national discussion about the accessibility of HIV / AIDS services to migrants. Jara Schmidt, a student in Biomedical Sciences of the Nijmegen University in the Netherlands was interested in doing this study for the Malaria Program as part of obtaining her Master degree. Jara identified four major issues with regard to access of the migrant gold miner population to HIV care:

- the lack of data about migrants obstructs the provision of services because the problem cannot be properly mapped,
- the minimum inclusion of migrants in the national policy of Suriname does not promote the accessibility of the service to migrants
- many migrants do not understand where they have to go within the healthcare system, and within the ministries there are still ambiguities about communication to the migrants and to the ministries themselves, and
- in the interior of Suriname availability of health care is more limited than in the coastal plains, resulting in decreased accessibility. Also, distance, traveling costs and language barriers are a problem for migrants seeking help for care.

Improving access to HIV care for this vulnerable population is not an easy task, and will need to be done via a multi-sectoral approach which will need to include adaptation of national legislation where necessary to include the migrant populations' access to care, inclusion of this population as a target group in policy and strategy development, using of the Malaria Program low-threshold facilities to support implementation of interventions, discussions of solutions for non-documentated migrants lacking insurance or
other means to cover the costs. First and foremost, however, more research needs to be done to solve the lack of data and insight in characteristics of the migrant population at risk and the magnitude of the HIV and access to care problem in this population.

The Caribbean Public Health Agency (CARPHA) in collaboration with the Caribbean Med Labs Foundation (CMLF) conducted a four-day HIV and Syphilis Rapid Test Training Workshop from December 11-14, 2017 at CARPHA, Port of Spain with support from the Pan American Health Organisation (PAHO/WHO). The main objective of this workshop was to strengthen the team approach to provision of HIV and Syphilis diagnostic services through joint training of multi-stakeholder teams. On behalf of Suriname two participants from the Bureau of Public Health, and Astrid Huur, laboratory head of the Malaria Program participated.

In August 2017 three Malaria Program team members, Astrid Huur (Laboratory Supervisor), Iwan Koffie, and Aylla de Miranda (MSD Field Supervisors) participated in an exchange visit with the Brazilian Malaria Program as part of the ABC (Brazilian Cooperation Agency) agreement between Suriname and Brazil. The objective was to share information and experiences about malaria prevention and control in gold mining areas. The participants visited screening centers and malaria program offices in Itaituba (state of Para) (figure 11). The visit was by overseen by Jose Bras, a technical consultant for the Malaria Program.

![Figure 11: Exchange visit of Malaria Program personnel with the Brazilian Malaria Program for orientation on prevention and control in gold mining areas.](image)

In November 2017 the annual refreshment training for microscopists was organized by the Malaria Program for national microscopists of the hospital and private laboratories. Because of the large number of trainees (42) the training was divided in two classes of 1 week (figure 12). Drs. D. Panchoe (head of the Anti-Malaria Campaign (AMC) at the Bureau of Public Health), Mr. S. Harpal (microscopist at the AMC-Laboratory) and Ms A.
Huur (Laboratory Head at the Malaria Program) coordinated the training. Trainees of the Academic Hospital, the Diakonessenhuis hospital, 's Lands Hospital, the Drs. Lachmpersad Mungra Streesziekenhuis hospital in Nickerie (LMSZN), the St. Vincentius Ziekenhuis hospital (SVZ), the private laboratories (Health Control and MyLab), and the Malaria Program, Medical Mission and Medical Faculty participated.

![Figure 12: Participants of first (left) and second (right) week of the national microscopy refreshment training after receiving their certificate.](image)

In December, as part of an agreement between Suriname and Brazil (Brazilian Cooperation Agency) a refreshment training was organized for personnel of HIV testing sites in Suriname (national focal point Drs. Monique Holtuin) for the use of the oral Rapid Diagnostic Tests. Part of the training included “field work”, which meant to invite people for testing. TropClinic was one of the localities where this testing was done together with participants from other health service providing organizations in Suriname.

7. International Interaction

Getting to Zero by 2020: A Network of countries

To track progress towards malaria elimination, substantial improvements in technical skills, surveillance systems and analysis of data for national, regional and global decision making are required in malaria endemic countries. It is important to establish a network for malaria eliminating countries which includes an online database platform to track progress towards elimination that allows data sharing among countries. Data access will facilitate proactively identifying challenges, bottlenecks and the follow-up on trends including cross border issues. To create the enabling environment for accelerated efforts towards elimination, it was decided by the World Health Organization (WHO) to hold an initial meeting in Geneva from 16 to 17 March 2017 (figure 13). This will be followed by annual meetings of the 21 national malaria control program managers, with participation of WHO regional and country staff to assess progress, share knowledge and build technical experience.
Donor interaction

In 2017 a number of meetings have taken place with representatives and consultants of the Global Fund. Most important activities included the development of three-year “Continuation Grant” for Malaria (2018-2021) as a follow-up of the current elimination project. The new project is set to start April 1, 2018. In addition the Global Fund is working with national counterparts to develop a transition plan for the Malaria and the HIV/TB projects taking into account the globally reduced availability of funds, which leads to reduced availability of GF funds, as well the ineligibility of Suriname for further GF support with regard to Tuberculosis prevention and control.

Meetings have taken place with representatives and consultants of the Inter-American Development Bank (IDB) as well. IDB is in communication with the Suriname Ministry of Health about the provision of a loan for priority health interventions.

Plasmodium falciparum Elimination meeting Lima, Peru.

As a follow-up on the implementation of the Plan of Action for the Elimination of Malaria 2016-2020, the Regional Malaria Program organized a meeting to review key malaria detection and surveillance interventions in the elimination of Plasmodium falciparum infection. In this regard a meeting on the elimination of \( P. \) falciparum; detection, treatment, and surveillance of cases was held in Lima, Peru, May 16-18, 2017. Drs. H. Cairo participated on behalf of the Ministry of Health Malaria Program.

Discussing increased import malaria from Sophie (mining are in French Guiana)

From early 2017 onward the import of malaria cases in Suriname from Sophie, a known illegal mining site in French Guiana, significantly increased. The Malaria Program communicated this with counterparts in French Guiana as well as with the Pan American Health Organization (PAHO) and the country portfolio manager of the Global
Malakit; Evaluation of a new malaria control strategy amongst gold miners working illegally in French Guiana

Malaria affects many gold miners working illegally in French Guiana. A study carried out by CIC “Centre d'Investigation Clinique” in Cayenne in 2015, showed that the prevalence of malaria in illegal gold miners working in French Guiana was 22.3%, of which 84% were asymptomatic. A large part of these (47.9%) were the result of P. falciparum infections. Self-medication practices are very common (52.4%). Taking into account that French Guiana, as a result of French national law and the hardline policy toward illegal gold miners, is currently not in a position to manage malaria transmission in these high risk areas according to international guidelines, a pilot project (study) was initiated to increase the part of illegal gold miners in French Guiana who complete their anti-malarial treatment when started, preferably after having been diagnosed with malaria. This project is carried out in a cooperative setting with Brazil, Suriname and France. It aims to assess a new malaria control strategy targeting gold miners working illegally in French Guiana, based on the distribution of self-diagnosis kits and self-treatment against P. falciparum malaria in cross-border areas with Brazil and Suriname (figure 14).

Figure 14: Malakit; self-diagnosis and self-treatment kit for cross-border moving gold miners in French Guiana.
The Malakit project is managed by Centre Hospitalier Andrée Rosemon in Cayenne, French Guiana (Coordinating Investigator: Dr M. Douine). The research partners are the National Malaria Program of Suriname, the Foundation of Scientific Research Suriname (SWOS), the National Malaria Program of Brazil, the Centre National de Référence du Paludisme, Institut Pasteur de la Guyane, the Centres Délocalisés de Prévention et de Soins in Cayenne, the Agence Régionale de la Santé de Guyane (ARS) and is supported by Global Fund and OMS/PAHO (technical advisor Mrs Laure Garancher).

8. Health Promotion and Awareness building

In January 2017 the Malaria Program, together with the foundation for post-academic Education in Medicine in Suriname (SPAOGS), organized a clinical evening on malaria. During this evening a new booklet, a malaria guideline for health personnel, was launched, and the contents presented and discussed (Drs M. Eersel). In addition a presentation and discussion was held on the national malaria elimination goal (Dr. H. Hiwat) on the malaria surveillance system (Drs. Cairo) and on the treatment of severe malaria infections (Dr. S. Vreden).

Malaria Program outreach was done during the bed net distributions throughout the year. Both Malaria and HIV prevention were topics of discussion. The close linking of bed net distribution to interactive outreach in order to obtain community engagement for the prevention of malaria, especially in mobile risk populations, is part of a new approach designed following unsatisfying result with regard to adherence to bed net use in the mining populations.

In front of the new Malaria Program building a large billboard was erected promoting bed net use. This billboard was actually there before the new accommodation as a first indicator for the planned new location of the Malaria Program.

Outreach also took place during the carnival celebration of the Brazilian community in Paramaribo. A small business card with street map showing the TropClinic location was distributed.

During the Caribbean Mosquito Awareness Week the Malaria Program together with the Bureau of Public Health published in article in the national papers on prevention of mosquito-borne diseases.

On World Malaria Day the Malaria Program send out her 2016 annual report to government, parliament, all ministries and partners and stakeholders together with a letter requesting full support for the "malaria elimination in Suriname by 2020" goal.

In the week of Malaria Day of the Americas the Malaria Program broadcasted an infomercial on several TV stations on the national elimination goal and the launch of the national Elimination Strategy.

Last, but not least, in cooperation with PAHO (support from USAID funds) and the Ministry of Education a game of quartets was developed with basic information on
prevention, diagnosis and treatment of priority mosquito-borne diseases (Malaria, Dengue, Chikungunya and Zika). The games were provided to all 350 primary schools in Suriname.

Figure 15: Game of Quartets on prevention, diagnosis and treatment of mosquito-borne diseases, developed for use by primary school students

9. Malaria Program surveillance results

Screening for malaria was done in the field by within the Malaria Service Deliverer network and during Active Case Detection surveys. The total number of people screened for malaria in the field was 6925 of which 314 (45.3%) people were positive for malaria. A total of 299 cases (95.2%) of the total number of positives from the field was the result of malaria import (Table 2). At TropClinic an addition 843 people were screened for malaria of which 186 (22.1 %) were positive. Of these positives 178 persons (95.7 %) were infected outside the Surinamese borders.

Table 2. Number of people screened for malaria by the Malaria Program during Active Case Detection surveys (ACD), within the Malaria Service Deliverer network (MSD) and at TropClinic, and number of positives in 2017; disaggregation in autochthonous and import malaria.

<table>
<thead>
<tr>
<th>Malaria</th>
<th>Number of people screened</th>
<th>#Positive</th>
<th>Autochthonous</th>
<th>Import</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACD</td>
<td>4294</td>
<td>18</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>MSD</td>
<td>2631</td>
<td>296</td>
<td>10</td>
<td>286</td>
</tr>
<tr>
<td>SUBTOTAL FIELD</td>
<td>6925</td>
<td>314</td>
<td>15</td>
<td>299</td>
</tr>
<tr>
<td>TROPCLINIC</td>
<td>843</td>
<td>186</td>
<td>8</td>
<td>178</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>7768</td>
<td>500</td>
<td>23</td>
<td>477</td>
</tr>
</tbody>
</table>
10. National Malaria Epidemiology

The total number of people screened for malaria within the national health system was 11381 (14.2% of the population at risk). In addition a total of 9897 blood smears from the national blood bank were checked for malaria by the Bureau of Public Health Anti-Malaria Campaign. The blood bank samples were all negative for malaria. Of the 11381 people who were seen at the national health facilities or during ACDs a total of 538 (4.7%) were positive for malaria infection. Of these 498 cases (92.6%) was the result of import malaria (Table 3).

A total of 476 (95.6%) of the diagnosed import cases were the result of malaria infection obtained in French Guiana (France; Table 4). The vast majority of cases from French Guiana were coming from the mining area of Sophie (central French Guiana). A total of 364 cases were identified from this area which is 76.5% (364/476) of the total number of malaria import cases from French Guiana.

Table 3: Total number of people screened for malaria in Suriname in 2017, total number of positives and disaggregation of positives in Surinamese (autochthonous) and import cases.

<table>
<thead>
<tr>
<th>Total number</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria people screened</td>
<td>11381</td>
</tr>
<tr>
<td>Positive cases</td>
<td>538</td>
</tr>
<tr>
<td>Surinamese cases</td>
<td>40</td>
</tr>
<tr>
<td>Import cases</td>
<td>498</td>
</tr>
</tbody>
</table>

Table 4: Country of malaria infection for imported malaria cases diagnosed in Suriname in 2017.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of cases</th>
<th>Percentage of import</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>1</td>
<td>0.2%</td>
</tr>
<tr>
<td>Brazil</td>
<td>3</td>
<td>0.6%</td>
</tr>
<tr>
<td>France (French Guiana)</td>
<td>476</td>
<td>95.6%</td>
</tr>
<tr>
<td>Guyana</td>
<td>14</td>
<td>2.8%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>4</td>
<td>0.8%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>498</td>
<td></td>
</tr>
</tbody>
</table>

The monthly distribution of cases diagnosed in Suriname is shown in Figure 16. Considering the origin of the majority of cases as described above, this distribution may be a reflection of the seasonality of malaria incidence in Sophie (French Guiana).
Figure 16: Number of malaria cases diagnosed in Suriname per month in 2017
The distribution of cases diagnosed in Suriname in 2017 is shown in figure 17. The vast majority of cases were the result of transmission in French Guiana, for the most part in the mining area of Sophie.

Figure 17: Map showing the distribution of the origin of malaria cases diagnosed in Suriname
Species diversity and abundance for malaria is shown in Table 5. The majority of malaria cases both in import and autochthonous malaria is the result of Plasmodium vivax infection. The relative contribution of Plasmodium falciparum is higher in import cases than in autochthonous cases.

Table 5: Malaria species for cases diagnosed in Suriname in 2017. Disaggregation to locality of infection.

<table>
<thead>
<tr>
<th>Malaria Species</th>
<th>Import Number of cases (%)</th>
<th>Suriname Number of cases (%)</th>
<th>Grand Total Number of cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Plasmodium falciparum</em></td>
<td>141(28.3%)</td>
<td>7(17.5%)</td>
<td>148(27.5%)</td>
</tr>
<tr>
<td>Mix (P. falciparum/P. vivax)</td>
<td>24(4.8%)</td>
<td>1(2.5%)</td>
<td>25(4.7%)</td>
</tr>
<tr>
<td><em>Plasmodium vivax</em></td>
<td>333(66.9%)</td>
<td>32(80.0%)</td>
<td>365(67.8%)</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>498</strong></td>
<td><strong>40</strong></td>
<td><strong>538</strong></td>
</tr>
</tbody>
</table>

Malaria Surveillance Data verification mission

As a result of the remarkable reduction of the malaria cases since the year 2000, Suriname is moving closer to malaria elimination. A mission by a multidisciplinary team of international experts and PAHO/WHO technical staff was conducted in Suriname from 2nd to 9th October 2017, to assess the national progress toward elimination (Figure 18).

Figure 18: Data verification Mission, October 2017; Dr. Marcos Espinal, Dr. Keith Carter (Both PAHO-WDC), Mr Horace Cox (Vector Control Services Guyana) and Dr. Y. Gebre (PAHO-Suriname) with Valdileia Pantoja Lima (MSD supervisor Brokopondo Lake area) (left), Dr. Dennis Navarro (PAHO-consultant), Dr. Blanca Escribano Ferrer (PAHO- WDC) and Ms. Rebecca Minneman (USAID) checking the books together with Iwan Koffie (MSD supervisor Benzedorp area) (right).
A data verification tool that was developed to assess the performance of the malaria diagnosis and surveillance systems in Central America, the Dominican Republic, and Haiti was used by team members in their visits to different health facilities, in Paramaribo and the interior. The assessment revealed that Suriname has made a concerted effort to maintain a well-functioning malaria surveillance system, trained people and access to free diagnosis and treatment in spite of the reduction in malaria cases. The malaria diagnostic system was also functioning well in all the sites the team visited. In addition, innovative and locally adapted strategies are strong points of malaria control in country.

However, main findings of the verification teams suggest that still some fragile aspects need to be addressed.

Main recommendations include:
1. The National Malaria Program should be given overall authority over malaria control efforts in the country. Coordination between the Malaria Program, the Epidemiology Unit of the BOG, Medical Mission and the National Reference Laboratory should be improved, particularly with regards to the malaria information management.
2. Establishment of a single Malaria Information System, defining and standardizing the flow of information, the forms for notification and case investigation and the approach to data analysis.
3. Improve and maintain malaria surveillance through passive and active case detection in the country, including the Amerindian and Maroon villages of the interior, and particularly in high-risk areas along the borders with French Guiana and Brazil and mining areas in the interior.
4. Develop guidelines for the parasitological diagnosis of malaria within the country that all laboratories should follow, including quality control of all diagnostic laboratories by the National Reference Laboratory and a routine feedback system.
5. Elaborate the Malaria Surveillance Manual, including the definition of a malaria focus, classification of confirmed cases and response activities. Identify and train personnel in case and malaria focus identification, classification and response measures.
6. Conduct focus investigation around each autochthonous case or cluster of cases ideally beginning within 7 days of detection of the case and maintain records of those investigations in the Malaria Program offices in Paramaribo.
7. Develop a strategy for entomological surveillance that recognize the particularities of the different areas of the country and the challenges for the prevention of the reintroduction of malaria transmission.
8. Monitor bed nets ownership and usage in stable communities and mining population.
11. Partnerships

The Malaria Program has continuous contact with partners and stakeholders both on national and international level. Partner meetings in-country included meetings with counterparts at the Ministry of Health and at the Bureau of Public Health- Anti Malaria Campaign and Epidemiology Department, as well as with the Medical Mission, and with private laboratories to discuss, among other things, data management in the light of malaria elimination.

Both the Ministry of Health and PAHO organized planning meetings in which the Malaria Program participated. The PAHO office in Washington DC provided technical support for the production of a new national strategy, for the SORT IT training and for a malaria data verification mission (see above for more information on these topics). Unfortunately technical support from the PAHO country office to the malaria program has been very limited in the past three years following the absence of a national specialist in infectious diseases. PAHO is moving forward in filling this position.

An important partner for the Malaria Program is the CCM (Country Coordinating Mechanism) which on behalf of the Global Fund oversees the Global Fund grant projects. The CCM has been very supportive in the process of development of the new grant proposal for Malaria, and has supported the re-allocation of grant budget for better use of savings. The CCM is also an intermediary in discussions and workshops on transition and sustainability.

The Malakit effort is an innovative intervention being prepared by Suriname, French Guiana and Brazil in a cooperative partnership with the aim to address the issue of high malaria incidence in gold mining areas in central French Guiana (see above for more information on Malakit).

The Brazilian Embassy supported the provision of training for malaria microscopists within the Framework of the ABC (Brazilian Cooperation Agency) agreements between Suriname and Brazil (see Capacity Building).

The Medical Mission has been a partner for bed net storage and distribution as well as for a pilot study on mobile Medical Mission health services provided in mining areas, and the execution of a KAP study in areas where malaria transmission has successfully been interrupting (ongoing).

The Dermatology Service supported the training of Malaria Program microscopists in the microscopic diagnosis of Leishmaniasis as part of the development of the provision of integrated health services to the target populations. Leishmaniasis is one of the priority infectious diseases among gold miners in the Interior of Suriname (see Capacity Building).

An important private sector partnership was with Newmont Suriname LCC who completed a one-year support of one Malaria Service Deliverer providing services in the Meriam mining area (Snesikondre and Tumatu). Newmont also supported the construction of new accommodations for the Malaria Program.
12. Publications

A new booklet on malaria guidelines for health personnel was launched in January 2017 by means of a clinical evening for doctors and other health professionals. The main goal of this booklet is to make sure that health service providers who are currently seeing malaria only sporadically, have all the necessary information to adequately manage (potential) cases close at hand.

On World Malaria Day on the 25th of April, the Malaria Program distributed its 2016 annual report to government representatives, policy makers and partners and stakeholders, together with a letter on malaria elimination by 2020 as the national goal for Suriname.

Following extensive process of interaction with PAHO, the national consultant, and meetings with stakeholders by the consultant, a new National Malaria Elimination Plan 2018-2022 was introduced during a national Malaria Symposium in October 2017 (see also section on Strategy).

For the annual meeting of the American Society of Tropical Medicine and Hygiene (ASTMH) three abstracts were submitted; 1) Suriname on the road to Zero malaria; an epidemiologic descriptive study, 2) Challenges in LLIN intervention among mobile migrant populations along the Suriname-French Guiana border, and 3) migration as a determinant of malaria in Suriname; challenges in reaching elimination. While the first abstract was accepted for an oral presentation (by Dr. Hiwat) the other two were accepted for poster presentation (by Drs Cairo).

Two manuscripts on malaria were submitted to peer-reviewed journals and accepted for publication. The first one compares primaquine double dose for 7 days to a single-dose treatment for 14 days in preventing *Plasmodium vivax* recurrent episodes. This publication was produced by M.S.M. MacDonald- Ottevanger, M. Adhin, J.K. Jitan, G. Bretas and S. Vreden. The second publication describes the decreased endemic malaria and near-elimination status in the stable population of Suriname and was produced by E. Van Eer, G. Bretas and H. Hiwat (figure 19). Both were published in Open Access journals.

![Figure19: Two publications on malaria accepted by peer-reviewed scientific journals.](Image)
13. Lessons learned

Malaria surveillance is key in malaria control and even more so in malaria elimination. When approaching elimination every single case becomes more and more important. As a result every mistake or loose thread in the surveillance system can have an enormous impact on national outcomes. One lesson learned is that as a Program we need to invest more in getting everyone within the national surveillance system onboard for malaria elimination by 2020. The key population at risk is a complex population of mobile migrant gold miners which requires our full dedication, but also a high level of flexibility and a low-threshold approach to be effective.

Another lesson learned is that mobile migrant miners are in no way comparable to the stable communities. Of course there are differences in culture and language, but it doesn’t stop there. The living circumstances differ due to being in remote uncontrolled environments, to being (highly) mobile and to being subject to a gold-based economy. The miners’ point of view on life, on personal priorities, and on health differ, with the ‘gold-rush’ often enough foremost on their minds. As a result it is not always possible to reach objectives in these communities which might be very easily achieved in (and are recommended for) stable communities. This is especially true for instance for bed net use, which we want to promote, and for the use of self-treatment, which needs to be discouraged. For the Malaria Program this means that we have to evaluate on a continuous basis to decide what the appropriate approach is in any given situation. And adjust where needed based on what can and cannot be achieved.

14. Next steps

The Global Fund support under the SUR-M-MoH grant 2015-2018 (implementation period 1) will be ending on March 31st 2018. The Malaria Program team is working hard to realize as much as possible all activities that are to be completed before the end of the grant. The next Global Fund grant, SUR-M-MoH grant 2018-2021 (implementation period 2) will be starting on April 1st 2018. During a planning meeting with the Malaria Program headquarters team and representatives of the CCM (Country Coordinating Mechanism) (figure 2 a preliminary schedule of activities was established based on the major challenges identified both on program, national and regional level (figure 20). The most important activities include strengthening of the surveillance system, expanding and improving the provision of integrated services to the key target populations and gaining further support from national counterparts for the elimination-by-2020 goal.

For more information follow us on www.maliasuriname.com.
Figure 20: Malaria Program headquarters team and CCM representatives after finishing up the annual planning meeting for 2018.
15. Literature

1 World Malaria Report 2017, World Health Organization

2 Global Fund to fight Aids, Tuberculosis and Malaria. https://www.theglobalfund.org


