Study on the knowledge, attitudes and practices of malaria and malaria treatment in the small-scale gold mining sector in Suriname

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Key Words

Malaria, Suriname, KAP study

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ACRONYMS AND ABBREVIATIONS

ABS	*Algemeen Bureau voor de Statistiek* (General Bureau of Statistics)
ACD	Active Case Detection
ACT	artemisinin based combination therapy
ATV	All Terrain Vehicle
BCC	Behavior Change Communication
BOG	Bureau of Public Health (Bureau Openbare Gezondheidszorg)
cabaret	Brothel (Por)
Centre de Prevención et Vaccinación	Prevention and vaccination centre
Centre de Santé	Health Centre
Currutela	Gold miners' village (Por)
FG	French Guiana
Garimpeiro	Gold miner (Por)
GDP	Gross Domestic Product
GNI	Gross National Income
GOS	Government of Suriname
IMF	International Monetary Fund
ITBN	Insecticide Treated Bed Net
KAP	Knowledge, Attitudes and Practices
MoH	Ministry of Health
MSD	Malaria Service Deliverer
MSH	Management Sciences for Health
MZ	Medical Mission Primary Health Care Suriname (*Medische Zending*)
OGS	*Ordening Goudsector* (Regulation Gold Sector), Commission
OTC	Over-The-Counter (medicine)
PAHO	Pan American Health Organization
PPP	Purchasing Power Parity
SIAPS	Systems for Improved Access to Pharmaceuticals and Services
Sranantongo	Suriname lingua franca
SU	Suriname
Tourtonnen lab	Malaria testing and treatment center in north Paramaribo, in the neighborhood where many Brazilian gold miners stay, shop, hang out or conduct business when they are in the city.
USAID	US Agency for International Development
WHO	World Health Organization

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EXECUTIVE SUMMARY

Introduction: This report presents the results of a knowledge, attitudes and practices (KAP study related to malaria treatment in the small-scale gold mining sector in Suriname. Its purpose is to improve access to adequate treatment and adherence to malaria treatment regimes in gold mining areas, thus contributing to the eradication of malaria in Suriname.

Methods: Data were collected in three mining areas: the Benzdorp general area, Papaiston/Cottica and Oelemari. A survey was conducted with 216 persons in small-scale gold mining areas who had been ill with (suspected) malaria in the past 1 ½ years, regardless of whether the malaria was proven by a test or not. The researchers conducted one focus group discussion with a mixed group of eight persons. Qualitative interviews were held with health service providers in French Guiana, with MSD in the Benzdorp general area, and with the owners of supermarkets and pharmacies selling malaria medication in the mining areas. Study limitations included the fact that random sampling was impossible; the limited number of persons who complied with the inclusion criteria; and the high travel expenses.

Results and Discussion: Interviewed inhabitants of mining areas were between nine and sixty-eight years of age, with an average age of 35.2 years. Almost one third (31.9%) of the respondents were women. In terms of their occupation, the largest group of respondents consisted of gold miners, followed by travelling vendors, cooks/kitchen aids, housewives and service providers. Educational achievement among respondents was generally low and did not differ much between women and men. By far the most spoken language in the visited mining areas was Portuguese, followed by Sranantongo. Two out of every five respondents had been working in the gold mining areas for more than seven years, with more men than women reporting a long mining history. Just over one third of interviewees reported that they had exclusively worked in French Guiana in the past 1 ½ years.

With regard to knowledge of malaria, 83.3 percent of respondents correctly identified the bite of a mosquito as the cause of malaria. The belief that malaria is caused by drinking or being near dirty water remains, however, persistent. Virtually all (99.1%) survey respondents were able to name one or more malaria symptoms such as headache, fever and joint pains. When asked how one can protect oneself against malaria, 72.2 percent of respondents named valid protective measures such as sleeping under a bed net (66.7%) and other strategies to either prevent being bitten by mosquitoes or to reduce their numbers. Knowledge of malaria testing and treatment locations in Suriname was suboptimal: More than one third of respondents had no idea where in Suriname they could get diagnosed and treated. Among those who could name a malaria service location in Suriname, most mentioned the services provided by the Suriname MOH malaria program; mainly the MSD and the Tourtonnen lab. Close to half (46.8%) of respondents had optimal malaria knowledge, meaning they named the mosquito as the cause of malaria, AND listed at least one symptom of malaria AND named at least one effective method to protect oneself against malaria AND knew where to go for malaria testing and treatment in Suriname.

About one third of respondents reported that they had been ill with malaria one time within the past 1 ½ years, while the remaining persons had experienced malaria more often. A significant share of respondents had experienced their latest malaria in the month preceding the interview (39.8%). More than half of the interviewees had their latest experience with (suspected) malaria in French Guiana. Persons working in French Guiana also reported more

cases of malaria than persons working exclusively in Suriname. Almost half of respondents did not know what type of malaria they had been ill with the last time they had or suspected to have malaria.

A minority of interviewees (18.5%) had slept under a bed net in the night prior to the interview, and only 11.1 percent of the complete sample had slept under an ITBN in the previous night. Women were more likely than men to sleep under a bed net.

Diagnoses seeking and malaria treatment behaviors of inhabitants of gold mining areas are complex, inconsistent, and largely based on practical considerations. Women are slightly more likely than men to take a malaria test when suspecting to be ill with malaria, while men relatively more often rely on self-medication. Just over half of the respondents had taken a malaria test the last time they suspected having malaria. The most popular place to go for malaria diagnosis was a health service in French Guiana, followed by the MSDs and any formal test location in Paramaribo. Proximity was the main reason to select one health service provider over another. Vice versa, distance from health services – and related travel time and travel expenses- was the main reason for inhabitants of gold mining areas to not get tested. An indirectly related factor is the undocumented status of some migrants, which reduces mobility. The second most mentioned reason for not testing was that the person believed to have already known his/her status. These data suggest that some inhabitants of mining areas are convinced that they know when they have malaria and how to treat it.

Using preventive malaria medication is uncommon in gold mining areas; only one woman took Artecom preventively and six men relied on home remedies. Among the persons who had tested positive for malaria the last time they had malaria symptoms, 76.5% received free medication directly from a health provider. Most remaining respondents reported that they had received a prescription. In French Guiana, P. *vivax* patients receive a first dose of Nivaquine from the health provider and a prescription to buy the remaining tablets at the pharmacy. This additional step in the treatment process resulted in some persons prematurely terminating treatment.

More than half of the respondents reported that they had used over- the-counter (OTC) medication at least once in the past 1 ½ years. By far the most common OTC medicine was Artecom, followed by Coartem and Nivaquine. Most inhabitants of mining areas buy OTC malaria medication in the mining region; in a (Chinese) supermarket, in a (Brazilian) pharmacy, or from traveling vendors. Reported and observed prices of OTC malaria medication varied between USD 7.50 and USD 190-, with the more isolated and difficult to reach places fetching relatively higher prices. The main reason to use self-medication, named by two-thirds of respondents, was geographic distance. Respondents who had relied on self-medication in the past 1 ½ years typically reported that the medicine had worked well because they had felt better/were cured; the malaria symptoms had disappeared; and the medicine had suppressed/incubated the malaria. Reasons to be dissatisfied with OTC medication included that the malaria had returned; the malaria had not been cured at all; or the medication had bad side effects.

The results suggest that theoretical knowledge of correct malaria treatment does not necessarily translate into responsible treatment behavior; almost one third of respondents among those who had said that one should complete the cure, had pills left the last time he or she used malaria medication. Among those who had terminated treatment prematurely, most (78.7%) had done so because they had felt better. Premature treatment termination was more

likely among persons using OTC medicine than among those who had received medicine from a health worker after testing for malaria.

With regard to the use of OTC medication other than malaria medication, the researchers found that 52.1 of respondents had bought some type of OTC medication in the month preceding the interview; primarily painkillers and antibiotics.

Conclusions and Recommendations: The researchers conclude that access to formal malaria prevention and treatment services in Suriname mining areas is suboptimal. The MSD provide –in theory free- malaria testing and treatment in most mining areas but in some places these services are unavailable and in other cases the MSD demand payment. Moreover, many gold miners do not know about the existence of the MSDs or other malaria services in Suriname. French Guiana does not provide malaria testing or other medical services in the (clandestine) gold mining areas on their territories. The large distance to formal malaria treatment locations, coupled with the easy access to illicit malaria medication in Suriname, motivates self-medication. Gold miners relying on self-medication, in turn, were less likely than persons who were diagnosed with malaria to complete their treatment (40.2% vs. 78.9%). These findings suggest that easy and nearby access to health service providers is crucial in improving medicine intake behavior. Overall, less than one third (30.8%) of persons with (suspected) malaria followed the correct steps for malaria treatment the last time they fell ill.

The researchers recommend, for the short term, execution of targeted ACD activities in the Suriname-French Guiana border area, and program activities to improve access to and use of ITBNs in the mining areas. In the area of Services, it is recommended that access to the malaria diagnosis and treatment services of both MSDs and the Touronne lab is enhanced. Furthermore, it may be useful to provide informal vendors with good quality medicines. Several Behavior Change Communication activities are recommended, including a campaign aimed at mining populations to promote correct and responsible malaria testing behavior and medicine intake – in the correct languages. In the area of Policy, the researchers recommend dialogue and collaboration with health professionals and authorities in French Guiana.

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

This report presents the results of a study on knowledge, attitude and practices related to malaria treatment in the small-scale gold mining sector in Suriname, hereafter referred to as KAP study. The KAP study was commissioned by the Government of Suriname/Global Fund "Searching for Gold, Finding Malaria" program in collaboration with SIAPS and PAHO.

In 2008, the Government of Suriname's Ministry of Health signed a grant agreement with Global Fund to execute a project entitled "Searching for gold, finding malaria". This program was a follow-up from an earlier Global Fund funded anti-malaria program, which had resulted in the virtual elimination of malaria from interior villages by 2007. However, the disease continued to affect small-scale gold mining areas. The main anopheles species in the Suriname interior are P. *falciparum* and P. *vivax,* while a few cases of P. *malariae* have also been recorded.

The "Searching for gold, finding malaria" program started in 2009, with as its main purpose to reduce the transmission of malaria in Suriname's small-scale gold mining areas, and thereby prevent a relapse of this disease in interior villages. The main program activities are ongoing and include free testing and treatment of people with malaria symptoms in the small-scale gold mining areas; active case detection (ACD)[1]; an information and awareness campaign; and the free distribution of Insecticide Treated Bed Nets (ITBN) in small-scale gold mining areas.

In 2009-10, the first malaria KAP study in small-scale gold mining areas concluded that non-treatment, incorrect or incomplete malaria treatment, and undiagnosed treatment with over the counter (OTC) medicine occurred frequently. Many people had bought OTC medicine (18.0%) and not finished the prescribed doses of medicine (19.4%). A follow-up evaluation in 2012 found that as compared to 2009, overall malaria knowledge among gold mining area inhabitants had increased, nevertheless, treatment behavior remained sub-standard. Only 38.6 percent of interviewees reported that they had used the services of a formal or government health clinic the last time they had malaria; a mere 37 percent of respondents in gold mining areas named the Malaria Program's Malaria Service Deliverers (MSD) as a location where one can test for malaria; and only 20.1 percent of respondents had used the services of an MSD the last time they had malaria.

The two studies' findings, informal conversations with gold miners, and observations of health specialists suggest that inhabitants of small-scale gold mining areas do not adhere to prescribed treatment regimes. They do not always test for malaria when they believe they have the disease; they take OTC medication; and they discontinue treatments once they feel better. These facts highlight a need to design and implement interventions that enable the mining population to access and use approved antimalarials in the correct way. However, gaps remain in assessing and understanding the reasons for treatment seeking behaviors in the mining population.

[1] Active case detection: a malaria control strategy in which most or all members of selected mining areas are tested and treated for malaria at once. Ideally, ACDs are repeated periodically in order to detect and treat asymptomatic cases of malaria as soon as they appear in the community.

In order to effectively fight malaria in Suriname, it is important that gold miners and other inhabitants of gold mining areas test for malaria, use the prescribed treatment, and use the treatment correctly. The Government of Suriname's malaria program aims to launch an intervention campaign to motivate gold miners to improve their treatment behavior.

The goal of the present study is to further document malaria treatment–seeking behaviors and provide a better understanding of current knowledge, attitudes and practices in mining areas with regard to malaria testing and the use of malaria medication.

Field work was conducted in August and October 2013

1.2. Study objectives

The broad objective of this KAP study is collect baseline data on malaria treatment knowledge and behavior in small-scale gold mining areas, as well as information that can be used to design an appropriate intervention for improving access to adequate treatment and adherence to treatment regimes in gold mining areas and Paramaribo, and thus control malaria in Suriname. The specific objectives are to:

- Map access to malaria medication, with respect to the four dimensions of access– physical availability, affordability, acceptability and geographic accessibility
- Provide an informed estimate of the magnitude of the population accessing malaria medication through unofficial channels, for both prevention and treatment of malaria;
- Identify what different types of medication (including traditional medication) the inhabitants of gold mining areas use to treat malaria;
- Determine where patients in the identified study population access treatment for malaria and other common ailments;
- Assess malaria patients' preventive and treatment-seeking knowledge, attitudes and behavior, including whether they complete treatment, and identify the trends compared to findings of previous studies.
- Determine factors contributing to the identified treatment seeking behaviors.

1.3. Background to Suriname

Suriname is situated on the South American continent, north of Brazil. The country (land mass: 163,820 km2) has a relatively small yet ethnically diverse population (population: 566,846 (July 2013 est.). Suriname's national language is Dutch but many other languages are spoken, including the national lingua franca Sranantongo and languages pertaining to the various ethnic groups. Approximately 85 percent of the population lives in the coastal area, mostly in the capital city of Paramaribo. The densely forested interior, which covers approximately 80 percent of the country, houses and provides sustenance to the Amerindians (app. 12.750) and Maroons (app. 54.750), who are tribal people of African

descent (IDB 2004). In the past two decennia other groups have entered the interior; mainly Brazilian *garimpeiros* (gold miners) but also other people who directly or indirectly work in the gold mining industry, laborers for logging firms, Chinese shop owners, development workers, and teachers and health workers from Paramaribo.

Most of Suriname's interior is rather isolated from the urban zones, and in many ways it is the most marginalized area of the country. Many interior families do not have easy access to clean drinking water, electricity, decent education, high-quality health care, and other public services (Kambel 2006).

With a per capita Gross National Income (GNI, PPP) of US$ 8,500- Suriname may be considered a middle income country (World Bank 2013; 2012 data). For the past few decades, mining has been the cornerstone of Suriname's economy. The Mining and Quarrying sector contributes 8 percent to the Gross Domestic Product (GDP), while the contribution of manufacturing (which included gold processing and refining) is 17 percent (IMF 2012). In 2011, IAMGOLD, Suriname's only large scale gold producer, produced almost 12,000 kg of gold. In that same year, the small-scale gold mining sector produced more than 19,000 kg of gold, with a market value of 914 million US dollar.

1.4. Malaria vectors in Suriname

Hiwat et al. (2012) report that three human malaria parasite species are present in Suriname: *P. falciparum*, *Plasmodium vivax* and *Plasmodium malariae*. This study explains:

> The majority of malaria cases reported from the interior are due to P. falciparum among the Maroons (descendants of African slaves), many of which live in high malaria risk areas, and generally showing a natural resistance against P. vivax infections. The Amerindians, the second largest ethnic group in the interior, and Brazilian gold miners ("garimpeiros") proved susceptible to all three malaria species. Mixed infections seldom occur (less than 2%) (Hiwat et al. 2012).

In Suriname, *Anopheles darlingi* is the primary vector for malaria transmission, but there also is an assumed secondary vector; *Anopheles nuneztovari* (Hiwat pers. com 18 Dec. 2013). Older studies have demonstrated that biting densities of *An. darlingi* peak in periods of (i) high water levels in the long rainy season, (ii) low water levels in the long dry season, and (iii) abundant rainfall in the short rainy season (Rozendaal 1992, cited in Hiwat et al. 2012). The biting cycle of *An. darlingi* may vary by season and across space. Generally, the biting periods of *An. darlingi* are crepuscular, nocturnal or variants of the two, but in some studies the species has also been found biting during the day (Zimmerman et al. 2013). In Suriname, *An. darlingi* is known to bite between about 6:00pm and 6:30am, with one or two peak hours within this period (Hiwat, pers. com. 2013). The BOG malaria team is familiar with locations with peak hours around 10:00pm and 2:00am, but sometimes biting activity is elevated between 4:00am-6:00am.

Anopheles nuneztovari tends to have a peak in biting activity in the early evening, between 7:00pm-10:00pm but can also be found at other hours, sometimes in the early morning (ibid.).

The hot and humid climate of Suriname coupled with the working and living conditions in gold mining areas facilitate the transmission of malaria in these regions.

1.5. Malaria services in small-scale gold mining areas in Suriname

After the first gold rush in Suriname at the turn of the 19th century (1880–1910), Suriname's gold was for many decades only exploited by small numbers of artisanal gold miners. This changed in the early 1990s, which marked the onset of the second gold rush in Suriname. Since then, small-scale gold mining has boomed in Suriname's forested interior. The exact number of gold miners and mining service providers is difficult to estimate because these people are not registered and they are mobile, moving both between countries and within the countries between mining areas. The Commission Regulation Gold Sector (*Commissie Ordening Goudsector*, OGS) has estimated that about 20,000 small-scale miners may be mining for gold in Suriname and that at least a similar number of people are providing auxiliary services[2]. Approximately three-quarters of the miners and mining service providers are Brazilian migrants. The remaining quarter consists primarily of Suriname Maroons; forest peoples of African descent.

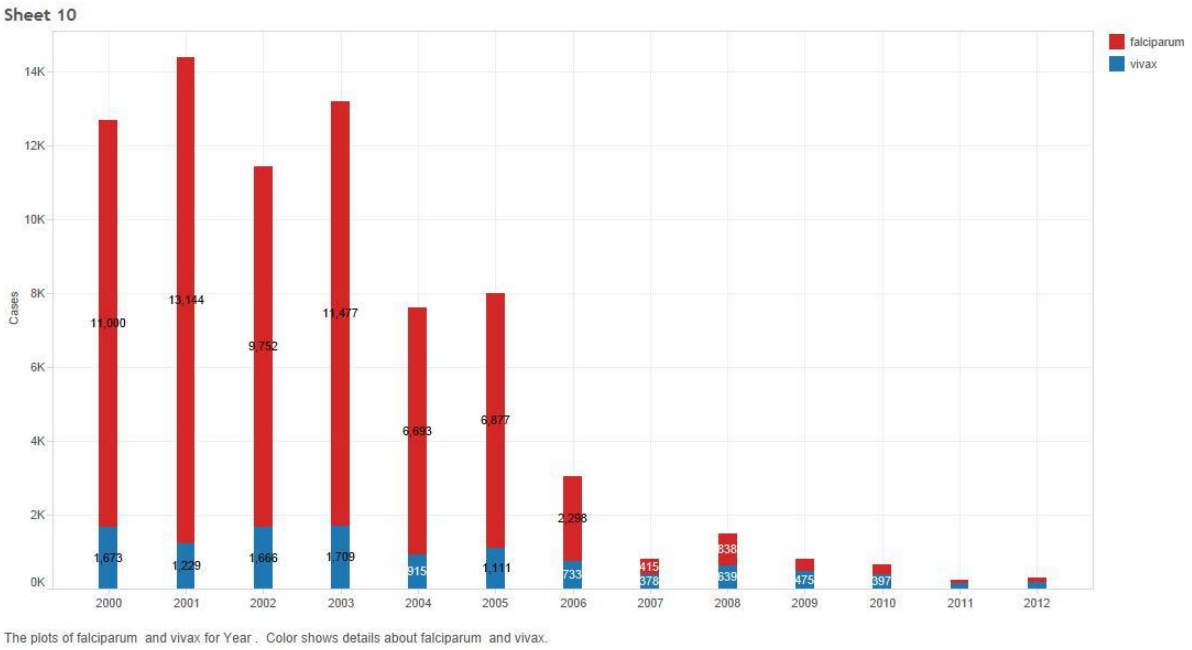
With the rise of small-scale gold mining, malaria boomed as well in the Suriname interior. Highly mobile populations; lack of adequate health infrastructure; "open" living and sleeping arrangements (often just a roof); large pits of standing water; long workdays; limited protection against mosquitoes; and the predominance of unmarried, risk-prone young adult males in small-scale gold mining areas are associated with high prevalence of malaria (Barbieri and Sawyer 2007). The times that gold miners are out to work, bathe and eat coincide with the times of day that the malaria mosquito most actively feeds on blood. Gold miners tend to work 12-hour days, starting around 6 am. The time that workers return to their base-camp to bath and eat (~6 pm) coincides with peak biting activity of the malaria mosquito. If gold mining teams include a night shift, these workers will start at about 6pm, to return to the camp to bath and rest at 6am – again during the high mosquito activity hours.

The Medische Zending (Medical Mission, MZ), the organization responsible for the delivery of primary health care in the Suriname interior, started an intensive anti-malaria campaign in interior villages with support from Global Fund, in 2005. This campaign consisted of the spraying of houses; testing and treatment of malaria cases; the distribution of free insecticide–treated bed nets (ITBN); and raising awareness among at-risk populations. This campaign was successful and the number of malaria cases dropped from 10,713 in 2003 to 1,487 in 2008, to 742 cases in 2011 (Figure 1). Among children under five, the number of malaria cases decreased from 3393 in 2001 to 48 in 2008 (ABS et al.2009: 37). The campaign excluded gold mining camps and settlements.

While these efforts were laudable, they were not sufficient as long as gold mining areas continued to exist as untreated foci of malaria transmission. Gold miners were minimally reached by the regular malaria campaigns because travel to the mining areas is logistically difficult and expensive, and the population consists largely of migrants who do not speak the local languages. Another obstacle to intervention programs was the miners' semi-legal status with no clear formal mining rights or working permits. Malaria re-entered interior villages as

[2] By March 2012, the Commission Regulation Gold sector (OGS), which is making an effort to register gold miners, had registered 3,827 Suriname nationals and 10,849 foreigners who either were working as laborers in the gold mining areas or owned mining equipment. The Commission OGS estimates that 40,000 persons work in the gold mining areas.

local gold miners from these villages returned home, and through social and economic contacts between gold miners and local people.



Source: PAHO, pers. com 31 Oct. 2013

Figure 1. Number of cases of P. falciparum and P. vivax between 2000 and 2012

In order to fight malaria in small-scale gold mining areas, as the remaining point sources of malaria transmission, the Suriname government in collaboration with Global Fund launched the "Looking for Gold, Finding Malaria" program in 2009, hereafter referred to as "malaria program".

The aim of the newly initiated program was to eradicate malaria from small-scale gold mining areas, and thereby eliminate malaria in Suriname as a whole. The malaria program executes various activities in small-scale gold mining areas in the Suriname interior, namely:

1. Distribution of Insecticide Treated Bed Nets (ITBNs) among small-scale gold miners and other inhabitants of small-scale gold mining areas in 2012 and 2013. Between January 2013 and September 2013 about 16,000 ITBNs have been distributed, among which 1726 in 2013.

2. Behavior Change Communication (BCC). Awareness materials were developed specifically for the small-scale gold mining areas, with images and in a language that reflect the living condition in these locations. The materials included a DVD-movie[3] in Portuguese, Sranantongo and English, three different posters, and flyers. These materials have been distributed in all small-scale gold mining areas. When the Malaria Program team visits the mining areas (e.g. for ACDs), these materials continue to be distributed.

[3] The movie was shown on national television, as well as in the gold mining areas, for example during church meetings and in bars/restaurants.

3. Active Case Detection (ACD). During ACD missions, most or all members of each mining community where malaria cases have been detected, are tested and treated for malaria. Malaria testing occurs with the rapid test but blood samples are also obtained for microscopic research. Positive cases receive appropriate medication. Between 2010 and the first half of 2013, the percentage of persons who tested positive for malaria ranged between 3.3 and 1.8 percent (Table 1). The fact that the percentage of positive cases among those who were tested in 2013 is higher than that in previous year does not necessarily mean that malaria has increased. It is more likely an indication of the malaria program's focus on the remaining "problem areas", notably the Suriname-French Guiana border region. The malaria program ACD data show that a significant portion of people who tested positive during ACDs in the past three years were in French Guiana two weeks prior to being tested (Table 2).

Table 1. Number of persons tested during ACDs, and the percentage positive cases among those who were tested, between 2010 and the first half of 2013

	2013 (March & May)	2012	2011	2010
Negative	1905	3656	1743	3970
Positive	64	68	39	111
Total	1969	3724	1782	4081
% Positive	3.3%	1.8%	2.2%	2.7%

Source: Ministry of Health, BOG Malaria Program

Table 2. Number and percentage of persons tested positive during ACDsbetween 2010 and the first half of 2013, by the country where they were two weeks prior to being tested.

	2013; March & May		2012		2011		2010	
	N	%	N	%	N	%	N	%
Fr. Guiana	22	10.6%	33	20.4%	9	20.5%	3	10.0%
Other countries (Br, Guy)[4]	1	25.0%	1	7.7%	0	0.0%	1	14.3%
Suriname	41	2.3%	34	1.0%	30	1.7%	107	2.6%
Total	64	3.3%	68	1.8%	39	2.2%	111	2.7%

Source: Ministry of Health, BOG Malaria Program

4. Malaria awareness rising through personal communication and interaction with the target group. When the malaria program staff members are in the small-scale gold mining areas, they work on raising malaria awareness by informing individuals and families from the target group about the causes of malaria, prevention, use of bed nets, testing, and correct treatments. In addition, people have been trained in the treatment of bed nets with insecticide.

5. Malaria Service Deliverers (MSD). In most small-scale gold mining areas, relatively steady residents have been identified and trained as deliverers of malaria services. The MSD are area residents from different nationalities, speaking the language most

[4] The percentage of persons tested positive who had been in Brazil or Guyana two weeks prior to being tested is high in all years but 2011, but due to the low number of persons tested from these countries the result is not indicative of transmission from these sources.

spoken in the area, and familiar with the local mining population. They received training in malaria testing (rapid-test), collection of blood samples on microscope slides for lab research and verification, provision of correct medication to positive cases, and reporting. At present there are 24 MSD active in Suriname, among whom three in the Benzdorp general area.

Program activities are executed in all locations where gold mining takes place but vary in intensity. The program is most active in the Benzdorp/Lawa region because of the large gold mining population in this region and its proximity to French Guiana. Many small-scale gold miners who work clandestinely in French Guiana live in, travel from, flee to, or visit the Suriname side of the border at Benzdorp. In the Oelemari region the Government of Suriname malaria program had not executed activities prior to the present field work. During the researchers' visit to Oelemari, study team members tested area residents for malaria and the program office sent insecticide-treated bed nets for all persons living and working in the concession area.

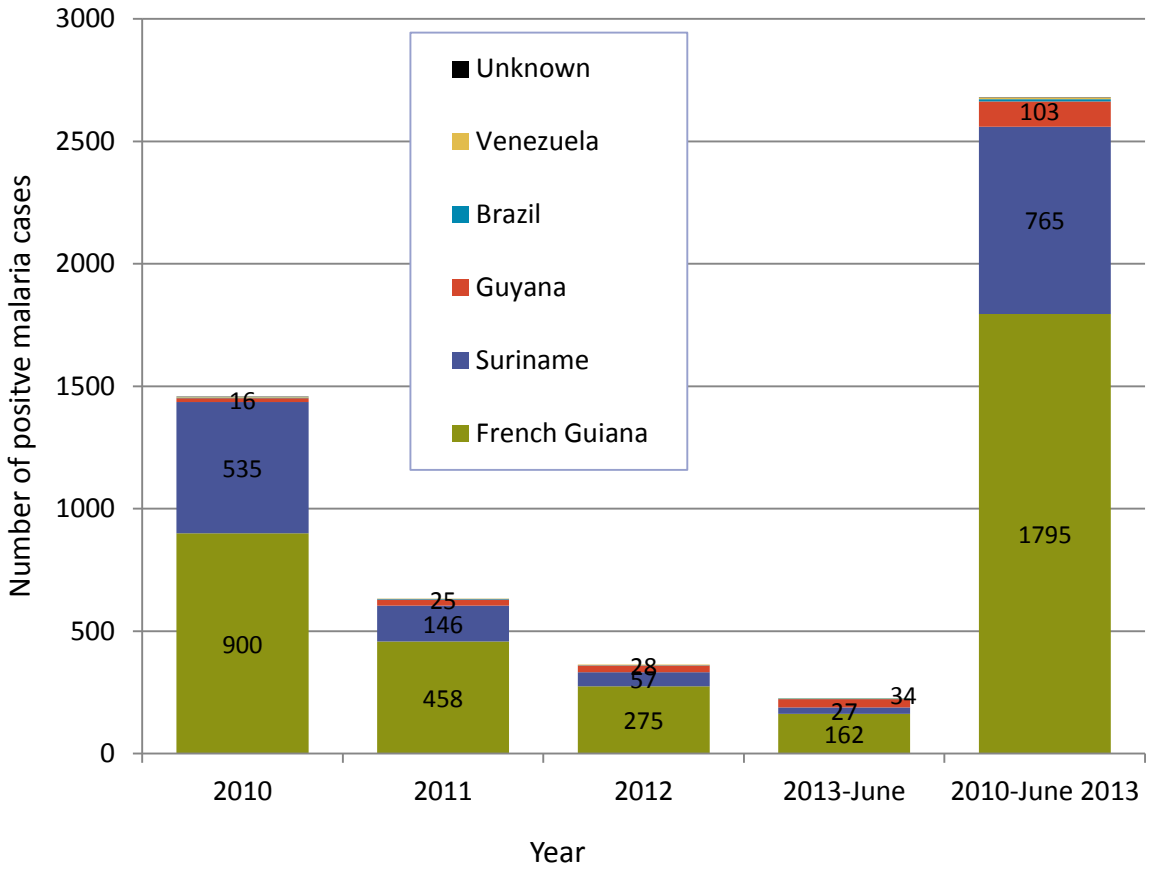
In 2009-10 and 2012 studies were conducted to assess existing knowledge, attitudes and behavior with regard to malaria among small-scale gold miners and people providing services to the miners in small scale gold mining areas. The main conclusions with regard to treatment were:

- Among those who had suffered from malaria at least once, 44.7 percent had at some point in time bought over-the-counter (OTC) malaria medicine, without testing for malaria (Heemskerk and Duijves 2012a). This was a slight decrease from 2009, when we found that 53.8 percent of respondents had at least once relied on self-medication (Heemskerk 2010).

- Among those who had malaria and received treatment, 86.4 percent of the 2012 respondents had completed their most recent treatment, as compared to 80.6 percent in 2009 (Heemskerk and Duijves 2012a; Heemskerk 2010).

1.6. Malaria services in small-scale gold mining areas in French Guiana

Data from the Government of Suriname Malaria Program suggest that a significant share of the people who test positive for malaria in Suriname have probably contracted the disease in French Guiana (FG) (Figure 2). Our data show the same pattern (See Chapter 3). Therefore it is important to briefly describe access to malaria testing and treatment in the interior of this country.



Source: Suriname Ministry of Health, BOG malaria program, December 2013 (Corresponding data table is presented in Table 10).

Figure 2. Number of persons who tested positive for malaria with MSD in the gold mining areas and the Tourtonnen lab in Paramaribo-city, with the country where they probably were infected

French Guiana is an overseas territory of France. In the French Guiana interior, malaria testing is performed in regular clinics and hospitals in the traditional communities. In a strong criticism on malaria-control in French Guiana, Nacher et al. (2013) have argued that national and European laws prevent France from launching the community-based approach to malaria, as is used in Suriname and Brazil, or other effective responses to malaria in the French Guiana interior. Among others, these laws make it illegal for someone who is not a health professional to perform a rapid diagnostic test or to prescribe treatment. At the same time, security issues prevent health professionals from providing their services in illegal gold mining sites. As a result, there are no persons offering testing and treatment in the French *garimpos* other than people who do so clandestinely. In this context, the World Health Organization has reprimanded France for its incapacity to effectively combat malaria in French Guiana (L'Agence Régionale de Santé de Guyane 2013; Annex C). In a critical article, the WHO argues that France is indirectly responsible for the resistance of malaria against medication. The article quotes Drs. Nacher, MD, dermatologist in Cayene, saying: “If French Guiana continues to enforce its national laws, there is a risk that the fight against malaria will fail” (Ibid).

For the study area, the nearest formal health facilities to take a malaria test are the *Centre de Santé* (Health Centre) and the *Centre de Prévention et Vaccination* (Centre for Prevention

and Vaccination) in Maripasoela. Trained health professionals test patients who come with symptoms to the health facilities for malaria using the rapid test. In addition, microscope slides are produced and sent to the capital city of Cayenne for analysis. Testing and treatment in the health centers are free, but patients with *P.vivax* need to buy the medication with a prescription at the pharmacy (~ USD 5.40).

Under the auspices of the *Agence Regional de Santé* (Regional Health Agency), the *Centre de Santé* executes bi-weekly malaria test missions along the Maroni (SU: Marowijne) River to conduct ACDs and malaria tests on demand in communities along the river. These missions do not cover the gold mining areas.

In terms of awareness and outreach, the health centre in Maripasoela distributes bed nets and informs people about the importance of sleeping under a bed net. In addition, the Center has posters and brochures with information in French and Aluku (local tribal language). Furthermore, the Centre extends preventive medication (Malarone) to tourists and other people who come from France for a short (<3 months) period. Details about the extension of malaria medication in French Guiana are described in Box 2.

1.7. Outline of report

The report is structured as follows:

Section1–Introduction and Background: This section provides an introduction to and description of the proposed KAP study and explains the purpose and structure of this report. The section also includes background information on malaria in Suriname.

Section2–Methods: presents the methods used for data collection and analysis. This Section also describes the study population and the survey sample.

Section3–Findings and Discussion: contains the survey findings and discussion. The results are organized according to thematic areas including a background on the study locations; the demographic and social profile of the study population; knowledge and perceptions of malaria; treatment seeking behavior; use of treatment; access to treatment; use of (illegal) medicines; bed net usage.

The results are discussed, as needed, in detail and provides a conclusion with regard to the factors that motivate treatment seeking behavior –testing and medication use- in the mining populations. This section identifies the immediate and root causes behind access and use of approved and OTC antimalarials and medicines

The final **Section4–Conclusions and Recommendations** contains conclusions and recommendations

Data collection instruments can be found in annex A and Annex B contains a list of OTC medication used by the inhabitants of gold mining areas.

2. METHODS

2.1. Sampling

Data was collected in three mining areas (Figure 1):

- Benzdorp general area (incl. Kabanavo, Peruano, Antonio do Brinco)
- Papaichton/Cottica,and
- Oelemari

2.1.1. Study population and sample size

The total number of persons working in the Suriname gold mining regions is unknown, and estimates of these figures vary widely. The Commission Regulation Gold Sector (*Ordening Goud Sector* - OGS), which is the government department responsible for managing and regulating the small-scale gold mining sector, has estimated the population of inhabitants of mining areas at 40,000 individuals (De Ware Tijd, 3 March 2012). About half of these persons may be small-scale gold miners, and the remaining half are mining service providers such as cooks, All-terrain-vehicle (ATV) drivers, sex workers, shop-owners and others working in the mining areas. A total of 2500-3000 persons may be working and living in the areas that are covered in this study. A large part of persons who were in our study area were there only for a couple of days to rest, to visit friends, to buy groceries or to hide from the French gendarmes. In these gold mining areas close to the border, people come and go.

The inclusion criteria for participation in the study were:

a) The person is working and/or living in a small-scale gold mining area, AND

b) The person has been ill with malaria, or suspects that he/she has been ill with malaria, in the past year and a half, regardless of whether the malaria was proven by a test or not.

We chose to include only people who had (suspected) malaria in the past one and a half year because people are less likely to accurately remember their behavior in response to malaria over a more extensive period. The period of 1 ½ years was chosen because the survey was executed in mid-2013, and we asked persons to recollect their experiences with malaria between January 2012 and the time of the interview. The start of the year is a reference point that many people are likely to remember because inhabitants of mining areas often go to the capital city or home (Brazil) for Christmas and/or New Year, or else they will organize some festivities in the forest.

A registration system of malaria occurrences exists but could not be used as a sample frame because it would be impossible to find the patients, given their mobility. Moreover, using the database of registered malaria cases would exclude people who did not take a formal malaria test in Suriname when they last had malaria, for example because they relied on self-medication or got tested in French Guiana. For these reasons the selection included both opportunist encounters and through recommendation by others. The researchers would approach every individual in the selected mining areas, explain the purpose of the study and ask whether the person had been ill with malaria in the past one and a half year, that is, since

January 2012. In the case of an affirmative answer, the person was asked whether he or she was willing to participate in the study, using the described informed consent procedures. We did not keep track of the proportion of people fulfilling the inclusion criteria among those contacted.

The researchers planned to take a sample of 300 individuals. This number was believed to be sufficient for meaningful statistical analysis, and allow the researchers to look at differences between different subgroups of miners (e.g. women versus men, locals versus foreigners). However, because it proved difficult to find persons who had experienced (suspected) malaria in the past 1 ½ years, the final survey sample consisted of 216 individuals. Of these respondents, 151 were from the Benzdorp general area, 39 were interviewed in the area of Papaiston/Cottica and the remaining 26 persons were interviewed in Oelemari. Details about the sample are provided in section 3.1 of the results.

One focus group discussion was conducted with a mixed group of eight persons in Peruano. In selecting focus group participants, we aimed for diversity in professions, sex, age and nationality. Participants needed to be in the area for at least half a year, but they did not need to have had malaria recently.

Qualitative interviews were conducted with two health service providers in Maripasoela, with two MSD in Benzdorp and Kabanavo, and with the owners of supermarkets and pharmacies selling malaria medication in the mining areas.

2.1.2. Study sites

The study sites were selected because of the expected presence of persons who have had malaria in the past one and a half year. This expectation is based on the database of PAHO/Malaria Program, recommendations from MOH Malaria Program staff, past studies, and informal reports from gold miners working in these areas. The Benzdorp general area and Papaiston/Cottica were also selected because they are situated along the border with French Guiana and many gold miners and mining service providers living/staying in this area work (partially) in French Guiana. In the past three years, a significant share of inhabitants from mining areas who tested positive form malaria in Suriname had -most likely- obtained the disease in French Guiana (malaria program unpubl. data 2013, see Fig. 2 and Table 10).

Another reason to include the Benzdorp general area in the sample was that the GOS malaria program has been active in this area for four years now, and several MSD are stationed in this area. Oelemari was selected as a study location because it is a relatively new, poorly known and isolated mining area. The study areas are depicted in Figure 3, and described in further detail below. Figure 4 provides photo impressions of the study areas.

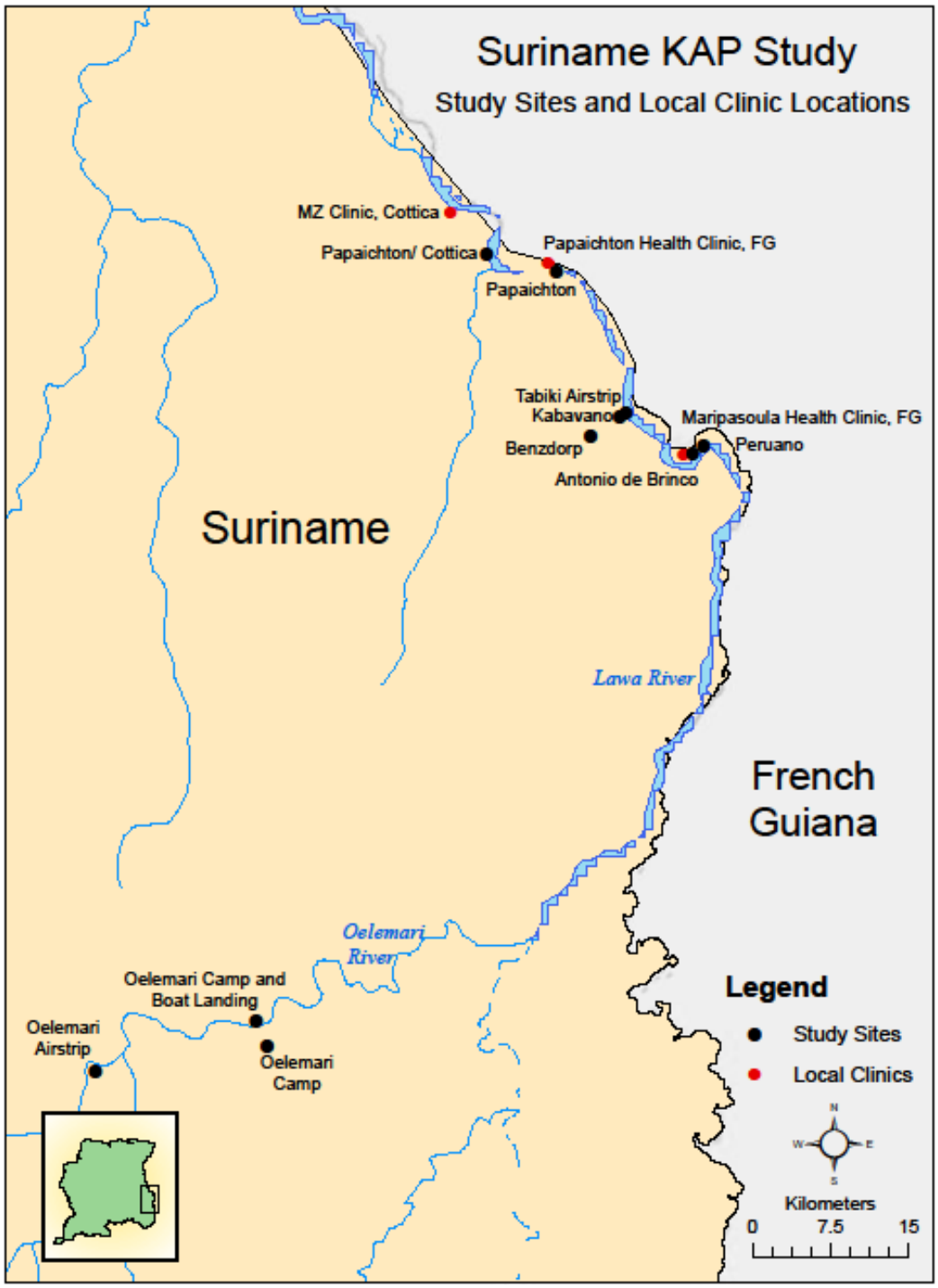


Figure 3. Fieldwork locations (produced by MSH)

Figure 4. Fieldwork impressions

The Benzdorp area is an ancient mining area. The actual location named 'Benzdorp' and the various satellite settlements may at present house approximately 2,000 gold miners and mining service providers. The area can be reached by plane, in about 1 ½ hours from Paramaribo. The main population enclaves are the Benzdorp curatela somewhat land inward and locations along the Lawa river (Kabanavo, Peruano, and Antonio do Brinco), which forms the border with French Guiana. These settlements are relatively well developed and contains businesses that offer a wide range of services, including supermarkets, ATV repair shops, brothels, hair and beauty salons, carpenters, mechanics, and so forth.

The nearest village to the Benzdorp mining locations is Maripasoela (FG); a large urban centre on the French side of the Lawa River. Maripasoela features a small yet modern hospital and a Prevention and Vaccination Center (Centre de Prevención et Vaccinación).

Papaiston/Cottica is a relatively new area where inhabitants from gold mining areas stay. The village of Papaiston is located in French Guiana, but people refer to the miners' settlements across the Lawa River in Suriname also as 'Papaiston'. At the Suriname banks of the Lawa river, three Chinese shops can be found. Mostly Brazilians are living or staying there along the river. More at the back mining takes place and some mining camps can be found. The village of Papaiston features a hospital, a school, and a variety of French public services. The village of Cottica is a Suriname Maroon village, and the miners' settlements near the village are referred to as "Cottica". The village of Cottica hosts a clinic from the Medical Mission Primary Health Care (MZ). Few persons stay permanently in the Papaiston/Cottica area. Instead the settlements serve as a hide-out for people being chased by the French *gendarmerie*, and temporary resting and shopping place. People in the river-side places tend to be transient; they come and go depending on the lever of mining repression in French Guiana. For this reason it was difficult to estimate the size of the population.

Oelemari is located in the far south-east of Suriname. One can reach the mining concession where the gold miners work by taking a plane from Paramaribo (1:15h) and next a boat (1h) to the concession entrance. In contrast to the situation of the other mining locations in the study, access to this area is highly controlled by the concession title holder. There is one point of entry into the forest, which is controlled by armed guards (the "boat landing", see Figure 3), and no-one enters the area without the company managers' knowledge. There is no traditional community near the mine sites, nor a population center for miners and mining service providers on the concession. Instead the gold miners reside in mining camps that are spread out in the forest, and can be reached by ATV. Oelemari is isolated and it is difficult for gold miners in this area to access health services. The estimated size of the population at this location is about 200 gold miners and mining service providers (Fraser, pers. com 9 Aug. 2013). To the consultant's knowledge no earlier studies have been carried out in this area and the GOS malaria program is not active in this location.

2.2. Study design

The study had a quantitative and qualitative component

Face-to-face, quantitative interviews

The researchers conducted a quantitative survey with both open-ended and closed-ended questions with inhabitants of small-scale gold mining areas. This survey took approximately 20-30 minutes to complete and contained the following sections:

Demographics and personal background: Questions about the respondent's demographic background including age, sex, nationality, language skills, literacy and migration behavior.

Working conditions: Questions about working locations in the past year; current primary working location; type(s) of work currently performing.

Malaria history: Number of malaria episodes in the past year; date and location of most recent malaria episode.

Malaria treatment: Access to malaria service providers in Suriname or French Guiana; prices of malaria treatment (medication, health service, transportation); actions undertaken in response to the most recent malaria episode; motivation for this action; type of treatment taken; completion of treatment; experience with treatment failure.

Auto-medication: Use of OTC medication; access to medication; motivations for auto-medication.

Malaria prevention: Use of LLNs; use of prophylaxis or other preventative medication.

Prior to use in the field, the data-collection tool was tested with three gold miners in Paramaribo who normally live and work in the Surinamese gold mining areas. Based on the test, the survey questions were adjusted, some questions were deleted and others were added. The test data were excluded from the final survey sample. In the study locations, the surveys were conducted by experienced and trained surveyors who are fluent in Portuguese and/or Sranantongo. The lead researchers controlled every completed survey form to ensure high data quality. One question that was deleted was asking about the gold mining areas in Suriname where the interviewee had worked in the past three years. This question was not adding valuable information and was confusing.

The final survey forms are attached in Annex A. Each study participant received a Srd 20 (~7 US) in the form of a mobile phone recharge card as compensation for his or her time.

Focus group discussion (FGD)

The FGD started out by asking about knowledge of the cause of malaria and protective measures. Next, the questions moved to the motivations behind using preventive medication, taking a malaria test, or relying on self-medication. Interviewers recorded any interesting details the interviewees might be adding to their answers. However, the FGD did not provide a lot of additional information. For this reason only one FGD was conducted.

Qualitative interviews

Qualitative interviews with health providers and MSDs focused on their experiences with malaria patients, the treatment regimens they prescribed and their observations in the community with regard to self-medication and adherence to malaria treatment. The interview with the medical staff of the *Centre de Santé* and *Centre de PrevenciónetVaccinación* in Maripasoela took approximately 40 minutes, and the interviews with the MSDs lasted for about 20 minutes.

Shop owners and pharmacy owners were interviewed about the malaria medication they sold, the origin of these medicines, and their interaction with malaria patients. Because most of the shop owners were Chinese with limited understanding of Dutch, Sranantogo or Portuguese, and with limited willingness to provide information, these interviews typically did not go beyond recording what types of medication the person was selling and prices.

2.3. Protection of Human Subjects and Ethical Review

Research procedures adhered to professional ethical standards for anthropological and health research. The research protocol was validated and ethical approval obtained from the Director of Health at the Ministry of Health. Prior to conducting a survey interview, the interviewee was approached in an unobtrusive manner. The surveyor introduced him or herself and explained the purpose of the research. It was also explained to the interviewee that participation in the research was voluntary and anonymous. Names of study participants were not recorded to guarantee respondent anonymity. Information provided to the survey team by the interviewees, was treated confidentially and was not documented in a way that can be linked to the source. All data have been presented in an aggregated manner.

2.4. Data analysis

Survey data were entered in the statistical software package SPSS by a trained data entry assistant. The data were cleaned and crosschecked prior to and during the analysis. Both summary statistics and bivariate statistics were used to explore determinants of knowledge, attitude and behavior of the target group. Bivariate analyses served to detect relations between the different variables.

2.5. Research team

The research team was headed by two anthropologists, assisted by six surveyors who were not MSDs, to prevent bias. Both the lead researchers and surveyors who were trained in testing for malaria offered their service during fieldwork. Inhabitants who were in need of a malaria test were tested by the team.

The surveyors spoke Dutch, Sranantongo, Brazilian Portuguese, and tribal Maroon languages. They were selected on the basis of their previous experiences with similar survey work; their language skills; and/or their familiarity with the research localities. Prior to entering the field, the consultant held an orientation session with the surveyors to discuss the sampling strategy, the research approach, and the survey questions.

During both trips the consultant reviewed all survey work, double-checked filled-out forms and gave instruction to optimize data collection. When possible the group split up to visit different locations in the same area at once, to work as efficiently as possible.

2.6. Study limitations and assumptions

Fieldwork was conducted under certain limitations

- **Sampling.** It was not possible to take a random sample of gold miners who work in the mining areas. Migrant workers in the mines are not registered in a public place and they are mobile; moving both within Suriname and between Suriname and other countries. An additional factor that made random sampling impossible is that we targeted persons who had suffered from (suspected) malaria in the past 1 ½ years, and in order to find sufficient interviewees we needed to interview every person who fit the inclusion criteria. Because inhabitants of gold mining areas with recent malaria experience were interviewed 'upon encounter' in target locations, the results cannot be extrapolated to the population of gold miners at large. Nevertheless, given the consistency of the quantitative research results with qualitative data and with information from earlier studies, we believe that the results representative for malaria treatment knowledge and behavior of gold miners in gold mining camps in the Suriname-French Guiana border area. The results do not necessarily reflect conditions in other parts of the country.

- **Sample size.** The team had planned to interview 300 persons but given the rare occurrence of malaria in Suriname mining areas, it was not possible to find more than 216 persons who met the inclusion criteria (had suffered from malaria in the past 1 ½ years) in the selected mining areas. Many approached persons said it had been at least 5 or 10 years since they last had experienced malaria. Because the answers of the respondents were largely consistent and more or less told the same story, the researchers do not believe that a larger sample size would have resulted in meaningful additional insights.

- **Travel expenses to and within mining areas**. Travel to and within the mining areas is extremely expensive, as are lodging and food. For example, a return flight to Oelemari with the research team costs about US$ 5900. Hence it was impossible to visit a larger number small-scale gold mining areas and the team had to select a limited number of locations. By selecting sites that had, based on information from the GOS malaria program, most recent malaria cases, we are confident that our sample is representative for the population of gold miners and mining service providers who recently had (suspected) malaria.

- **Language barrier with Chinese supermarket owners**. Because many Chinese supermarket owners did not (or pretended they did not) speak Dutch, Sranantongo, English, French or Portuguese, it was difficult to obtain reliable information about the origin of the malaria medication the sold in their shops, and about their interaction with (suspected) malaria patients.

In collecting data and interpreting the results, the team relied on various assumptions.

- **Representativeness.** The researchers assume that by surveying inhabitants of mining areas from different subgroups in terms of nationality, gender, and profession, the study provides an accurate representation of the mining population, their habits, their opinions and their attitudes.

- **Reliability**. We also assume that interviewees answered to the questions to their best knowledge and in a truthful manner.

3. RESULTS AND DISCUSSION

3.1. Demographic and social profile

The sample included small-scale gold miners and others living and/or working in gold mining areas in a wide range of ages. Based on year of birth we found that the youngest interviewee, the child of a *garimpeiro* (Brazilian gold miner), was nine years old at the time of the interview, and the oldest interviewee was 68 years of age (N=216). In total four children under the age of 18 were interviewed after obtaining consent from a parent or caretaker. On average, interviewees were 35.2 years of age, with no significant difference between women and men.

Almost one third (31.9%) of the interviewed persons in gold mining areas were women, which is quite a large number considering that virtually all gold miners are men. These women provided a variety of services to the miners and/or were the spouses and other family members of miners (Figure 5).

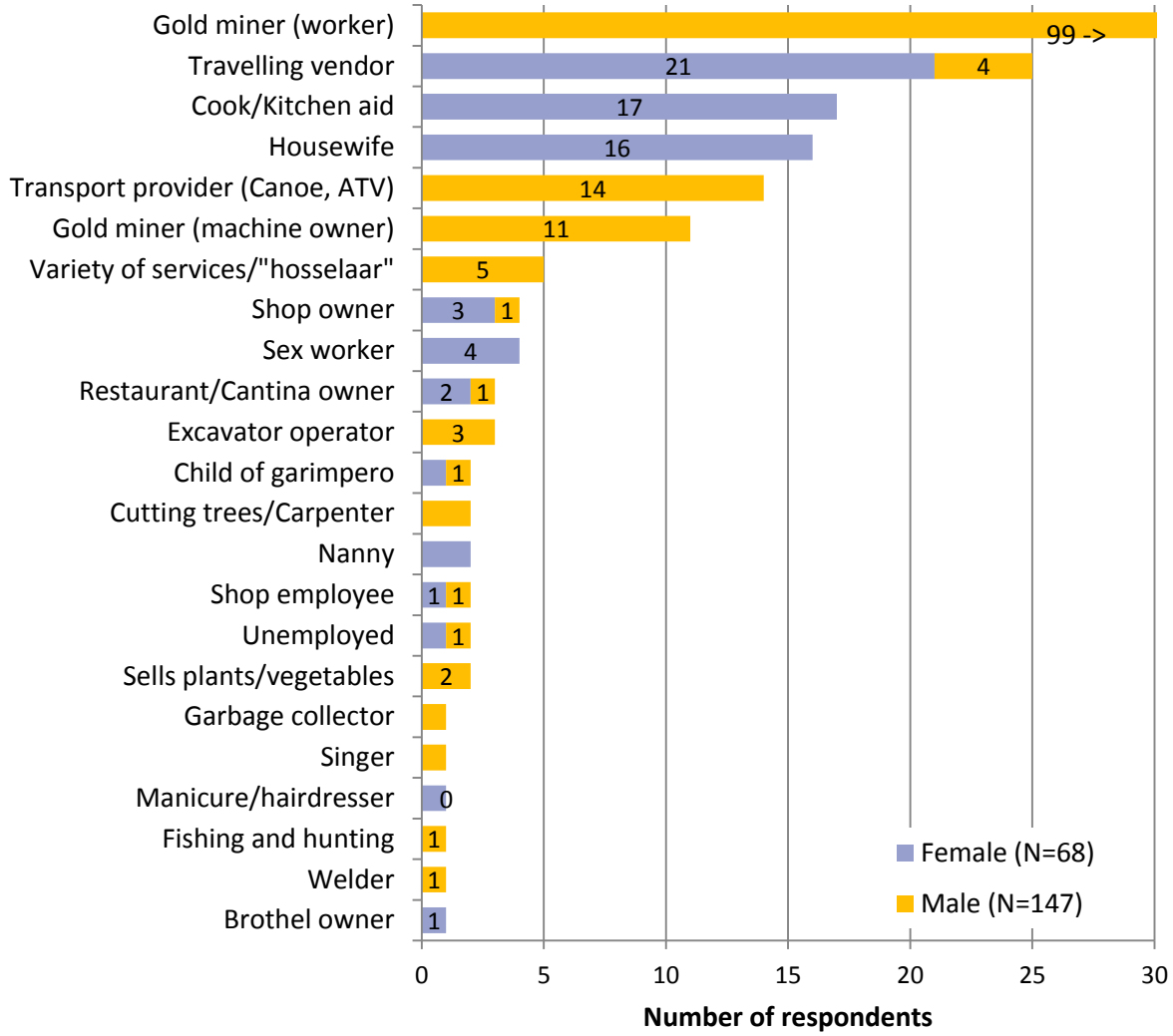


Figure 5. Professions executed by male and female survey respondents in the gold mining areas

Figure 5 lists the various professions that interview respondents in the mining areas performed (see also Figure 7). The largest group of interviewees (45.8%), all men, consisted of gold miners who were working as laborers in the mining pit (N_{total}=216). Other professions that were exclusively performed by men included providing transport with an All Terrain Vehicle (ATV) or canoe, mining machine owner, excavator operator, and a variety of service jobs such as excavator operator, logger/carpenter, fishing and hunting, and other defined and undefined odd jobs. Interviewed women in the mining areas were most often traveling merchants but also worked as cooks, sex workers, shop or restaurant owner, nanny, and several other service jobs.

The largest share of respondents was Brazilian (92.1%) and the remaining interviewees were Surinamese (5.1%), Guyanese (2.3%) and Peruvian (0.5%, 1 person) (N_{total}=216).

Educational achievement among respondents was generally low and did not differ much between women and men (Figure 6). In total 37.6 percent of respondents had not completed primary school. Another 13.0 percent had completed primary education but not gone beyond, and 19.5 percent of respondents had dropped out somewhere in secondary school. Less than a third of respondents (29.4%) had either completed secondary school or studied further at the tertiary level (college/university).

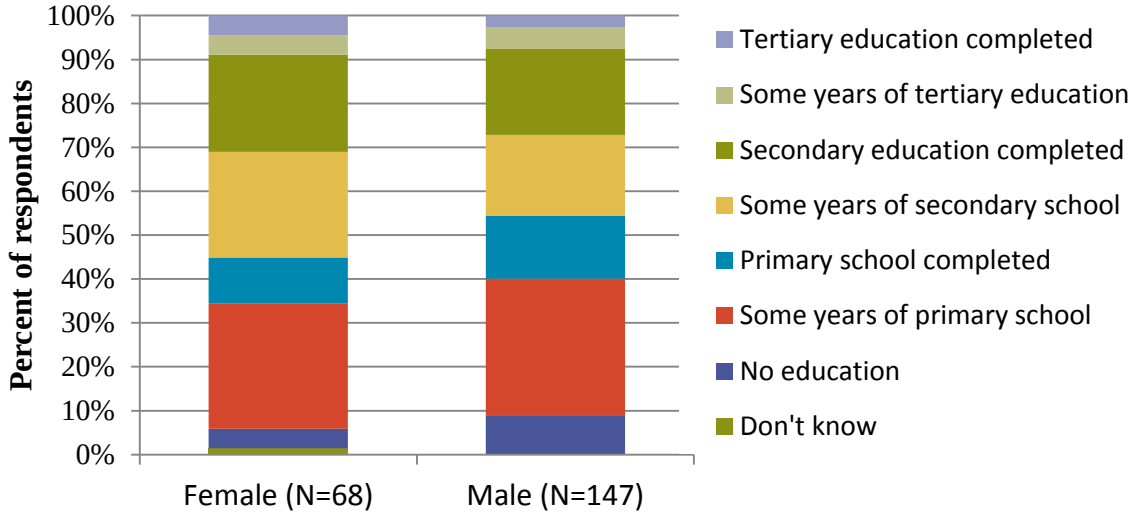


Figure 6 Educational achievement of male and female interviewees in the mining areas

A listing of self-reported language skills in the visited mining areas shows that virtually everyone speaks Portuguese either fluently (94.9%) or well enough to be understood (4.2%) (Figure 8). The second most frequently spoken language is *Sranantongo*, which can at least be understood by almost half (44.9%) of the mining population in the elected mining areas. French, English and Dutch are only spoken and understood by a small minority. These findings suggest public health outreach programs for the mining areas should make use of *Sranantongo* and Portuguese

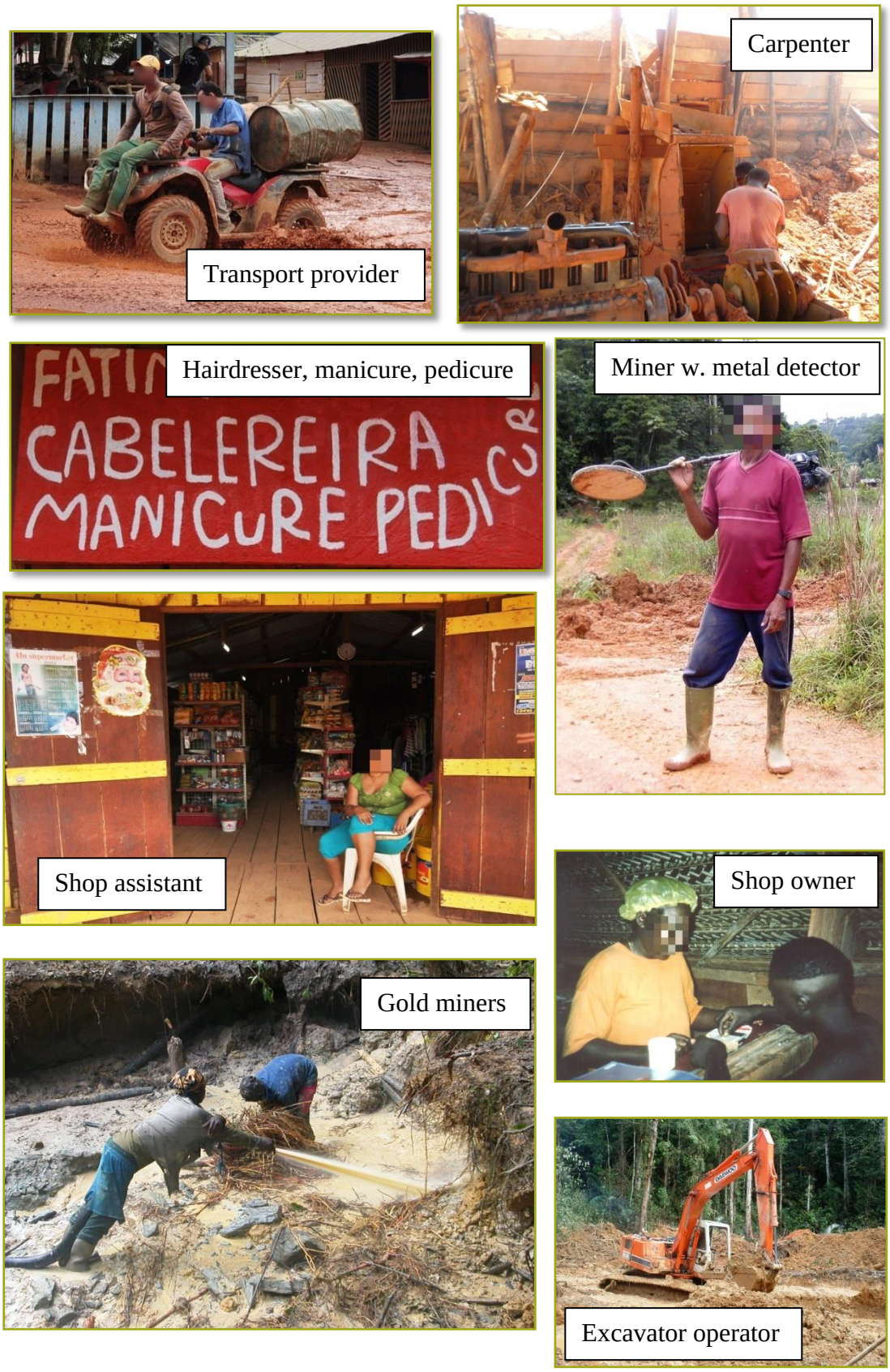


Figure 7. Professions in the gold mining areas

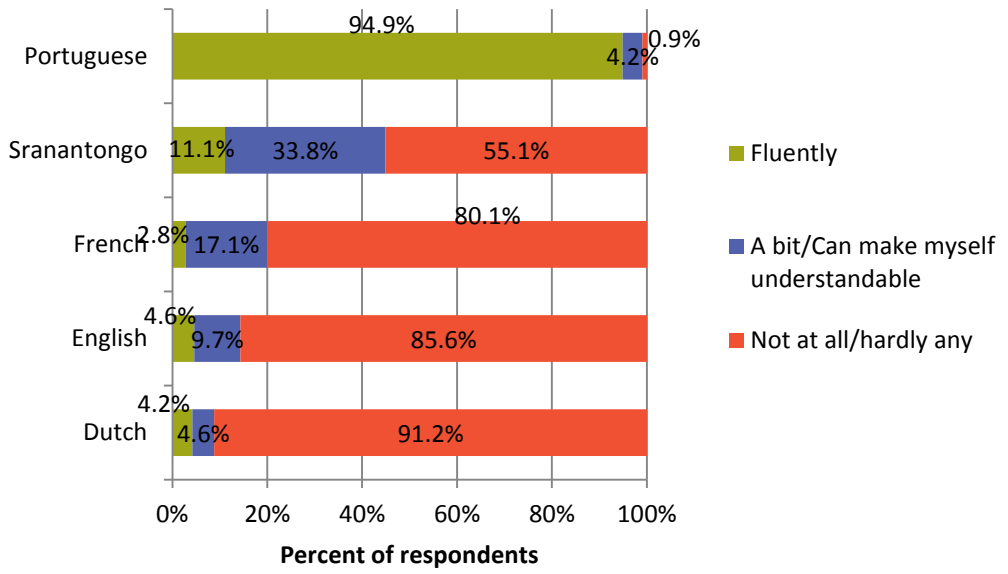


Figure 8. Self-reported language skills of the gold mining population (N=216)

With regard to their working history, 41.7 percent respondents reported that they had been working in the gold mining areas for more than seven years, with more men (49.0%) than women (27.5%) reporting such a long mining history. Vice versa, women were more likely than men to have entered the small-scale gold mining sector only recently, that is, less than a year ago (15.9% versus 8.8%). About a quarter of the total sample (24.5%) had been mining for between one and three years, and another 22.2 percent of respondents had been active in this mining subsector for between four and seven years.

Gold miners and other inhabitants of mining areas were also asked in what countries they had worked in the past 1 ½ years. More than a third of interviewees (34.3%) reported that they had exclusively worked in French Guiana – even though they were interviewed in Suriname (N_{total}=216) (Table 4).

Table 3. Place of interview by countries where the respondent had worked in the past 1 ½ years

	Countries where the person worked in the past 1 1/2 years					
Mining community	**Only Fr. Guiana**	**Only Suriname**	**Suriname & Fr. Guiana**	**Brasil & others**	**Guyana & others**	**N**
Peruano	31	7	21	1	0	59
Antonio do Brinco	19	11	26	3	1	58
Benzdorp	0	2	0	0	0	2
Kabanavo	7	4	18	0	0	29
Papaiston	16	6	16	3	0	39
Tabiki	0	2	1	0	0	3
Oelemari	0	12	10	2	4	26
N	**73**	**44**	**92**	**9**	**5**	**216**

The largest share of these respondents were interviewed in the larger Benzdorp region (Benzdorp, Peruano, Antonio do Brinco, Kabanavo), and another group was interviewed in the area of Papaiston. They were either living on the Suriname side of the border because of the tolerant attitude of the Suriname government vis-à-vis undocumented migrants, or they had temporarily fled their French working location to avoid being captured by the *gendarmerie*. The largest share of respondents from the make-shift settlement of Peruano belonged to this group. Another 42.6 percent of respondents had worked in both Suriname and French Guiana in the past 1 ½ years. The answers suggest that particularly in the border area between Suriname and French Guiana, people are going back and forth across the border, travelling between living and working locations in either country. Even though they work in French Guiana, very few of these gold miners speak any French and hence there is little need for Behavior Change Communication in this language (in Suriname). Still, Communication campaigns should take into account that most gold miners and mining service providers on the Suriname side of the Suriname-French Guiana border spend a significant share of their time in French Guiana. This finding has implications for the type of information provided about health services and malaria treatment.

A much smaller proportion of respondents had recently only worked in Suriname (20.4%), and very few persons had recently worked in the gold sectors of Brazil (4.2%) or Guyana (2.3%). One 65-year old Brazilian woman said that she had worked in Venezuela in the past 1 ½ years.

3.2. Malaria knowledge

Knowledge of malaria was tested by asking respondents about the cause, prevention, symptoms and treatment of malaria.

When asked about the cause of malaria, 83.3 percent of respondents named the bite of a mosquito (N_{total}=216). This figure presents a considerable increase from 2012, when only 63.7 percent of respondents reported that that malaria is transmitted by a mosquito (Figure 9). In 2009, knowledge of malaria transmission was even worse, with only 60.2 percent of foreigners and 44.8 percent of Suriname respondents reporting that malaria was transmitted by a mosquito.

Despite the large number of inhabitants of gold mining areas who knew that malaria is transmitted by a mosquito, popular misconceptions still exist. Most persistent among these misperceptions is the idea that one gets ill from malaria from being near dirty water or drinking dirty water (Table 5). One person asserted: “People think it is the mosquito but that is not truth”. Instead, this 57-year old Brazilian man was convinced that drinking dirty water caused malaria. We suspect that malaria awareness campaigns that have emphasized the elimination of places with standing water as mosquito breeding sites, have resulted in people believing that the water poses the risk, rather than the mosquito. Also the reference to ‘dirty environment’ may have to do with campaigns promoting a clean environment to diminish mosquito breeding sites. Other issues that people mentioned as causes of malaria included being in the forest or the gold fields, being outside at ‘mosquito time’, and a bat or sand fly bite.

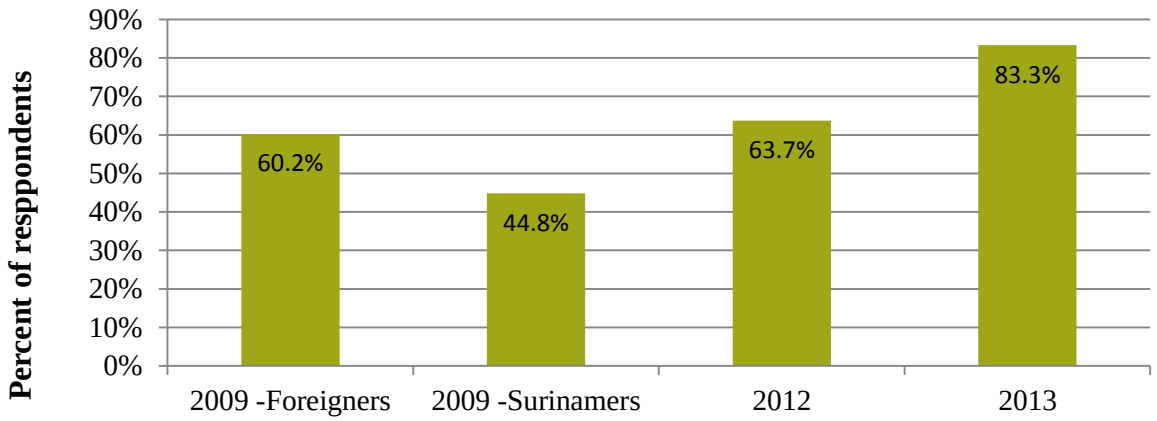


Figure 9. Share of respondents who named the mosquito as the cause of malaria, in 2009, 2012 and 2013

Table 4. Perceived causes of malaria (N=216)

Named cause of malaria	N	%
Mosquito bite	180	83.3%
Being near dirty water	42	19.4%
Drinking dirty water	24	11.1%
Dirty environment	12	5.6%
Being in the forest/gold fields	4	1.9%
Be out at 'malaria time'	2	0.9%
Bat bite	2	0.9%
Eat poorly/Eat taboo foods	2	0.9%
Failure to protect yourself	1	0.5%
Mampira (sand fly)	1	0.5%
Sleep in the dark	1	0.5%

Virtually all (99.1%) survey respondents were able to name one or more malaria symptoms, an increase from 2012 when 88.1 percent of respondents were able to do so. The most often named symptom was a headache (named by 86.1% of respondents) (Table 6). Other often mentioned symptoms were fever (69.4%), joint pains (52.8%), feeling cold/trembling (36.1%) and throwing up/nausea (25.5%). Many other symptoms that can be produced by malaria were mentioned, suggesting that the respondents had extensive experience with malaria. Only two persons could not name any valid malaria symptom.

Table 5. Symptoms of malaria named by inhabitants of gold mining areas (N=216)

Symptom	N	%
Headache	186	86.1%
Fever	150	69.4%
Joint pains	114	52.8%
Feeling cold/trembling	78	36.1%
Throwing up/nausea	55	25.5%
Diarrhea	32	14.8%
Feeling weak/tired	25	11.6%
No appetite	14	6.5%
Body pain	13	6.0%
Bitter taste in the mouth	5	2.3%
Back ache	4	1.9%
Liver pain/inflammation	4	1.9%
Spleen pain/infection	3	1.4%
Kidney pain/infection	3	1.4%
Dizziness	3	1.4%
Bone pains	2	0.9%
Looking pale	2	0.9%
Pain in hands	1	0.5%
Stomach pain	1	0.5%
Cramps	1	0.5%
Pain in the eyes	1	0.5%
Pain in the legs	1	0.5%
Feeling "messed-up"	1	0.5%
Don't know	1	0.5%

We also asked people whether they knew how to protect oneself against malaria. Two thirds of respondents named sleeping under a bed net as a way to protect oneself against malaria (66.7%, Table 5). Various other strategies were mentioned to either prevent being bitten by mosquitoes or to reduce their numbers, such as: using repellent (20.8%), insect spray (0.5%) or insecticide (0.5%); wearing long sleeves and long trousers, particularly after 6pm (1.9%); keep the surroundings clean (4.6%); and avoiding places with mosquitoes (0.5%). Consistent with the erroneous belief that malaria is caused by dirty water, some respondents mentioned either not drinking dirty water (5.1%) or avoid being in the proximity of dirty water (7.9%) (N=216).

Only a few people referred to medicines (home medicine and commercial medicine) that may be taken in order to avoid getting ill with malaria such as the use of preventive medication (5.6%), Artecom (0.5%), strong liquor (0.5) and liver medicine (0.5%). It was specified that ‘bitter medicine’ is most effective against malaria. On the other hand, one person mentioned that one should avoid eating ‘taboo foods’ in order to keep malaria away (N=216).

Table 6. Ways to protect oneself against malaria, as mentioned by inhabitants from gold mining areas (N=216)

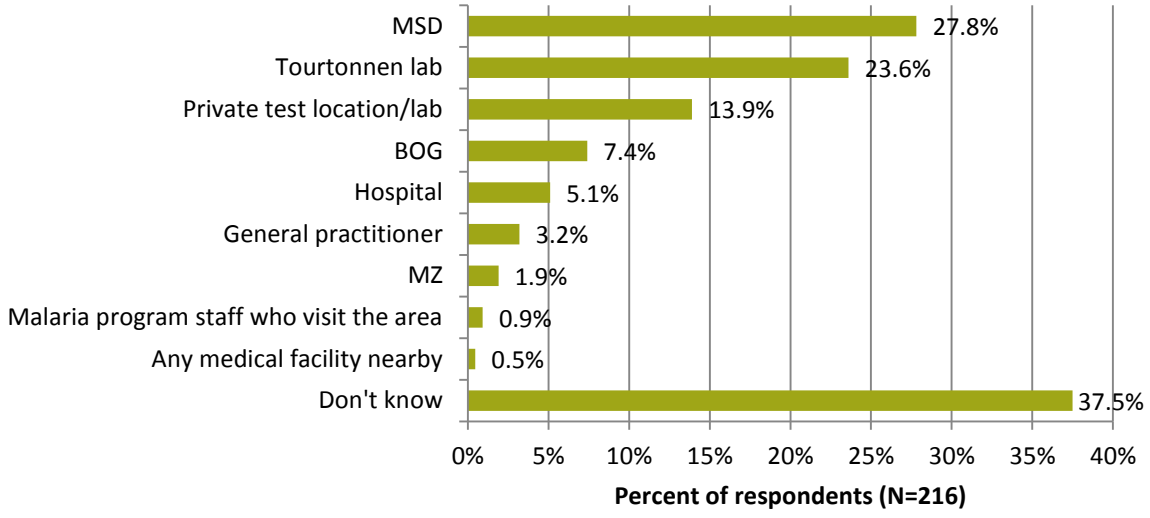
Protective measure	N	%
Correct answers		
Sleep with a bed net	144	66.7%
Use repellent	45	20.8%
Use preventive medication	12	5.6%
Avoid going into the woods/mining areas	12	5.6%
Keep the surroundings clean	10	4.6%
Wear long sleeves and long trousers (after 6pm)	4	1.9%
Be careful after 6 in the afternoon (and around 5am)	3	1.4%
Use insect spray	1	0.5%
Avoid places with mosquitoes	1	0.5%
Avoid places with malaria	1	0.5%
Destroy places with standing water to get rid of the eggs of the mosquito	1	0.5%
Incorrect answers		
Don't know	39	18.1%
Do not get near dirty water	17	7.9%
Do not drink dirty water	11	5.1%
Do not believe that one can prevent malaria (in the mines/the bush)	7	3.2%
Always use med for liver	1	0.5%
Drink strong liquor	1	0.5%
Eat nothing that can affect your liver	1	0.5%
Injection against malaria at BOG	1	0.5%
Not eat 'forbidden' foods	1	0.5%
Sleep in a bed, so mosquito cannot bite you	1	0.5%
Sometimes I take Artecom	1	0.5%
Spread spray (smoke) outside (eg Malation).	1	0.5%
Stay in Brazil	1	0.5%
Stay in the woods, especially in the evening	1	0.5%

Seven persons argued that one cannot prevent malaria. One *garimpeiro* explained that one should wear long sleeves after 6:00pm, but it is difficult to adhere to the practice when working in the interior. Another respondent said that using protection would not matter because the malaria is already in his liver. Also in the focus group, participants mentioned that since malaria was already present in their liver, it was senseless to try to protect oneself.

In judging whether people had correct knowledge of ways to protect oneself against malaria, we considered as correct answers any strategy to minimize the number of mosquitoes or prevent oneself against mosquito bites. These strategies included sleeping with a bed net, using insect repellent, keeping the surroundings clean, wear long sleeves and long trousers, and use insect spray or smoke to get rid of mosquitoes. In addition, the use of preventive malaria medication was considered a correct answer. Answers such as “avoid going to the mining areas” or “not go to the forest” were not counted as correct answers because they are not feasible strategies for people who make a living in the gold mining areas. In total 72.2 percent of respondents were able to name protective measures against malaria. This figure

presents a decrease from 2012, when 85.8 percent of respondents could name one or more ways to protect oneself against malaria.

In order to test people's knowledge of malaria, respondents also were asked whether they knew where in Suriname they would be able to get tested and treated for malaria. Their answers are depicted in Figure 10.



MSD= Malaria Service Deliverer, a MOH malaria program service in the mining areas
Tourtonnen lab = Malaria test location in Paramaribo, operated by the MOH malaria program
Private test location = Any lab where patients pay for blood tests, incl. Medilab, Mylab and Health Control
BOG = Bureau for Public Health, a governmental health care facility
MZ = Medical Mission Primary Health Care Suriname, which operates clinics in interior communities

Figure 10. Places to get tested and treated for malaria named by respondents in the gold mining areas (N=216)

More than one third of interviewees responded that they had no idea of where in Suriname they would be able to take a malaria test and obtain malaria treatment (37.5%). Curiously, persons who indicated that they had only worked in Suriname in the past 1 ½ years were not better informed about malaria test locations in Suriname than persons who indicated that they had only worked in French Guiana during this period (Table 8). In fact, their knowledge of Suriname test locations was even slightly worse than that of persons who had worked only or also in French Guiana. Our data did not allow us to review these results by length of time in the specific gold mining areas. Earlier studies suggest that local mining populations are much better informed about health services in the Suriname interior that migrant miners, and much more likely to use these services (Heemskerk and Duijves 2012b).

Table 7. Knowledge of test locations in Suriname by area where the person worked in the past 1 ½ years

	Don't know where to test		
Area where the person worked in the past 1 ½ years	**N**	**%**	**N_{total}**
Only in French Guiana	27	37.0%	73
Suriname & French Guiana	30	32.6%	92
Only Suriname	19	43.2%	44
Total	**81**	**37.5%**	**216**

This finding suggests that many persons in the Suriname-Guiana border area make use of the health facilities in French Guiana for malaria testing and treatment, as well as for other medical services. Gold miners in the visited regions indicated that they not only favored the health services in this location because of their close proximity, but also because they are free of cost and based on European standards.

Among those who could name a malaria test and treatment location in Suriname, most mentioned the services provided by the Suriname MOH malaria program. These services are delivered by the Malaria Service Deliverers (MSD) in various locations in the gold mining areas; by the malaria laboratory in Paramaribo known as 'Tourtonnen lab'; and by malaria program staff who visit the area for Active Case Detection (ACD), the distribution of insecticide-treated bed nets (ITBN), and outreach activities. The only other medical services in the interior are the health services provided by the Medical Mission Primary Health Care Suriname, popularly known as 'MZ' (*Medische Zending*). For all other mentioned health service centers, such as private clinics, hospitals, and general practitioners, inhabitants from gold mining areas would have to travel to Paramaribo. In total 62.5 percent of respondents could name a location in Suriname where one can be tested and treated for malaria.

An important malaria knowledge indicator is the percentage of persons who have adequate knowledge of malaria causes, prevention, symptoms and treatment. In order to calculate this indicator we developed the variable 'optimal malaria knowledge', which represents the proportion of respondents who:

1. Correctly identified the mosquito as the cause of malaria, AND
2. Listed at least one symptom of malaria, AND
3. Named at least one effective method to protect oneself against malaria, AND
4. Knew where to go for malaria testing and treatment in Suriname

Combining the various measures, we can conclude that close to half of the respondents (46.8%) had knowledge of the cause, symptoms, preventive measures, and treatment of malaria (Table 9). This figure resembles that from 2012, when 47.3% of respondents had optimal malaria knowledge (Box 1).

We need to place one cautionary note in comparing the current data with data from previous studies. The 2013 survey explicitly asked about knowledge of malaria test locations *in Suriname*, whereas in 2012 test locations in French Guiana were also considered as correct answers. The number of respondents who could not name any test location would probably have been lower, and the overall number of persons with optimal malaria knowledge would

have been higher, if knowledge of test locations across the border had been considered among the correct answers[5].

Table 8. Percentage of respondents with optimal malaria knowledge

Respondent:	Percentage
Can correctly name the cause of malaria, as being the bite of a mosquito	83.3%
Can correctly name one or more symptoms of malaria	99.1%
Can name at least one effective method to prevent malaria	72.2%
Knows where to go for malaria testing and treatment in Suriname	62.5%
Has optimal knowledge of causes, symptoms, prevention, and treatment of malaria	46.8%
N	216

Box 1. Global Fund Indicator: % of gold miners who…

(a) Know that malaria is caused by a mosquito, AND
(b) Can name at least one symptom of malaria, AND
(c) Know at least one way to protect oneself against malaria, AND
(d) Are informed about where to get malaria treatment.

Year	% Respondents with optimal knowledge
2009	33.1%
2012	47.3% (N=268)
2013	46.8% (N=216)

3.3. Experience with malaria

In order to get an idea of exposure to malaria in the target areas, we asked inhabitants how often they had had malaria in the 1 ½ years prior to the interview, that is, between January 2012 and the interview date. About one third of respondents reported that they had been ill with malaria one time within that period (32.9%; Figure 11). A substantial number of interviewees, however, reported that they had had malaria more often; two to three times (29.3%), four to five times (34.7%) or even more than five times (0.9%) in the past 1 ½ years.

[5] In 2012, 82.6 percent of interviewees reported that they knew where to go for malaria research; 18.1 percent of these persons had named a location in French Guiana as a place to go for malaria testing and treatment. Among foreign migrants, 25.4 percent named a French Guiana health service as a place for malaria research. These persons were primarily interviewed in the Benzdorp general area.

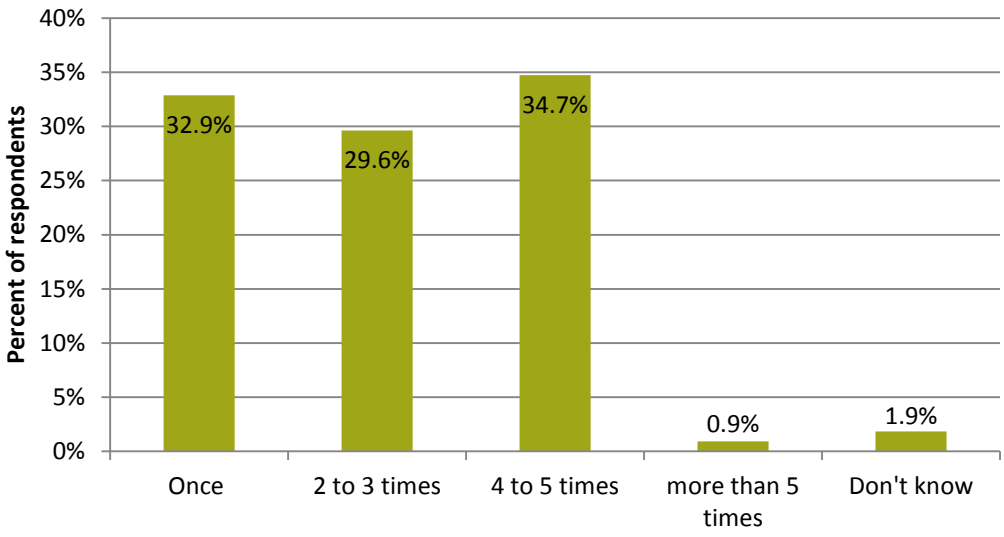


Figure 11. Number of incidences of malaria reported by respondents (N=216)

Several respondents asserted that they had chronic malaria, which was captured in their liver and surfaced once in a while. This idea was particularly common in the Suriname-French Guiana border region. When performing the malaria test during the field work, however, virtually all these persons tested negative for malaria. Others said they had malaria monthly or bi-monthly. In validating this information, it is important to consider that many of these people do not get tested when they suspect having malaria (see section 4.4) and take medication haphazardly (see section 4.5). Hence it is possible that they did not really have malaria every time they suspected having it, but another medical condition resulting in head ache, fever, joint pains or other symptoms indicative of malaria. Indeed it is not unlikely that the combination of extensive periods of heavy physical labor, working long hours in the burning sun, poor nutrition, excessive alcohol consumption, bad hygiene and stress (of being chased by the French *gendarmerie*; of separation from one's family) results in headaches and other malaria-like symptoms.

Another possibility is that these persons were truly ill with malaria and had temporarily suppressed it with an incomplete dose of medication, so that the malaria returned after some weeks. It also is possible that they had *P. vivax* and treated it without Primaquine[6]. All interviewees who indicated that they believed they still had malaria were tested though, and only very few were found to be positive.

When asked about the last time they were ill, or suspected they were ill, with malaria, 39.8 percent of respondents said that they had experienced their latest malaria in the month preceding the interview. A similar share of people, 41.7 percent, had experienced their latest suspected malaria episode between one and six months ago. For fewer people it had been between half a year and a year ago (13.4%) or more than a year ago (5.1%) that they had felt ill with malaria.

More than half of the interviewees said they had their latest experience with malaria in French Guiana (Figure 12). This information is in line with our observations that in gold

[6] 8-[(4-Amino-1-methylbutyl)amino]-6-methoxyquinoline phosphate

mining areas that are located relatively further from the Suriname-French Guiana border (incl. Oelemari), people hardly get ill with malaria anymore.

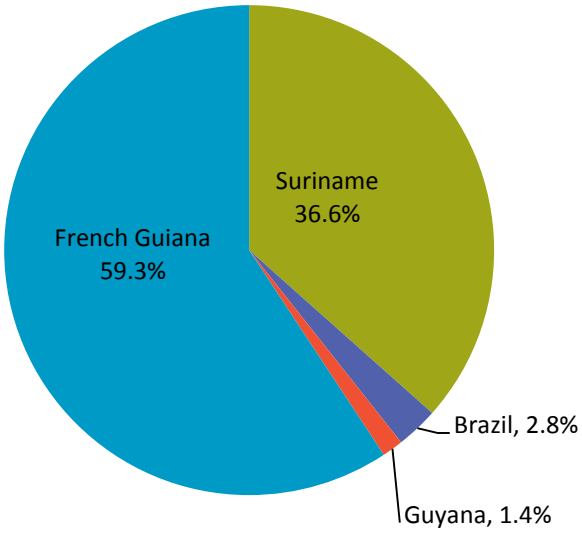


Figure 12. The country where the person was the last time he or she experienced malaria

Furthermore, also data from the MOH malaria program indicate that the largest share of persons who test positive for malaria in any of their test locations (MSD or malaria clinic in Paramaribo) had probably contracted the disease in French Guiana (Table 10).

The same conclusion can be derived when comparing the number of recent experiences with malaria of persons who had only worked in Suriname and those who had worked in French Guiana, among other places, in the past half year (Figure 13). About half of the respondents who had recently only worked in Suriname had been ill with suspected) malaria more than once in the past 1 ½ years, versus 70.1 percent of those who had worked in French Guiana.

Table 9. Number of persons who tested positive for malaria with MSD in the gold mining areas or the Tourtonnenlab in Paramaribo city, with the country where they probably were infected with malaria.

Suspected country of infection	2010	2011	2012	2013-June	2010 to June 2013
French Guiana	900	458	275	162	1795
Suriname	535	146	57	27	765
Guyana	16	25	28	34	103
Brazil	3	3	1	2	9
Venezuela	2	1	2	1	6
Unknown	2	0	0	0	2
Total	226	633	363	226	1448

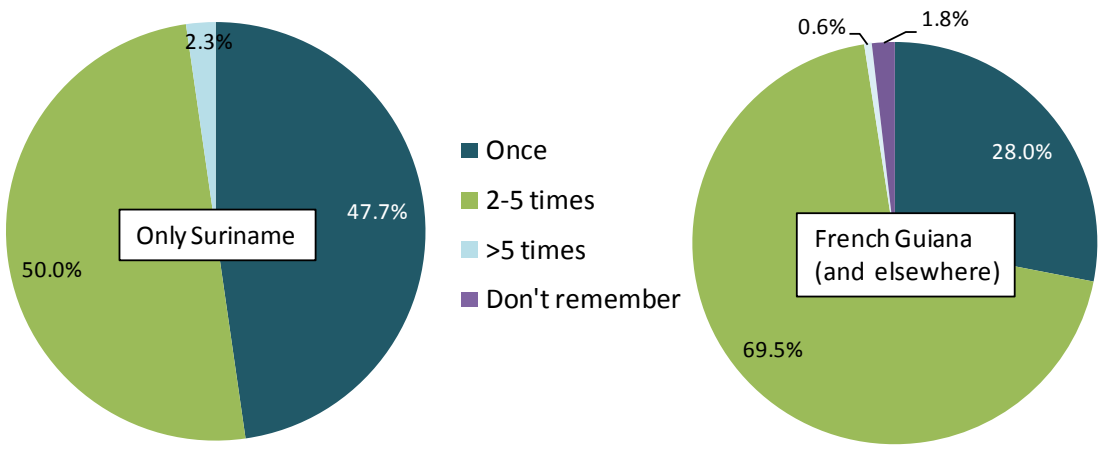


Figure 13. Number of times the person had malaria in the past 1 ½, by country where the person had worked during this period

When asked what type of malaria they had been ill with the last time they had or suspected to have malaria, the largest number of persons (N=98; 45.4%) said they did not know or did not remember (Figure 14). A large share of persons in this group did not know what type of malaria they had had because they had not gone for testing. Curiously, various respondents who had not tested for malaria asserted that they did know what type of malaria they had contracted.

Among the other forms of malaria that were mentioned were: 'dengue', 'a sort of weak malaria' and 'unknown malaria'. In a focus group in the Benzdorp area inhabitants of gold mining areas also mentioned malaria-hepatitis; in their perception a rare but mortal kind of malaria.

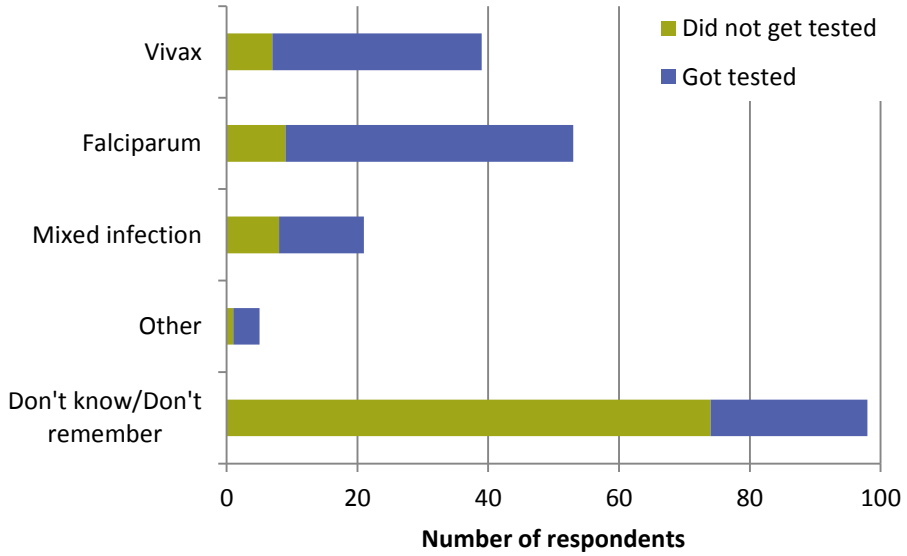


Figure 14. Type of malaria that was experienced, by whether or not the person had gotten tested for malaria (Ntotal=216).

3.4. Malaria Prevention: Use of bed nets

Only a minority of interviewees (18.5%) had slept under a bed net in the night prior to the interview (N_{total}=216), with women (26.1%) being more likely than men (17%) to use a bed net (Figure 15). This figure presents a sharp decrease from survey results obtained in 2009 and 2012, which suggested that in those years respectively 59.4 percent and 49.4 percent of inhabitants of mining areas had slept with a bed net in the night prior to the interview.

In informal interviews, respondents indicated that they did not sleep with a bed net because there was no malaria anymore in Suriname, because they felt too warm/stuffy sleeping, or because they did not possess a bed net. The researchers were also informed that persons working in French Guiana prefer to sleep without a bed net because they have to be able to pack up and run off quickly when they are charged by the *gendarmerie*. Another contributing factor could be that the gold miners in the study area are very mobile, and hence it is possible that many of them only arrived in the area after the Malaria Program distributed bed nets. Yet another factor is that the researchers only interviewed people who had been ill with (suspected) malaria in the past 1 ½ years. It is possible that persons who did sleep under a bed net had not contracted malaria recently, and therefore were excluded from the study.

Of the 40 persons sleeping with a bed net, 24 had used a net that was insecticide treated. In other words, only 11.1 percent of the complete sample had slept under an ITBN in the previous night (Figure 15). Again, relatively more women (17.4%) than men (8.2%) used an ITBN at the time of the interview.

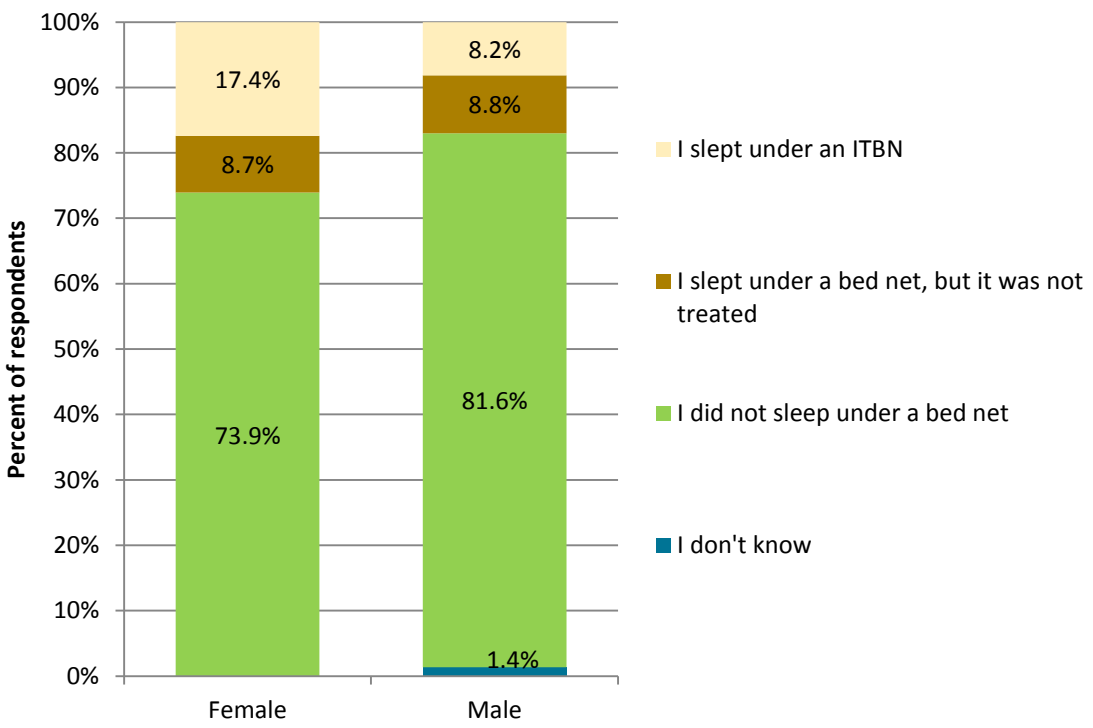


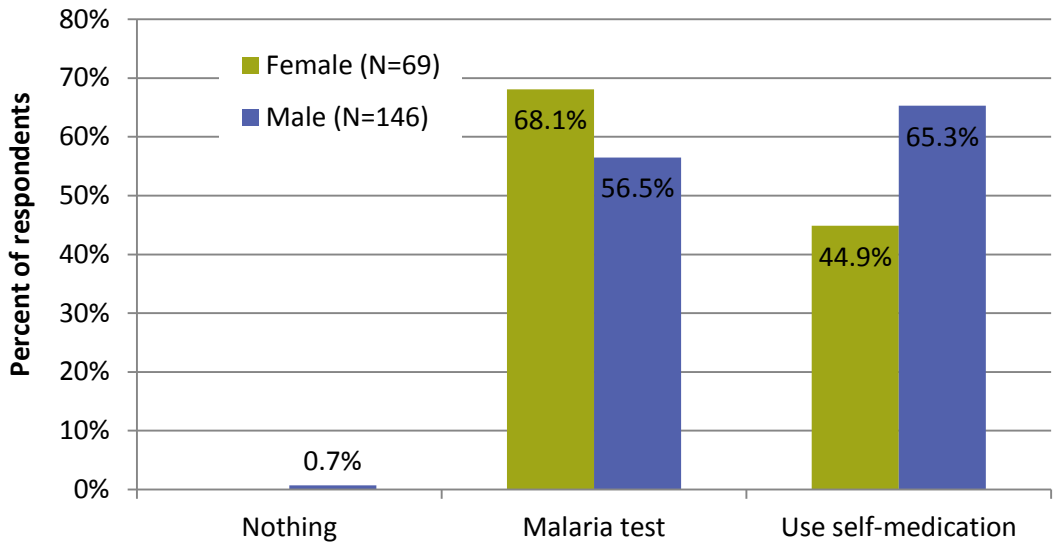
Figure 15. Share of male (N=147) and female (N=69) respondents sleeping with an (Insecticide-Treated) Bed Net

3.5. Malaria testing

Malaria treatment behavior of inhabitants of gold mining areas is complex, inconsistent, and largely based on practical considerations such as money, time and distance. Respondents were asked about their responses to suspected malaria in the past 1 ½ years (January 2012 to time of the interview). The answers suggest that women are slightly more likely than men to take a malaria test when suspecting to be ill with malaria (resp. 68.1% and 56.5%; Figure 16).

Men, on the other hand, are relatively more likely to rely on self-medication; respectively 65.3% of men versus 44.9 of women had used self-medication at least once in the 1 ½ years prior to the interview. One possible explanation for this finding is that men, who most often are gold miners, tend to work in the deep forest at a long distance from health services. Meanwhile women, who are more likely to provide services to miners, often live and work in satellite settlements and/or near communities that offer malaria testing facilities.

One person said that he had done "nothing" in response to malaria. This man had experienced asymptomatic malaria and only discovered that he had the disease when he was tested during an ACD.



*Totals add up to more than 100 percent because some persons who had malaria multiple times in the past year had used different strategies to deal with it

Figure 16. Strategies undertaken by male and female inhabitants of gold mining areas in response to suspected malaria, between January 2012 and the time of the interview*.

Just over half of the respondents had taken a malaria test the last time they suspected having malaria (54.2%; N_{total}=214). The largest group of these people, or fifty persons, had been tested by a health professional in French Guiana, typically in Maripasoela (43.9%; N_{total}=114; Figure 16). This finding corresponds with the finding in the previous section that the largest share of interviewees had experienced their most recent malaria in French Guiana. It also reinforces the impression that inhabitants of gold mining areas and satellite settlements on the Suriname shores of the Suriname-French Guiana border (Benzdorp area, Papaiston Cottica)

often work and seek health care across the border, in French Guiana. Persons working in Oelemari were much less likely to travel to French Guiana for malaria treatment (Figure 17).

The second most common place to get tested for malaria is by an MSD in the Suriname mining areas (22.8%; N_{total}=114). People in the Papaiston/Cottica area were least likely to have been tested by an MSD the last time they suspected having malaria. This is not surprising, given that there is no MSD active in this area, and the nearby French village of Papaiston features a modern health clinic.

The MSD are supposed to test for malaria and extend medication to positive patients for free. However, inhabitants of gold mining areas reported that some MSD take a fee of 0.5 or 1 g of gold (~ US$22-45) to perform a malaria test, and one of the MSD in the Benzdorp general area said he charged €5- (~US$7). The team also received information that at least one of the MSDs from the Benzdorp general area regularly crosses the border into French Guiana gold mining areas, where he conducts the malaria tests and sells medication at 2 g. of gold/treatment course (~US$90-). One interviewee (recorded in "other") said he was tested for malaria by this MSD the last time he had malaria.

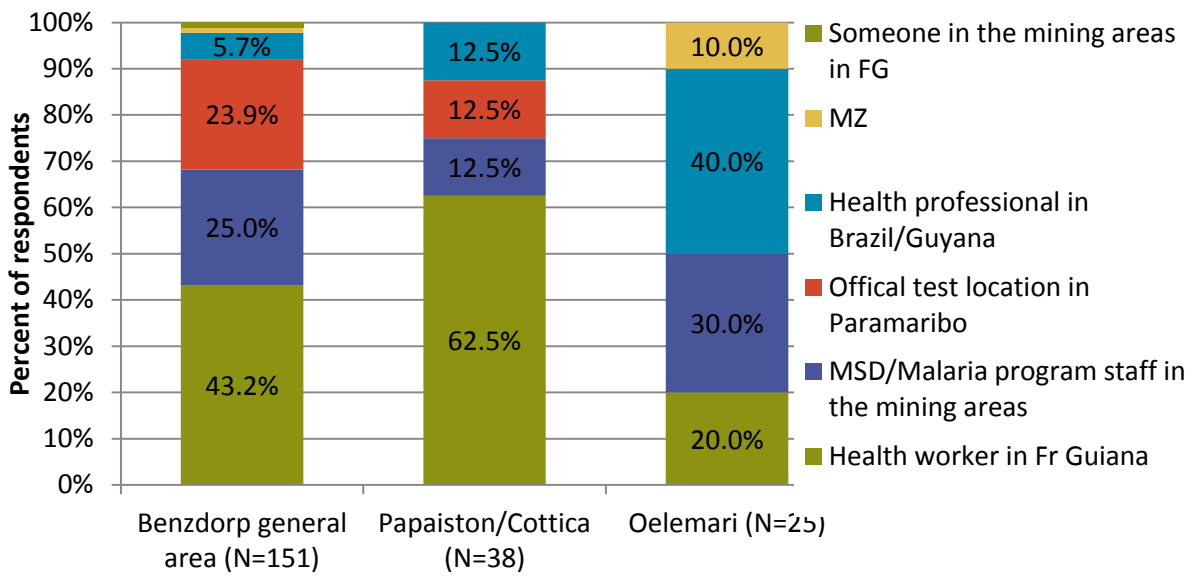


Figure 17. Places where respondents got tested the last time they were ill with malaria, only showing respondents who indicated that they had taken a malaria test the last time they suspected having malaria (N_{total}=114)

A similar share of interviewees (19.3%; N_{total}=114) had been tested in an official test location in Paramaribo, such as the MOH malaria lab ('Tourtonnen lab'), a private lab or the Bureau for Public Health (BOG). Lower numbers of interviewees had been tested by a health professional in Brazil or Guyana (9.6%), by MZ (1.8%), by the BOG (1 person), or by malaria program staff during an ACD (1 person). In the Oelemari area, a relatively large share of persons had been tested in Brazil or Guyana the last time they suspected malaria. This result may be explained by the relatively recent arrival of a group of Guyanese workers in this mining area.

For people who had taken a malaria test the last time they thought they had malaria, proximity of the test location had been the main reason to select a specific health service (79.6%; N_{total}=113; Figure 18). This group included persons who had been tested by health professionals in Paramaribo. These interviewees typically had not travelled there for the purpose of being tested but they happened to be in town when they started feeling ill, and subsequently took the test.

Among people who had been tested in French Guiana, 89.6 percent reported that proximity had been their main motivator for selecting this specific health service. Three persons among those who had taken the malaria test in French Guiana said that there is no other place to get tested in the area, and hence they relied on the French health services. This answer indicates that some inhabitants of Suriname mining areas are poorly informed about the MSD services. This idea was confirmed by other comments. For example, one person in the Benzdorp general area reported that he felt ill but he had no gold to go to Paramaribo, and hence he took the test in French Guiana.

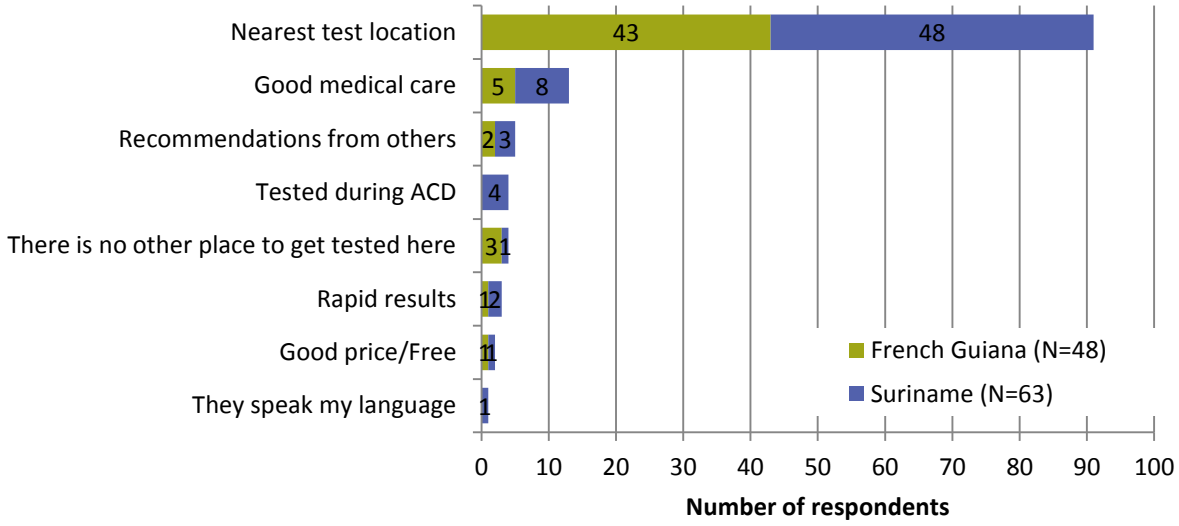


Figure 18. Motivation to select a specific health service the last time the person suspected having malaria, distinguishing people who tested in French Guiana (N=48) and those who tested in Suriname (63).

Respondents who had not taken the malaria test the last time they suspected having malaria also indicated that distance was their main motivation. In Figure 18, which presents the reasons mentioned for not taking a test the last time the person suspected having malaria, the reasons related to distance are marked in blue. In addition to stating that the nearest health post was too far away (mentioned by 67% of respondents), also financial reasons (too costly to travel to the health post, 4%), travel time (4%), and the lack of MSD services in the area (4%), referred to geographical barriers, i.e. the substantial distance between the location where the person fell ill and the nearest test location. Also the answer that the person only fell ill when he/she was already in the mining area, suggests that he/she would have taken a malaria test if he/she would be in an urban center or somehow near a health facility.

Among those people who had taken the malaria test the last time they suspected being ill with malaria, 86.8 percent tested positive (N_{total}=114). This result suggests that inhabitants of gold mining areas recognize the symptoms of malaria well. Fifteen persons had tested negative the

last time they suspected having malaria. Of those fifteen, six said they tested again to be sure and one person reported that he just waited until the complaints went away. Four other persons reported they bought malaria medication such as Artecom and Nivaquine over the counter, since they did not trust the test result. Another four persons bought other type of medication to soften the complaints, such as painkillers, kidney medication, and antibiotics.

Respondents who had not taken the malaria test the last time they suspected having malaria also indicated that distance was their main motivation. In Figure 19, which presents the reasons mentioned for not taking a test the last time the person suspected having malaria, the reasons related to distance are marked in blue. In addition to stating that the nearest health post was too far away (mentioned by 67% of respondents), also financial reasons (too costly to travel to the health post, 4%), travel time (4%), and the lack of MSD services in the area (4%), referred to the substantial distance between the location where the person fell ill and the nearest test location. Also the answer that the person only fell ill when he/she was already in the mining area, suggests that he/she would have taken a malaria test if he/she would be in an urban center or somehow near a health facility.

Another barrier to getting tested, which was mentioned by two persons, is the undocumented status of some migrants. In Suriname this status usually does not pose a problem, unless the government executes (haphazard and infrequent) clean-sweep activities in the mining areas. In French Guiana, however, the military police and the army execute constant controls and undocumented aliens may be arrested and their possessions may be confiscated. Even though health workers treat any patient regardless of nationality or migration status, the risk of running into the gendarmerie may motivate some persons to not seek health services.

Box 2. Malaria treatment in Suriname and French Guiana

In both Suriname and French Guiana, malaria testing is free of charge for any patient, regardless of nationality or immigration status. Health workers in the two countries, however, prescribe different treatment regimes for malaria.

In the Suriname interior, malaria testing is done by Medical Mission health staff in traditional communities, and by Malaria Service Deliverers (MSD) in the mining areas. The MSD are area inhabitants who typically do not have any professional medical background and who have been trained to perform the malaria rapid-test, produce a microscope slide for analysis in the city, and administer the correct medication in the case of a positive test result. Patients who test positive for P. *falciparum* receive Coartem (artemether- lumefantirne) for three days (8 tablets per day) and three tablets of primaquine. Patients who test positive for P. *vivax*/P. *malariae* are treated with a combination of chloroquine and primaquine (14 pills). Patients receive these medicines directly from the MSD free of charge.

In the French Guiana interior, malaria testing is performed in regular clinics and hospitals in the traditional communities. For the study area, the nearest health facilities to take a malaria test are the *Centre de Santé* (Health Centre) and the *Centre de Prévention et Vaccination* (Centre for Prevention and Vaccination) in Maripasoela. Trained health professionals test patients who come with symptoms to the health facilities for malaria using the rapid test. In addition, microscope slides are produced and sent to the capital

city of Cayenne for analysis. Patients who test positive for P. vivax are treated with "Nivaquine"®[7]. The patient receives one dose of Nivaquine directly and free of charge from the health worker. Because P. *vivax* is considered a non life-threatening disease, the patient has to buy the remaining pills of the treatment at the pharmacy with a prescription. At the time of the research, the pharmacy at Maripasoela sold the complete Nivaquine treatment as a prescription drug for €3.95 (USD5.33). Primaquine is not prescribed, unless specifically authorized by France. Patients with a positive test result for P. *falciparum* receive Riamet (artemether & lumefantrine combination). The Health Centre provides this medicine directly and free of charge to the patient.

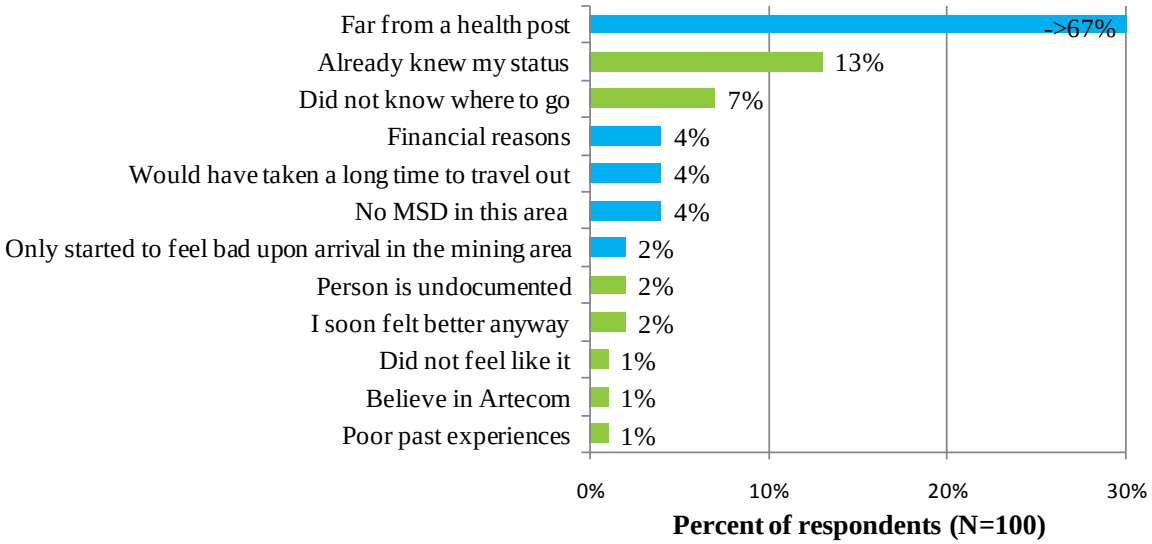


Figure 19. Reasons for not taking a malaria test the last time the person suspected being ill with malaria, the blue color indicating any reason having to do with goegraphical barriers.

The second most mentioned reason for not going testing was that the person "already knew his/her status". This answer suggests some inhabitants of mining areas are convinced they know when they have malaria and how to treat it. This attitude also surfaced in the focus group discussion. For example, one participant asserted: "There are different medicines for different forms of malaria. But Artecom helps for all different malaria types." Convictions such as the one described undermine efforts to motivate people to get tested prior to taking self-medication.

When conducting malaria tests, we found that many people believed that alcohol use would interfere with the test result, and that people who had been drinking could not be tested. One man conveyed that coconut water hides malaria in one's blood when testing. We have no indication that these factors have kept people from taking a malaria test.

[7] Nivaquine is an anti-malarial of which the active ingredient is chloroquine sulphate

3.7. Use of malaria medication

Inhabitants of gold mining areas take a wide array of medicines and remedies to deal with (suspected) malaria. We discuss the use of preventive medication, prescribed medication, and self-medication.

3.7.1. Preventive medication

The use of medication to prevent malaria is not popular among inhabitants of mining areas. One woman said she used Artecom as a preventive medicine in order to prevent a relapse of malaria. She buys this medicine in the supermarket, either in the mining areas or in Paramaribo city, and argued that it worked well because the symptoms stay away. Six male interviewees reported taking a variety of home remedies to prevent malaria such as: three drops of creolina (disinfectant) per day; bita (Suriname bitter forest medicine); tea of the quina (*Cinchona pubescens*) plant (BR); aguardente[8] with painkillers; and whiskey with marihuana seeds. Formal prophylaxes were not used. One of the respondents indicated that only French *gendarmes* (police) use malaria prophylaxis. FG health staff reported that persons from mainland France who come to stay for less than 3 months are given Malarone.

3.7.2. Prescribed medication

As discussed in the previous section, 54.2 percent of respondents were tested for malaria the last time they suspected being ill with malaria, and 86.8 percent of these persons tested positive (99 persons). Three quarters of persons in this group (76.5%; N_{total}=98) received free medication directly from a health provider.

Most of the remaining respondents (18 persons) reported that they had received a prescription. Three persons from this group had been tested in a private lab in Paramaribo where they received a prescription for medication. Yet the largest share (12 persons) had been tested by a health worker in French Guiana. We suspect that they were positive with P. *vivax*, had received a first dose, and had been sent to the pharmacy to buy the remaining tablets (Box 2).

Three interviewees explicitly mentioned that the health facility had given them one dose of medication plus a prescription for the remainder of the cure. Due to this additional step in the treatment process, however, some persons prematurely terminated treatment. For example, one man said that he went to the pharmacy in Maripasoela to get the remaining Nivaquine tablets. However, the pharmacy had run out and after waiting for two days he did not feel like waiting any longer for the new supply. He felt better anyway, and hence he returned to the gold fields. Another man said that he only bought part of the medication because he ran out of money. These answers suggest that every additional bit of effort people need to do for treatment diminishes the chances that they will adhere to the prescribed treatment regime.

Two persons mentioned that they had tested positive for malaria and subsequently bought OTC medication. Their cases are described in Box 3.

[8] aguardente is a generic term for alcoholic beverages that contain between 29% and 60% alcohol by volume

Box 3. Combining testing and self-medication

Eliane is a 27-year old Brazilian woman who has only been working in the small-scale gold mining sector for about a year. She works as a cook in the clandestine *garimpos* in French Guiana, and believes that she has already had two to three malaria episodes. Less than half a year ago she again felt malaria symptoms such as fever, a head-ache, and pain in her joints. Because she was far from a health center, Eliane felt that she had no other option than to have herself tested by the Brazilian man who performs malaria tests against payment in French gold mining areas. This Brazilian, she asserted, is testing and selling medication illegally. He told her that she tested positive and she bought medication from him. As soon as Eliane started feeling better she stopped taking the tablets and left the remaining pills for a next malaria episode. Curiously, when asked whether she agreed with the statement that: "You can stop your malaria treatment as soon as you feel better", she responded that this statement was false.

Alfredo is a 45-year old Brazilian gold miner with a long history in small-scale gold mining. "It is really difficult to protect yourself against getting malaria," he asserted. "If it would be caused by a mosquito you could use a bed net, but I think it is caused by the water." Against malaria he uses artecom or eloquine (active ingredient mefloquine), which is sold in the *garimpos* of French Guiana. When he experienced his most recent malaria attack Alfredo was at Benzdorp and he paid 1 gram of gold to be tested by the local MSD. This person told him that he had a mixed infection and sold him Artecom. Alfredo said he did not finish the treatment but left some pills because "the person [vendor] only wants to sell the medication but you yourself know when you are feeling better".

3.7.3. Self-medication

Hundred and twenty seven out of a total of 216 interviewees (58.8%) reported that they had used over- the-counter medication at least once in the past 1 ½ years. By far the largest share of these persons had relied on Artecom[9] (83.5%; Table 11). Smaller numbers of respondents had used Coartem (12.6%), the medication extended by Suriname public health services, and Nivaquine (7.1%), which is prescribed by French health care providers. All other medicines that had been used for self-medication were named by three or less respondents. Recent studies have indicated that the quality of malaria medicines that are bought over the counter is of questionable quality (Box 4). Problems encountered with OTC malaria medication included poor quality of (counterfeit) medication, wrong labeling, and incomplete dosing (e.g. lack of primaquine content in the case of the artemisinin-based combination therapy (ACT) Artecom).

[9] Artecom® is a fixed-dose combination of piperaquine-dihydroartemisinin-trimethoprim co-blistered with a primaquine phosphate tablet

Table 10. Malaria medication bought by respondents for self-medication in the past 1 ½ years (N_{total}=127)

Medicine	N	%
Artecom	106	83.5%
Coartem	16	12.6%
Nivaquine	9	7.1%
Lariam/Mefloquine/Eloquine	3	2.4%
Malarone	3	2.4%
Chloroquine + Primaquine	2	1.6%
Coartem + Primaquine	1	0.8%
Primaquine	1	0.8%
Chloroquine	1	0.8%
Halfan	1	0.8%
Creoline	1	0.8%
Undefined medication	1	0.8%
Plant-based medicine	1	0.8%
Antibiotics	1	0.8%
Xantinon (liver medication)	1	0.8%
Aguardente	1	0.8%

Most inhabitants of mining areas buy malaria medication in the mining region; in a (Chinese) supermarket or (Brazilian) pharmacy (68.3%), or from traveling vendors (10.3%; Table 12). These traveling vendors are particularly active in French Guiana, where repression by the French authorities makes it difficult to establish a fixed shop in the mining areas. A smaller share of respondents said they had already acquired the medication in Paramaribo. These people often had obtained their medicines at the popular Brazilian supermarket and pharmacy Transamerica, or in any of the Chinese shops in the Brazilian neighborhood in North-Paramaribo. Four persons mentioned that they had obtained medication from a friend or colleague, and in three cases the enterprise where the person worked had provided medicine.

Table 11. Location where the respondent obtained malaria medicine the last time when he/she used self-medication

Location	N	%
Supermarket/pharmacy in the mining areas	86	68.3%
Traveling vendor in the forest	13	10.3%
Supermarket/pharmacy in Paramaribo	11	8.7%
From a friend/colleague	4	3.2%
From the enterprise where I worked	3	2.4%
Brazil	3	2.4%
In French Guiana	2	1.6%
Health post/pharmacy in FG	2	1.6%
Homemade	1	0.8%
Paris	1	0.8%
Total	126	100%

Box 4. Concerns about the quality of OTC malaria medication

Recent lab studies found that a significant share of anti-malarial medicines available in private and informal sector facilities were of questionable quality, as reported by Evans et al. (2012) for Suriname and Guyana, and by Pribluda et al. (2012) for all Amazon Malaria Initiative countries including Suriname. In Suriname, the most popular informally sold malaria medicine is Artecom. A common problem with regard to Artecom in this country was that there was no content information on the dose of the primaquine tablet in the package or the insert (Evans et al. 2012; Pribluda et al. 2012). Furthermore, the same lot number was found for samples collected in both Guyana and Suriname, suggesting the possibility of a common supply source and/or illegal cross-border commerce of malaria medicines.

In various cases, quality control tests found that the tablets had no primaquine content, which can pose a health risk to patients. A consulted health worker in French Guiana reported that he knew of two cases of people who died from taking poor quality malaria medication.

The high incidence of poor quality anti-malarials coupled with the ease with which the artemisinin-based products can be acquired and the availability of clinically inappropriate artemisinin-based monotherapy, constitute a major cause for worry (Evans et al. 2012). The haphazard use of these drugs not only poses a risk to patient safety but also present serious implications for the development of drug-resistant strains of the Plasmodium parasite (ibid.).

Prices of medication vary based on the location where they are bought, with the more isolated and difficult to reach places demanding higher prices. The price of Artecom was SRD25 (USD7.50) in a Chinese supermarket at the Tourtonenlaan[10]; €8- (USD 11-) in the supermarkets in Benzdorp and Peruano; and between €8- and €10- (USD 11-14) in the supermarkets in Kabanavo and Papaiston. In Oelamari, Artecom could only be bought in the one Chinese supermarket near the boar landing at a cost of 1 g. of gold (~USD 38) [11]. Several gold miners reported that they had bought Artecom in the mining areas for 1 to 3 g. of gold (~USD 38-114). Coartem, the medication extended by the Suriname government, was reportedly sold in the mining areas for 1 to 2 g. of gold (~USD 38-76). A traveling vendor in French Guyana was said to sell malaria medication for 4 to 5 g. of gold (~USD 152-190), but we do not know what medication he sold.

Chinese supermarket owners in the mining areas who were asked about the origin of the medication they sold (all Artecom) said they had obtained it in Paramaribo city. We have not heard of persons who directly imported Artecom from abroad.

[10] This seller was an independent small supermarket without ties to the Tourtonnen lab. It was located in the same street though; the street where many Brazilian gold miners forgather when they come to the city of Paramaribo.

[11] On October 30, 2013, the world market price of gold was USD 43.66 per gram. The gold that is used as a trade commodity in the forest is worth less though, because it still contains impurities. When selling gold to the official gold buyers in Paramaribo, people received US 38- per gram of purified (98%) gold. The difference between the world market price and the official buying price contains royalty for the Suriname government, administrative costs, and profit of the gold buyer.

The main reason to rely on self-medication, the last time the person used it, was that the person was too far away from a health post when he or she started to feel ill (64.3%, N_{total}=126; Figure 20). This result is consistent with the data earlier presented in Figure 19, which showed that geographical barriers were the number one reason that people had not taken a test the last time they believed they had malaria.

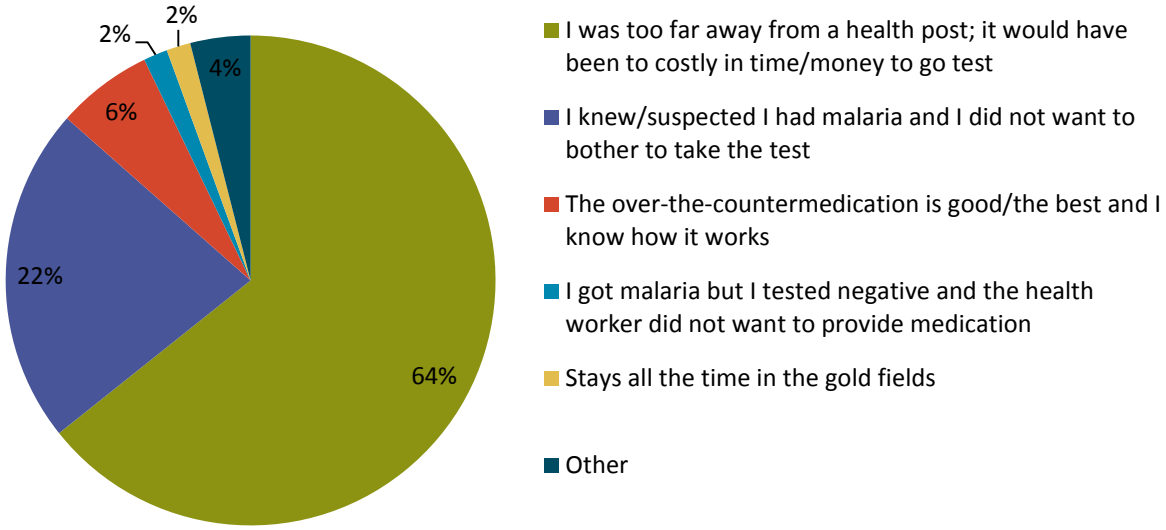


Figure 20. Reasons to rely on self-medication rather than go see a doctor the last time the interviewee used it (N=126)

In many locations, the costs in time and money to travel to the nearest health post or MSD are substantial. For example, someone who falls ill in one of the mining camps in Oelemari first needs to take an ATV to the boat landing (~ 1 to 2 hr), next take the boat to Jawpasi (~1 hr) and from there travel onwards to the nearest community clinic in French Guiana or Suriname (~ 2 to 4 hr). This trip may cost hundreds of dollars each way, depending on the availability of transportation and the possibility to share transportation with others. Gold miners and mining service providers working in French Guiana mining areas confront the additional barrier of having to pass various military "road blocks" (on land or in the rivers) or patrols.

The second most mentioned reason to use self-medication was that the person suspected that he or she had malaria, but just did not bother to take a test (22.2%; N_{total}=126). As one person conveyed: "I was lazy to go test". Yet other respondents reported that they were already familiar with the medication they bought; they believe it is good/the best and easy to use and hence this is what they used to get better when they felt ill with malaria (6.3%).

Two persons said they tested negative but since they 'knew' they were ill with malaria, they bought their own medication. One of these persons had disagreed with the statement "When you test negative for malaria, it is a good idea to take malaria medication anyway, just to be sure." Again, this result suggests a discrepancy between malaria treatment knowledge and behavior. In the total sample 15.7 percent of respondents agreed with the statement: "When you test negative for malaria, it is a good idea to take malaria medication anyway, just to be sure." More than three-quarters of the sample disagreed with this statement (76.9%) and 6.9 percent said they did not know.

Two other respondents conveyed that they stayed all the time in the gold fields and hence they never were anywhere near a health post. Other reasons to rely on self-medication rather than go see a health professional, all mentioned by one person, included:

- "I could no longer bare the pain and fever" [and hence he took the first medication he could lay his hands on].
- "I had no money to go test"
- "I already felt better when I went to go test because I already took Artecom
- "It is not necessary to see a doctor to obtain kidney medication"
- "The MSD had run out of medication"
- "There was police control [in FG] and hence I could not leave" (Box 5)

Box 5. Using self-medication
José is a young (21 yr) Brazilian man who provides canoe transportation to gold miners in Suriname and French Guiana. He already had –or suspected he had- malaria for two to three times in the past 1 ½ years, but he has not always gone for testing. The last time that he suspected having malaria he was very far out in the forest in French Guiana, and it would have been both expensive and time consuming to travel to a health post. Moreover, there were police patrols on the 'road' and hence he preferred to stay where he was. In such cases he buys malaria medication in the supermarkets in the mining areas; either Artecom or Coartem, which in this location are both sold for 1 g. of gold (USD. 38-) per package. When asked whether these medicines work well, he responds Yes and No. Coartem cures, but with Artecom the malaria returns.

We suspected one of the reasons that people used self-medication might be that they have no trust in the Suriname medication. One third of the total sample (33.3%; N_{total}=216) were of the opinion that Brazlian malaria medication is better than Suriname medication, and 38.6 percent of respondents (N_{total}=215) believed that French malaria medication is better than Suriname malaria medication. We found not much difference between people who had used self-medication in the past 1 ½ years and those who had not, in their relative trust in Suriname malaria medication. This observation suggests that relative trust in the Suriname malaria treatment as compared to that of other countries does not affect whether or not people choose to treat their malaria with OTC medicine.

The grand majority of respondents of those who had relied on self-medication in the past 1 ½ years, reported that the medicine had worked well (84.9%; N_{total}=126). Sixteen respondents (12.7%) said the working of the medication had not been satisfactory, and another two persons (2.4%) said that there was a yes and a no to this question. The 105 respondents who had been satisfied with the working of self-medication *and* who explained their answer reported that: they felt better/the symptoms had disappeared (56.2%); they were cured (10.5%); and the medicine had (temporarily) suppressed/incubated the malaria (30.5%; N_{total}=105). One person who provided this last answer explained that the OTC medication helps suppress malaria so that the patient has time to travel to the city for treatment. One interviewee reported that the medicine is strong (1%); one person said that it works "sometimes" (1%), and one person responded that his body had gotten used to malaria (1%).

The fact that the curative effect of certain forms of self-medication is temporary was for other respondents a reason to be discontent with the medicine they had used. Half of the respondents who had said that the medication had worked poorly explained that the effect had been short-lived and the malaria had returned (50%; N_{total}=18). Other respondents in this group said they had not been cured at all (33.3%). Two respondents voiced the opinion that the medication did not function well because it has bad side effects and is dangerous. One person reported that he was used to malaria but we have no information on how this response related to the effect of the medication.

When specifically asked it, 39.7 percent of those who had relied on self-medication reported that they had suffered from side effects. A wide array of side effects was named. The most common side effects were related to high blood pressure such as palpitations and 'feel blood rush through the veins'. A focus group participant conveyed: "Not everyone can take Artecom; it gives palpitations. People with heart problems cannot take it because it is strong."

Other side effects seemed to be stronger related to anemia, such as dizziness, feeling weak/heavy/languid; shaking/trembling; and low blood pressure. Others complained about skin problems such as dark spots on the skin, itchiness, a kind of goose bumps, and a feeling as if 'someone bites you over your entire body'. Other complaints included insomnia diarrhea, bitter taste in the mouth, heavy eyes, nausea, stomachache, pain in limbs (arms, legs) and pain in organs (heart, liver, kidneys).

Other person cautioned for the bad side effects of Artecom: "The [curative] effect is rapid," he said, "but if you do not take it correctly it can kill you." Another person recalled a case where a gold miner had taken an overdose of Artecom and subsequently died.

Respondents who had used self-medication in the past 1 ½ years were asked whether they already recommended this medication to friends, family or colleagues. Thirty-eight percent of respondents said they had already recommended self-medication to others in the mining area, and 64.3 percent reported that they had not done so (N_{total}=126). The most important motivation to recommend self-medication is that it had helped the person get better and/or suppress malaria (43.5%; N_{total}=46). Others argued that the medicine they used was very good/effective (15.2%); that there is no other medication in the gold fields (15.2%); and that they would want to help a friend (8.7%). Other reasons to recommend self-medication were mentioned by just one or two persons, and included: not everybody knows; it helps to get to a place to take a test; and sometimes the tests take a long time.

The most often mentioned reason for not recommending self-medication to others was that the respondent believe that everyone already knows about it and uses it (44.9%; N_{total}=78). Other people were cautious about recommending medication because of the possible complications this could cause. They reasoned that the medicine might not work for everyone (9.0%) and that using it could be dangerous (6.4%). Some medicines (i.e. Artecom) were believed to produce heart problems or, in people with existing heart problems, death (5.2%). One person reported that he would never recommend using Artecom because his friend had died using it. In this context, respondents also said that they were not a doctor and hence they could not recommend medicine, and that it was not good buying medication without prescription (2 persons each answer).

A smaller number of respondents said they would not recommend self-medication because the medicine may not be good for malaria treatment. They said the malaria will return after a

while, doctors advise against it, it does not cure malaria, and it had not helped in their own case.

3.8. Completing treatment

About three quarters of the 114 persons who had obtained medication from a health worker after taking a malaria test said they had used and completed the medicines they had received or bought (78.9%; N_{total}=114; Figure 21).

Among those who had relied on self-medication the last time they suspected malaria, fewer persons reported that they had completed the medication (40.2%). More than half (57.7%) of the persons using self-medication had pills left when they stopped taking medicine, versus 14 percent of those who had been tested. Persons taking Artecom usually said they would take just one or two doses of 2 pills, and if they would feel fine they would leave the remainder of the package for the next malaria attack. A female focus group participant conveyed: "I always take four, and save the remaining four for when the malaria returns."

In 2012 and 2009 more respondents (resp. 86.4% and 80.6%) reported that they completed the malaria cure. However, in these years the question was posed differently and thus we cannot conclude that treatment behavior has deteriorated. In the previous years, respondents were asked: "The last time that you took malaria medication, did you finish the treatment?" which made it very easy to respond with "yes". This year (2013), we asked respondents: "How many pills were left when you stopped taking medicine, the last time you used malaria medication?" We suspect that this line of questioning has generated more reliable results.

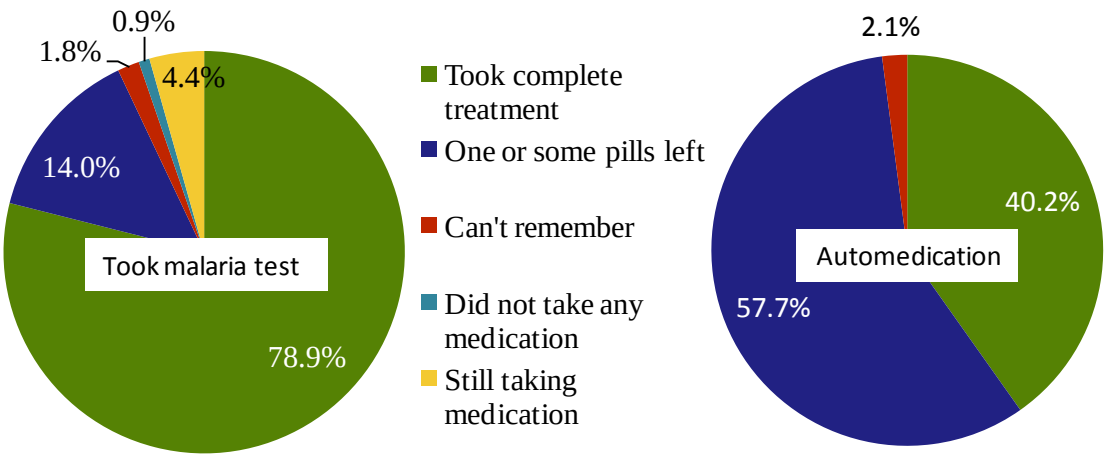


Figure 21. Share of respondents who completed their medication versus those who did not, comparing persons (N=114) who got tested for malaria and persons who relied on self-medication (N=97) the last time they suspected malaria

The survey results suggest that what people know is not consistent with what they do in the context of treatment. A quarter of respondents from the entire sample (25%; N=216) agreed with the statement: "You can stop your malaria treatment as soon as you feel better." A small share of respondents said they did not now (2.8%) and the remaining respondents asserted

that one has to complete the malaria treatment (72.2%). Curiously, almost one third of respondents among those who had said that one should complete the cure, had pills left the last time he or she used malaria medication (30.1%; N=156). This finding suggests that theoretical knowledge of correct malaria treatment does not necessarily translate into responsible treatment behavior.

When asked why they had stopped taking medication prematurely, most respondents said that they had felt better (78.7%; N_{total}=75). Others stopped taking medication because they had experienced side effects (17.3%), forgotten to take the pills (4%), to save pills for a next malaria (2.7%), and other reasons listed in Table 13. The results feed the impression that the inhabitants of gold mining areas perceive the Artecom medication not as a cure that must be taken in defined doses and completed (like antibiotics), but as a package of separate pills that can be taken based on need (like pain killers).

Table 12. Reasons for not taking all pills in the malaria cure (N=75)

Why did you have pills left?	N	%
I felt better	59	78.7%
Experienced side effects	13	17.3%
Forgot to take the pills	3	4.0%
Malaria comes back so I saved pills	2	2.7%
The pharmacy did not have all medication	1	1.3%
Medication vendors just want to sell	1	1.3%
Wanted to drink alcohol	1	1.3%
I have not yet bought medication/I am still taking medication	2	2.7%

We also asked health workers and MSD whether they believed that their malaria patients completed the treatment and if not, why. A French infectologist at the *Centre de Prévention et Vaccination* in Maripasoela (FG) said he suspected that people sell part of the malaria medication. He had obtained this information from hearsay. This information is confirmed by reports that some persons had bought Nivaquine (the medication provided by FG health services) for self-treatment, even though this medicine can only be obtained with a prescription. We do not know whether making money was the motivation for quitting treatment, or whether the person had stopped taking pills because he or she already felt better, and subsequently decided to sell the remainder of the package.

The MSD at Kabanavo (Benzdorp general area, SU) reported that he knew that there are people who do not complete the treatment, because they tell him themselves when they come by at his shop. However, he did not know the reason for prematurely quitting treatment. The MSD at Benzdorp said she believed that malaria patients did take the complete treatment.

3.9. Medication use (other than malaria)

In order to obtain preliminary insights in general use of OTC medicine in small-scale gold mining areas, respondents were asked about their use of any type of medication (other than malaria medication) in the previous month. Just over half (52.1%) of respondents had indeed bought some type of non-prescription medicine; one person could not remember (0.5%); and

the remainder of the respondents had not bought OTC medication (47.4%; N_{total}=216). All but three persons among those who had used OTC medication in the past month were respondents of Brazilian descent. Fifty-five percent of Brazilians had used some form of OTC medication in the past month, versus 9.1 percent of Surinamers (1 out of 11) and two out of five interviewed Guyanese. There was not much of a difference between respondents who had been interviewed at different locations.

Respondents primarily bought OTC medication against pains such as headache (28.6% of those who had bought OTC medication), backache (12.5%), stomach ache (4.5%) and general pain in the body and/or bones (10.7%; N_{total}=112)). Another popular reason to buy OTC medication was some form of (suspected) ailment in the liver, kidney or spleen (26.8%). Also common were inflammations (8%) and infections (3.6%). Other people named a wide variety of infirmities and health complaints such as fever, anemia, digestive problems and flu and flu-like symptoms.

Among the wide variety of OTC medicines that people acquired in the month preceding the interview, by far most bought were painkillers (58.9%) and antibiotics (48.2%). In addition, people used a variety of –principally Brazlian- medicines with a combination of active ingredients. Among the most popular ones of these medicines is Tandrilax, a combination of painkiller, muscle relaxant and anti-inflammatory (Annex 1). In addition, several people used medication against dyspepsia (e.g. Silimalon, Epocler), which are used for digestive problems but also against liver problems related to alcoholism. Other medicines that respondents had recently bought included antifungal medication (e.g. nizoral), anti-inflammatory medicines, a variety of liver medicines, a variety of medicines to alleviate muscular pains and musculoskeletal/rheumatic complaints. Annex A contains a list of a selection of medicines used by inhabitants in the mining areas in the month preceding the interview.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

This KAP study investigates behavior, attitudes and practices related to malaria treatment among the inhabitants of small-scale gold mining arias in Suriname. The acquired information contributes to efforts by the government of Suriname to improve access to and use of approved, good quality medicines among gold mining populations and to ensure quality care at the malaria service delivery point. The results also are of use to PAHO and the Amazon Malaria Initiative (AMI), in their work to support Amazon country governments to improve malaria medicine management and malaria treatment regimes.

In past years, malaria figures in Suriname have dropped dramatically. As a result, it was difficult to find persons who had been ill with (suspected) malaria in the past 1 ½ years in most mining areas, with the exception of areas near the Suriname-French Guiana border. The present research confirms what data from the GOS malaria program suggest: a significant share of malaria cases in Suriname is made up of persons who contracted malaria in French Guyana or in the Suriname-French Guiana border region. This study, therefore, not only looked at malaria treatment in Suriname but also collected information about gold miners and health services in French Guiana. Because the study was conducted in the border area, the results apply primarily to this region and are not necessarily indicative of the gold mining areas in Central Suriname.

The nearest places where inhabitants of the visited gold mining areas can go for malaria testing and treatment are the health centers in French Guiana communities (Maripasoela, Papaiston) or, in Suriname, MSD in the mining areas or MZ clinics in riverside communities (Kawemhakan, Cottica). All these places offer malaria services at no cost. Among the respondents who had taken a malaria test the last time they suspected being ill with malaria, over 43.9% had been tested by a health professional in French Guiana. The Health Center/Prevention and Vaccination Center in Maripasoela is the nearest health service center for the inhabitants of the Benzdorp area, and the health center at Papaiston was closest for the persons interviewed at Papaiston/Cottica. Many persons who used these services were actually working in French Guiana mining areas, but they lived or were seeking refuge from French prosecution on the Suriname shores of the Lawa River. The French health centers provide free malaria testing and treatment, though persons who are tested positive for P. *vivax* need to buy part of their treatment at the local pharmacy (~USD 5-).

The second and third most mentioned locations where one could be tested for malaria were the services from the GOS malaria program in respectively the gold mining areas (MSD) and Paramaribo city (Tourtonnen lab). Together these services had been the locations of choice for another 42.1 percent of respondents. Gold miners seemed unaware of the presence of the Medical Mission clinics[12] in Kawemhakan/Anapaike (for people in Oelemari) and Cottica (for people in Papaiston/Cottica). These clinics have been specifically developed for local community inhabitants, but people from other places –regardless of their nationality- will also be treated against a fee of SRD 70- (~USD 20-). We found in earlier research that

[12] The MZ services approximately 60.000 interior inhabitants through 57 health posts. Health care is provided by health workers, GZA, who are specifically trained by MZ to serve in the interior. The majority of these GZA originate from local communities. The GZA diploma is recognized by the Ministry of Health and falls under the inspection of nursing and caring professions

Brazilians often prefer to go to the more modern, European clinics at the French side of the river, which they believe to be more professional (Heemskerk and Duijves 2012b). The fact that MZ staff typically does not speak Portuguese is another reason for gold miners not to seek medical help at these clinics (ibid.).

Access to formal malaria prevention and treatment services is reasonable in Suriname mining areas, thanks to the services provided by MSDs in most mining areas. MSD services are widely accepted and there is no indication that people doubt the reliability of the diagnostic tests or medication. These services should be extended for free but in some cases fees of anywhere between USD 8 and 40 are requested to perform the malaria diagnostic test. Even though these fees are not high compared to other expenses in the gold mining regions, they may deter persons from going for a test. For miners in isolated regions such as Oelemari, traveling to the nearest place to be tested and treated for malaria still may take a day. When shared transportation is not available, such travel could cost hundreds of dollars. Training more MSDs to cover a wider geographic, and improving local knowledge of their existence and location, would improve access to their services.

French Guiana does not provide malaria testing or other medical services in the (clandestine) gold mining areas on their territories. Nevertheless, people in different localities reported that in these places, a Brazilian man conducts the malaria test against payment. At least one of the persons trained as an MSD for Suriname is reportedly involved in this activity.

Among the persons who had malaria in the past 1 ½ years, about 60 percent had used OTC malaria medicines, with more men than women reporting the use of OTC medication in response to (suspected) malaria. This practice is particularly common among persons who work in the deep interior at some distance from malaria testing services. Physical distance to the nearest place to be tested and related costs in time and money are the main reasons to rely on self-medication.

Access to illicit malaria medication in Suriname is easy. Various supermarkets and (informal) pharmacies in Paramaribo sell Artecom; at present the most popular OTC malaria medicine in small-scale gold mining areas in the Guianas. Inhabitants of gold mining areas either buy these medicines in the city, or they buy them in supermarkets/pharmacies or from traveling vendors in the mining areas. The price of illicit malaria medication varies, with the main determining factor being the relative isolation of the location. In Paramaribo, OTC malaria medicines sell for about USD 8- per package; in the Chinese supermarkets in the Benzdorp area for about USD 11-14, in the more isolated Oelmari area for about USD 38-, and in the far forest prices rise to almost USD 200-.

People who had used these medicines typically said they worked well because the malaria was suppressed or treated – though some users of Artecom reported that the malaria had returned. The use of Artecom also was associated with side-effects, and there is a widespread belief that people with heart problems should not take Artecom. Apparently there is no or little government control on the sale of illicit malaria medication. A small share of respondent had bought formal medication extended by French and Suriname malaria services over-the-counter (resp. Nivaquine and Coartem). Field reports suggest that at least one of the MSD sells his testing services and malaria medication in French Guiana.

Hardly any inhabitants of mining areas use medication to prevent malaria. The frequent use of small doses of Artecom resembles a preventive strategy, but this medicine typically is only

taken once symptoms appear and hence would not classify as preventive medicine. Only one woman said she used Artecom preventively. Also the use of home remedies to prevent malaria was rare (less than 3% of respondents) and no-one reported the use of formal prophylaxis.

The use of bed nets to prevent malaria was low. Only just over 10% of gold miners reported sleeping under an ITN the previous night, which was a lower figure than reported in earlier survey years (2009, 2012). Ironically, the low incidence of malaria is one of the reasons why people do not sleep with a bed net.

With regard to the completion of the treatment, persons who had been tested and received medication from a health worker/MSD were more likely to complete their treatment regime than persons relying on self-medication (about four fifths versus two fifths). This finding suggests that good access to health service providers is crucial in improving medicine intake behavior. Particularly Artecom is often used in individual doses to treat symptoms (like common pain killers) rather than a cure that needs to be completed to get well (like antibiotics). The most common reason to stop taking malaria medication was that the person felt better. Others stopped taking medication because they experienced side effects, because they forgot to take the pills, or to save pills for a next malaria episode.

Summarizing the results graphically (Figure 22), we see that about half of the persons with suspected malaria were diagnosed at a health facility or with an MSD the last time they suspected malaria. Of these persons, 86.7 percent was tested positive, representing 45.8 percent of the total sample. Of the positively diagnosed persons, 76.3 percent directly received medicine (the complete treatment) from the health provider, representing 35 percent of the complete sample. Of the persons receiving free treatment after having been diagnosed positively with malaria, 83.8 percent completed their treatment. In other words, less than a third of persons with suspected malaria in the past 1 ½ years was tested, received treatment, AND completed the treatment the last time they suspected being ill with malaria. When excluding the 15 persons who tested negative from the total sample (as they would not need treatment) we can conclude that 30.8 percent of persons with (suspected) malaria followed the correct steps to be treated for malaria the last time they fell ill.

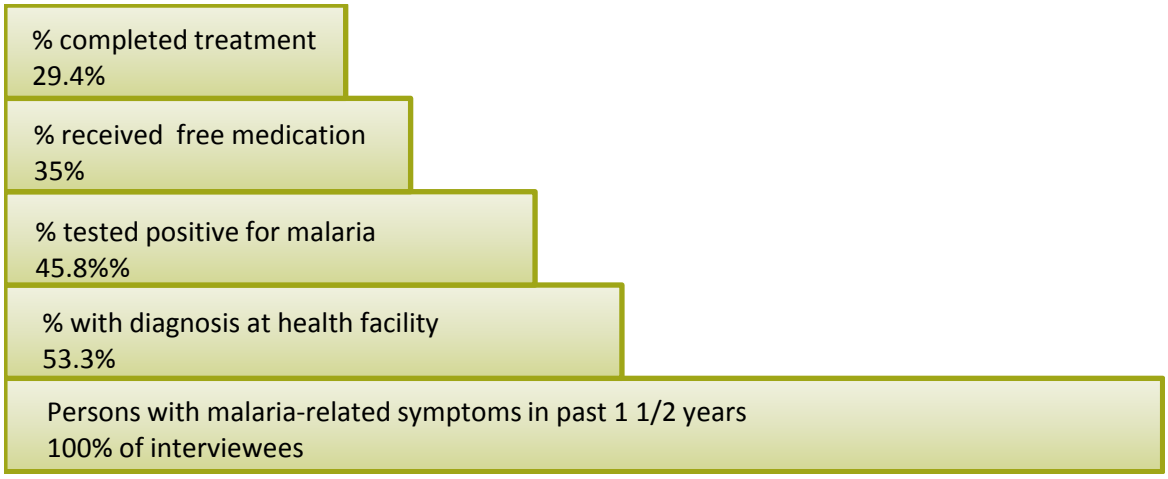


Figure 22. Share of persons taking a malaria test, receiving medication, and completing the treatment the last time they experineced (suspected) malaria

Finally, the researchers conclude that malaria eradication efforts will only be effective if they take the regional nature of malaria, gold mining populations, and malaria treatment behavior into account. At present, Suriname and French Guiana do not collaborate in their fight against malaria. The design of a common malaria eradication strategy, with common goals and compatible treatment regimens may not be a panacea but would be a good first step on the road towards the complete eradication of malaria in Suriname.

4.2. Recommendations

Considering:

I. Present efforts by the Government of Suriname, USAID Amazon Malaria Initiative, the SIAPS Program, and PAHO to improve the four dimensions of access (geographic accessibility, physical availability, affordability, and acceptability of malaria medicines) to malaria medication in Suriname and its neighboring countries;
II. That the broad objective of this KAP study is collect baseline data on malaria treatment knowledge and behavior in small-scale gold mining areas, as well as information that can be used to design an appropriate intervention.
III. The data collected in the framework of this consultancy and our key findings reported here above,

The researchers assert that intervention efforts in the area of malaria treatment are direly needed in small-scale gold mining areas. Recommendations are organized in four sections; quick wins, Behavior Change Communication, services and policy. “Quick wins” are a list of specific activities that are viewed as something that can be done with little effort and can normally be done in a short period of time. “Services” refers to recommendations aimed at improving migrant and mobile population access to malaria prevention and treatment, as well as their motivation to adhere to malaria treatment regimes. Recommendations in the area of “Behavior Change Communication” provide input in the main knowledge and information gaps that require attention. In this section the researchers also suggest practical tools for awareness building. “Policy”-related recommendations suggest ways in which policy makers in Suriname and its neighboring countries can, in collaboration, help eradicate malaria through legal and policy measures.

Quick wins

1. Respond to the regular influx of gold miners and mining service providers from French Guiana with targeted ACD activities in the Suriname-French Guiana border area.

    a) Establish contact with the French authorities to know when Harpie operations are launched. On these occasions, miners are chased out of the French Guiana forests, and many seek refuge on the Suriname side of the river.
    b) Ask MSDs in the Benzdorp general area to report when gold miners en masse cross the river from French Guiana to Suriname.
    c) Organize more frequent ACD missions in the Suriname-French Guiana border areas, particularly in the locations where malaria cases are reported.
    d) Carry out ACD activities in the peak seasons of *An. darlingi* activity, namely during: (i) high water levels in the long rainy season, (ii) low water levels in the long dry season, and (iii) abundant rainfall in the short rainy season

2. Improve access to and use of ITBNs in order to protect people during the hours of the day that the malaria vector is most active.

    a) Design a bed net model that is appropriate and functional for gold miners. That is, it should be strong; easy to put up; and fit both hammocks and twin-size beds.
    b) Distribute ITBNs in newly emerged small-scale gold mining areas (e.g. Papaiston/Cottica) and in areas with a relatively high population turn-over such as the Suriname-Frenmch Guiana border area.
    c) Use aggressive bed net installation methods in gold miners' communities and camps. Instead of just handing out the bed nets, malaria program staff could go door-to-door to show people how the net is properly installed, how it should be treated (e.g. washing, drying), and how it can be re-treated with insecticide after a year or two.
    d) Also distribute ITBNs to persons working in French Guiana who take temporary refuge in Suriname.
    e) Propagate the use of bed nets as the most effective way to protect oneself against malaria, as well as against other insects and pests (e.g. bats).

Services

3. Improve access to MSD services

    a) Train new MSDs, particularly in the Suriname-French Guiana border area (e.g. Papaiston, Peruano) and particularly remote areas (e.g. Oelemari). Work with mining title holders and mine managers to identify the most appropriate locations for new MSD.
    b) Maintain regular contact with the MSDs and show them that their work is important and highly valued. Increase their fees and provide them with a monthly phone allowance to report weekly to the urban lab. Malaria testing and treatment data can also weekly be sent by phone (e.g. every Monday).
    c) Establish a supervisory system for MSDs. Appoint two to three MSD supervisors who pay both unannounced and planned (e.g. bi-monthly) visits to all MSDs.
    d) Develop an MSD logo to be printed on a flag or large sticker that can be placed in locations where an MSD is located.
    e) Improve the awareness of MSD services through an information and awareness campaign aimed at the inhabitants of mining communities (See section BCC).

4. Improve access to the Tourtonne malaria lab.

    a) Launch an information campaign aimed at the inhabitants of small-scale gold mining areas to promote the lab.
    b) Offer a wider range of testing services in the Tourtonne lab, such as testing for and treatment of HIV/AIDS, tuberculosis and leishmania and general blood tests – against a regular fee for medical consultation. The extension of services is already planned by the Government of Suriname. This approach may draw more attention to the lab and enhance its status as a medical service.
    c) Train lab personnel to deal with vulnerable and migrant populations. At present, the International Organization for Migration is conducting Caribbean-wide

training-of trainers sessions about these topics, and by the end of November Suriname will have at least two trainers.

5. Provide informal vendors with good quality medicines

    a) Given the remoteness of many mining areas and the existence of a virtually open border with French Guiana, where no malaria services are provided in gold mining areas, it will not be possible to completely eradicate self-medication. In order to make sure that people who rely on self-medication at least use the appropriate medication, the MoH, at least in Suriname could provide private vendors with good quality medicines. The vendors can still sell them at suggested price.
    b) Enforce the Suriname drugs policy regarding selling medication through informal channels.

Behavior Change Communication

6. Launch a BCC campaign aimed at the inhabitants of mining areas to promote correct and responsible malaria testing behavior and medicine intake.

    a) An intense campaign should have three main messages: Take a malaria test when you suspect you have malaria; Take correct (government endorsed) medication once you have been diagnosed with malaria; ALWAYS complete your medication.
    b) Given geographic challenges, it is not realistic to expect that al inhabitants of mining areas will take a malaria test when feeling symptoms. Persons taking OTC malaria medication should be convinced to at least complete their medication.
    c) Campaigns should take into account that most gold miners and mining service providers on the Suriname side of the Suriname-French Guiana border spend a significant share of their time in French Guiana and use French medical services. For example, advocacy of correct medication and treatment should present the systems of both countries as correct treatment regimes.
    d) Given the relatively large number of malaria cases and high incidence of self-medication in the Suriname-French Guiana border area, campaign efforts should foremost focus on this region.

7. Reach populations by speaking their language

    a) Public health outreach programs for the mining areas should make use of Sranantongo and Portuguese.
    b) Given the continuously growing population of Chinese in small-scale mining areas, the malaria program should employ someone with Chinese language skills to reach this group.
    c) Educational achievement of gold mining populations is relatively low, and hence malaria outreach materials should make minimal use of written text and use clear and straightforward messages.

8. Use ACD missions for continuous education and awareness building

Even though today the grand majority of inhabitants of mining areas know that malaria is transmitted by a mosquito, the idea that malaria is caused by drinking or being near dirty water remains popular. Furthermore, some persons believe that malaria is a chronic disease that cannot be cured. Malaria program staff performing ACDs should make an active effort to enfeeble these misperceptions.

9. Use the malaria lab and ACD missions to collect time series data about treatment behavior.

    a) Design a brief questionnaire with about 10 questions about malaria and malaria treatment, which can be posed to persons come to the Tourtonnen lab for malaria diagnosis
    b) Use the questionnaire also during ACD missions
    c) Enter the data collected through interviews, coupled to the person's test results, continuously in a database and produce bi-annual reports with the most relevant results.
    d) Adjust the message of, and tools used for, education and awareness in response to new data and insights.

Policy

10. Formulate an official policy with regard to MSD asking payment for services.

    a) Have conversations about payment for MSD services with MSD in different areas. Record their ideas and suggestions for a possible payment structure
    b) Develop regulations for MSD that are very explicit about them asking payment for services; allowed or not allowed, if allowed how much and for what.

11. Enter dialogue with health professionals in French Guiana

    a) Invite health professionals from Suriname *and* Fr. Guiana (e.g. medical staff of the health centers in Maripasoela and Papaiston) to the presentation of this study.
    b) Combine the presentation of the study with a workshop, with the aim to generate ideas about malaria eradication in the Suriname-Fr. Guiana border region.
    c) Send health professionals and authorities from Suriname *and* Fr. Guiana a hard copy of the report.

12. Foster collaboration between Suriname and French Guiana health authorities.

    a) Invite health authorities from Suriname *and* Fr. Guiana to the presentation of this study.
    b) Organize a bi-lateral meeting for health professionals following the presentation of the report, so that the professionals from these countries can discuss their approach to a shared problem.
    c) Make efforts to align the malaria treatment strategies of both countries, and if this appears impossible, make sure that the health authorities of the countries are at least informed about the formal malaria treatment procedures in the neighboring country.

d) Make an effort to convince French health authorities to provide the full Nivaquine treatment to P. *vivax* patients rather than handing a prescription, which increases the risk of people not terminating their treatment.
e) Seek assistance from the authorities in French Guiana to forewarn the Suriname malaria program when Harpie activities occur near the project area.
f) Place pressure on French Guiana to adapt its policy on malaria testing and treatment to the daily life realities in and around the gold mining areas in this country.

REFERENCES

- Barbieri A.F. and D.O. Sawyer (2007). *Heterogeneity of malaria prevalence in alluvial gold mining areas in Northern Mato Grosso State, Brazil*. Cad. Saude Publica 23(12):2878-86.
- Evans, L., V. Coignez, A. Barojas, D. Bempong, S. Bradby, Y. Dijiba, M. James, G. Bretas, M. Adhin, N. Ceron, A. Hinds-Semple, K. Chibwe, P. Lukulay, V. Pribluda (2012).*Quality of anti-malarials collected in the private and informal sectors in Guyana and Suriname*. Malaria Journal 11:203
- Heemskerk, M. (2010). *Searching for gold, finding malaria. Baseline study in three small scale mining areas in the Suriname interior.* Report submitted to malaria program, Ministry of Health, Bureau of Public Health.
- Heemskerk, M. and C. Duijves (2012a*). Looking for gold, finding malaria. Assessment of changes in malaria-related knowledge, attitudes, and practices resulting from the Ministry of Health malaria program in small-scale gold mining areas in Suriname.* Report submitted to malaria program, Ministry of Health, Bureau of Public Health.
- Heemskerk, M. and C. Duijves (2012b). *Migrant & mobile populations and access to HIV services in gold mining areas in Suriname. In-Country Mixed-Methods Research and Data Collection*. Report submitted to EPOS Health Management GmbH
- Hiwat, H. et al (2012) *Novel strategies lead to pre-elimination of malaria in previously high-risk areas in Suriname,* Malaria Journal 2012, 11:10
- Inter-American Development Bank (IDB)(2004). Suriname, An overview of Indigenous and Tribal Peoples. Report nr: SU-CSS-003/SU-P1001
- International Monetary Fund (IMF) (2012). Suriname. 2012 Article IV Consultation. IMF country report No. 12/281
- Kambel, Ellen-Rose (2006). *Indigenous Peoples and Maroons in Suriname*. Economic and Sector Study Series. RE3-06-005. Inter-American Development Bank.
- L'agence Régionale de Santé de Guyane (2013). *Paludisme. La France épinglée par l'OMS.* Informatique October 2013.
- Nacher, M., P. Guérin, M. Demar-Pierre, F. Djossou, F. Nosten and B. Carme (2013). *Made in Europe: will artemisinin resistance emerge in French Guiana?*Malaria Journal 2013, 12:152
- World Bank (2013). GNI per capita, PPP (current international $). Online data tables. URL: http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD
- Zimmerman, R.H., L.P. Lounibos, N. Nishimura, A.K.R. Galardo, C.D Galardo and M.E Arruda (2013) *Nightly biting cycles of malaria vectors in a heterogeneous transmission area of eastern Amazonian Brazil*. Malaria Journal 2013, 12:262

ANNEX A. RESEARCH INSTRUMENTS

1. Malaria Questionnaire

Inclusion of interviewee: *Ask the below question to determine whether the person should be included/ continue to be interviewed, or not*
Did you have, or suspect you had, malaria in the past 1 ½ year (2012-2013)?
1. Yes 2. No (Participant is not part of the target group. Discontinue the interview)

Date: _____ Location: _____

General Demographic and Socioeconomic Information

1. Gender (circle) : 0 = Female 1 = Male

2. What is your date of birth (insert: day/month/year) : . . / . . / . . . .

3. Where were you born?
   1. Suriname
   2. Brazil
   3. Guyana
   4. Dominican Republic
   5. French Guiana
   6. China
   7. Other:_____

4. What do you do in the mining area at this moment (Circle all that apply)
   1. Gold miner (worker)
   2. Gold miner (machine owner)
   3. Sex worker
   4.Transport provider
   5. Brothel owner
   6. Shop employee
   7. Shop owner
   8. Housewife
   9. Unemployed
   10. Travelling vendor
   11. Other: _____

5. How long have you been working in gold mining?
   1. < 1 year
   2. 1-3 years
   3. 4-7 years
   4. > 7 years

6. In what countries have you been working in the gold mining sector in the past 1 ½ years (2012-2013)?
   (more than one answer possible; circle all applicable answers)
   1. Suriname
   2. French Guiana
   3. Brazil
   4. Guyana
   5. Other;_____

7. In how many gold mining areas in Suriname did you work or live for more than a month in the past three years?
   1. Only 1
   2. 2-3
   3. 4-6
   4. More than 6

8. What is your highest level of formal education?

	Completed	**Not completed**
Primário/GLO	1	2
Secondário/VOJ	3	4
Tercero/VOS etc.	5	6

7. No education
8. Don't know
9. Other:_____

9. What languages do you speak?

	Yes, fluently	**I understand a little**	**Hardly/not at all**
Dutch			
Sranantongo			
English			
Portuguese			
French			

General Malaria Knowledge and Experience with Malaria

10. What is the cause of malaria? (circle all that apply – do NOT read out the answers to the interviewee)
    1. Bite of a (malaria) mosquito
    2. Drinking dirty water (river/creek)
    3. Being near to dirty water
    4. Dirty surroundings (trash)
    5. Other:_____

11. Can you name symptoms of malaria? (circle all that apply – do NOT read the answers)
    1. Headache
    2. Fever
    3. Feeling cold/shivering
    4. Feeling weak/tired
    5. Throwing up/Nausea
    6. Bitter taste
    7. No appetite
    8. Diarrhea
    9. Joint pains
    10. Body pain
    11. Don't know
    12. Other

12. Can you indicate whether the following statements are true or false?

	TRUE	**FALSE**	**Don't know**
a. You can stop malaria treatment as soon as you feel better			
b. Malaria can kill people			
c. Malaria medication from Brazil is better than that from Suriname			
d. Malaria medication from French Guiana is better than that from Suriname			
e. When tested negative for malaria it is wise to take malaria medication anyway, just to be sure			

13. How often have you been ill with malaria in the past 1 ½ year (2012-2013)?
    1. Once (1 time)
    2. 2 to 3 times
    3. 4 to 5 times
    4. more than 5 times
    5. Don't know

14. The last time you were ill with malaria, in what country were you?
    1. Suriname
    2. Brazil
    3. Guyana
    4. French Guiana
    Other country_____

15. When is the last time you were ill with malaria?
    1. In this past month
    2. In the last 1-6 months
    3. 7-12 months ago
    4. More than a year ago
    5. Don't know

16. What type of malaria was it? (Do NOT read the options to the interviewee)
    1. Falciparum
    2. Vivax
    3. Mixed infection
    4. Don't know
    5. Other, namely: _____

Malaria Prevention

17. How can one protect oneself against malaria?
    1. Sleep under bed net
    2. Use preventive medication (bita)
    3. Use mosquito candle
    4. Use Baygon etc. (insect spray)
    5. Use repellent
    6. Stay away from dirty water
    7. Keep your area clean
    8. Don't drink dirty water (creek/river)
    9. Don't know
    10. Other_____
18. Did you sleep under a bed net last night?
    1. Yes 2. No 3. I don't know

19. If you slept under a bed net last night, was that bed net impregnated? That is, was the bed net the type that is treated with a chemical that repels and/or kills mosquitoes?
    1. Yes 2. No 3. I don't know 4. Did not sleep under a bed net

20. Which medicines do you take at this moment or did you take in the past 1 ½ year (2012-2013) to protect yourself against malaria? (incl. bita etc).
    1. I did not use preventive medication
    2. I used Artecom
    3. I used: _____
    4. I Forgot the name (try to describe)_____
    5. Can't remember

Questions 21-26 only apply to people using preventive medication

21. If you have preventive medication with you; can I see it?
    Write name of the medicine:
    _____

22. Where did or do you obtain the preventive medication?
    1. Store or supermarket in the mining areas
    2. Pharmacy in the mining areas
    3. Supermarket in Paramaribo (e.g. Transamerica)
    4. Pharmacy in Paramaribo
    5. Health facility, namely (*write name of the health facility*): _____
    6. Other source (*specify*):____ _____

23. What were the reasons you started to use preventive medication?
    1. I got malaria several times and I do not want to get it again
    2. People in my surrounding had malaria
    3. It makes me feel better/stronger
    4. Other: _____

24. What has been the effect of preventive medication; does it work?
    1. Yes, because: _____
    2. No, because: _____

25. Have you experienced side effects of this preventive medication?
    1. Yes, Itching
    2. Yes, skin problems (rashes, dark spots etc)
    3. Yes, other: _____
    4. No

26. Have you recommended taking preventive medication to your friends/family?
    1. Yes, because: _____
    2. No, because:_____

Malaria Treatment

27. What strategies have you used to get better when you had malaria in the past 1 ½ year (2012-2013)? (Circle all that apply)
    1. Nothing 3. Use auto medication
    2. Go for a test 4. Other_____

Questions 28-35 only apply to people taking auto-medication

28. In the past year (2012-2013), which anti malarials have you used to cure malaria (only auto-medication, not prescribed)? **Use picture chart** (Circle all that apply)

1. Coartem	5. Chloroquine + Primaquine	9. Lariam/Mefloquine
2. Coartem + Primaquine	6. Artecom	10. Artemisinin (red/white)
3. Chloroquine	7. Anate	11 Coartem.
4. Primaquine	8. Adesunate	12. Other;_____
		13. Don't know

29. Are you currently taking medicines to cure malaria?
    1. Yes 2. No

30. If you have malaria medicines with you; can I see it? *Write name of the medication:* _____

31. Where did or do you obtain medicines against malaria the last time you needed them?
    1. Supermarket in the mining areas
    2. Pharmacy in the mining areas
    3. Supermarket in Paramaribo (e.g. Transamerica)
    4. Other: _____

32. What were the reasons you started to treat yourself without seeing a health professional or health worker, the last time you did this?
    1. I got malaria but I tested negative and the health worker did not want to provide medication.
    2. I was too far away from a health post when I had malaria, and it would be too costly and/or time consuming to go see a health worker/MSD and take the test.
    3. I knew/suspected I had malaria and I did not want to bother to take the test
    4. The medication I bought works better than the one the health workers give.
    5. Other reason: _____

33. What has been the effect of the medication you bought; did it work?
    1. Yes, because: _____
    2. No, because:_____ _____

34. Have you experienced side effects of this medication?
    1. Yes, such as_____
    2. No

35. Have you recommended self- medication to your friends/family?
    1. Yes, because: _____
    2. No, because: _____

36. Do you know where to go for testing and treatment of malaria **in Suriname**? If yes, please state where? (Please circle all answers that are mentioned but do NOT READ the ANSWERS to the interviewee)

1. MSD	4. BOG	7. Hospital

2.Health clinic MZ 5. General clinic/Practitioner 8. Brahma/Medilab
3. Malaria Lab Tourtonne 6. Don't know where to go 9. Other

37. Did you get tested the last time you suspected to have malaria?
1. Yes, by an MSD 4. Yes, in official test location in Paramaribo (e.g. Tourtonnen lab; Brahma)
2. Yes, by health worker in Fr Guiana 5. Yes, by a health worker in Brazil
3. Yes, by MZ 6. No I did not go for a test
7. Other;
_____

If YES, go to 38; if NO, go to 40

38. If yes, why there?(circle all that apply)
1. Nearest place 4. Good price/Free 7. Quick results
2. Good medical care 5. Speak my language 8. I trust them to be professional/good
3. Recommendations of others 6. Friendly staff 9. Other;_____

39. Did you test positive?
1. Yes – **Go to Question 41**
2. No – **Go to question 43**

40. If you did not go testing, why did you not go for testing?(circle all that apply)
1. I knew my status without testing 5. Didn't know where to go
2. Too far from health services 6.Takes too much time to get there
3. Results take too much time 7. Financial reasons
4. Bad experiences in the past 8.I take medication anyway, namely_____
5. No MSD in the area 9. Other_____
Go to Question 44

41. If tested positive, did you directly obtain medication from the health worker/MSD?
1. Yes, I directly received medication. 3. No, I didn't receive anything
2. No, I got a prescription 4. Other: _____

42. If you obtained medication or a prescription from the health worker the last time you had malaria, did you use this medication?
1. Yes
2. No, because: _____
Go to Question 44

43. If you were tested negative, what did you do?
1. Just waited until it would go away/until I felt better
2. Test again
3. Bought malaria medication over the counter in a supermarket/pharmacy
4. Obtained malaria medication from friend/acquaintance
5. Other: _____

44. The last time you took malaria medication, who gave you information on how to properly use your medication?
1. Health worker 3. Friend 5. No one

2. MSD 4. Shop owner/seller 6. Someone else_____

45. The last time you took malaria medication, did you fully understand how to use this medication, that is; what dose/how many pills per day and at what times?
    1. Yes, it was completely clear
    2. No, I did not understand everything but I asked friends and other people around me
    3. No, I did not understand everything but I went back to the health worker
    4. No, I did not understand everything but I did what I thought was right
    5. No, I did not understand everything so I discontinued treatment
    6. Other: _____

46. How many pills were left when you stopped taking medication, the last time you used malaria medicine?
    1. No pills were left – **Go to Question 48** 3. Some pills left
    2. One pill was left 4. Can't remember

47. Why did you have left over pills?
    1. I felt better and stopped 3. I forgot to take pills 5. Other reason:_____
    2. I experienced bad side effects 4. They did not work 6. No left over pills

48. In the past month, have you used any over-the counter medication other than malaria medication (without prescription) in a supermarket or pharmacy?
    1. Yes **- go to 49**
    2. No **- end of survey**
    3. I don't know **- end of survey**

49. If Yes, what kind of illness or health problem did you use it for?
    _____

50. What type of medication did use (more than one answer possible)?
    1. Antibiotics, such as “red-and-black”, penicillin, amoxicillin, etc.
    2. Painkillers, such as Paracetamol, Aspirin, Paracaf, Ibuprofen, etc
    3. Wound crème/antibiotic crème/anti-fungal crème/disinfectant crème
    4. Shilling oil/hot-and-cold crèmes against muscle aches
    5. Eye-drops/nose-spray/ear drops
    6. Anti-cough medication/medicines against common colds
    7. Other: _____

2. Interview guide health workers

General information

1. Date: _____ 2. Location: _____

3. Type of health service (circle): MZ clinic / French health post / Pharmacy in mining areas / MSD / Other: _____

4. Name of health service: _____

5. Function of interviewee: _____

Malaria Prevalence and Prevention

6. What is the main function of this health service? What kind of services do you offer?

7. What kind of services do you offer in the area of malaria prevention, diagnosis and treatment?
   a) Active malaria awareness and education; outreach, advice, etc.
   b) Passive malaria awareness and education: availability of brochures and posters
   c) Malaria testing - rapid test
   d) Malaria testing - microscopy
   e) Extension of malaria medication to positive patients
   f) After-treatment care, such as: _____
   g) Other: _____

8. Do you see a lot of patients who come to test for malaria? How many times a week do you perform the malaria test?

9. How many persons have tested positive for malaria at this health post in the past month? How many of these persons were people working in gold mining areas?

Malaria Treatment

10. What type of medication do you prescribe/give when people test positive for *M.Falciparum* or *M.Vivax*?

11. Does the patient receive these medicines immediately from you or from someone else?

12. Is any cost involved in malaria testing and/or treatment?

13. Do you have any indications (observations, patient accounts) that there are people who do not take the complete cure, that is, who do not take all pills in the pack? What makes you think that? (they come back without feeling better etc.)

14. After you have provided medication to patients, have you asked them whether they have completed the cure? If so, what did they say?

15. What reasons patients mention for not completing the cure? (they start to feel better and stop taking pills etc.)

16. Given your experience in this community, do you believe that many people use auto-medication? Could you give an estimate of the share of people who use auto-medication when they believe they have malaria, versus those who take a test? Would it be more or less than half? Just a small share(<5%)?

17. Do you think that people who test negative for malaria buy and take malaria medication anyway? Is this common behavior?

18. What types of medicines against malaria do people in this community buy over the counter?

19. What are the sources of these antimalarials?

20. Do people in this community use preventative medication against malaria? Do you know what types of medicines they use, and how they use them?

21. Apart from taking auto-medication and not completing the cure, can you give examples of other treatment behaviors that are ineffective or undesirable?

22. Are there any other things you would like to mention about malaria treatment behavior?

3. Focus Group guide

General
Date: _____ Location: _____
Number of persons in group: _____
Number of males/females:_____
Nationalities: _____

1. Do you know what malaria is; how you get it?

2. People talk about malaria as a disease, but is malaria one disease or are there different types that feel differently? Have you experienced different types of malaria? If there are different types, how many do you think there are?

3. What do you and your family members do to protect yourselves against malaria?

4. Do you take any medication to prevent getting malaria?

5. Is it common for people in this area to take preventive medication? Why do you think they do this?

6. What kinds of preventive medication are used in this area and where can you obtain/buy this?

7. What is the cost of preventive medication here in the gold mining areas or elsewhere (Paramaribo)?

8. When you do fall ill with malaria, what do you do?

9. We just established that there are different types of malaria. Can they be cured with the same medication? That is, do the same medicines always work, or do you need different types of medication to cure different types of malaria? How do you know what medication you need?

10. What is in your experience the best medication against malaria? Why?

11. In this region, where can you obtain this medication? What is in your opinion the best place to obtain malaria medication?

12. What does this medication cost when you buy it here in the mining area, or elsewhere (in Paramaribo, in French Guiana?)

13. In this area, where do people go for malaria testing?

14. How long does it take to get to the testing location, is it nearby and easy to reach? How much does it cost to get there?

15. What does it cost to get tested for malaria? Is the price the same in all locations?

16. Has there been a time when you thought you had malaria and didn't get tested? Please explain.

17. Have you heard about Malaria Service Deliverers? Do you know where they are located?

18. If there is an MSD nearby, have you used their services? Why or why not?

19. When you get malaria medication you get a whole lot of pills that you need to take for several days or even two weeks in a row. Sometimes people have pills left over when they stop to take medication. When you've had malaria, did you take all your medicine? Why or why not?

20. Have you experienced, in your family or among your friends, that people do not take all the pills that were subscribed? Why do you think people stop taking pills before the cure is complete?

21. Do you know what can happen if you take your medication wrong or if you don't finish the treatment?

22. When you get malaria medication does the MSD/health worker explain how to use it? If you have had such an explanation, was it clear to you?

23. If there is no MSD or health worker to inform people how to use malaria medication (e.g. in the case of auto-medication), how do people know how to use this medication?

24. What do you think is important to lower malaria prevalence? What can be done here in the gold mining area? What actions are important?

Audit Sheet

1. Name general area: BENZDORP/CABANAVO/ANTONIO DO BRINCO/PERUANO/ OELEMARI / OTHER: _____

2. GPS location: _____

3. How do people reach this area, from Paramaribo? (mode, time and price):
_____
_____

4. Est. number of inhabitants: _____

5. Nearest general health care provider: _____

6. Distance to the nearest general health provider: _____ km

7. Time needed to travel to the nearest health care provider: _____h _____ min.

8. Costs to travel to the nearest health care provider: _____ SRD/EUR/USD

9. Presence of MSD: Yes / No

10. Nearest place where one can test for malaria: _____

11. Distance to the nearest place where one can test for malaria: _____ km

12. Time needed to travel to the nearest place where one can test for malaria: ____h ___min

13. Site has participated in Active Case Detection from the malaria program:
☐ No, never ☐ Yes, in (years): _____

14. Distribution of LLN has taken place in this location: NO / YES in year:_____

15. Malaria awareness posters visible? Where? _____

16. Other general observations or comments:

ANNEX B. SELECTION OF OTC MEDICINES USED BY RESPONDENTS

Tandrilax is South American medicine, which is prescribed for pain and inflammation due to infection, arthritis, surgery or injury. It contains carisoprodol (muscle relaxant), diclofenac sodium (a non-steroid anti-inflammatory), and paracetamol (a generic term for acetaminophen).

Silimalon is a Brazilian medicine against complaints related to digestion and the processing of food, such as dyspepsia (heaviness and drowsiness after meals, difficult digestion, nausea and vomiting), excess food, migraine digestive, intolerance to fatty foods, malaise caused by alcohol abuse.

Tilatil is a Brazilian medicine for the initial treatment of inflammatory and degenerative diseases, painful musculoskeletal system rheumatoid arthritis, osteoarthritis, arthrosis, ankylosing spondylitis, and extra-articular disorders.

Diclofenaco is a Brazilian nonsteroidal antiinflammatory drug (NSAID) that is used as an analgesic and anti-inflammatory. It is prescribed to reduce inflammation, as a muscle relaxant and as an analgesic. It reduces pain caused by minor injuries and pain as intense as those of arthritis.

Epocler is used for treating dyspepsia vomiting and/ or, nausea, ailments induced by overeating. It also is useful for treating digestive migraines. Other ailments include food intolerance, specifically for fatty foods. In addition it is also used for supporting the liver toxic by alcoholic patients and patients suffering from hepatitis in liver.

Xantinon is a Brazilian medicine used for the treatment of hepatic metabolic disorders such as an antioxidant, reducing hepatic oxidative stress in cases of liver disease. People take it when they have a bitter flavor in the mouth suspected to be caused by malfunction of the liver.

Petarcarinate is used to prevent pneumonia in people infected with HIV.

Nizoral is used to treat certain serious fungal infections in the body.

ANNEX C. NEWSPAPER ARTICLE: FRANCE REPRIMANDED BY THE WHO

Paludisme : la France épinglée par l'OMS

L'Organisation mondiale de la Santé reproche à la France son **incapacité à lutter efficacement contre le paludisme en Guyane**, où la **législation empêche toute action de soin et de prévention sur les sites d'orpaillage clandestin**.

Le docteur Mathieu Nacher déclare que « le combat contre le paludisme risque d'échouer si la Guyane continue d'appliquer les lois nationales » / photo TF

ET AUSSI...

Taubira déjà en 2002

En 2002, l'actuelle ministre de la Justice interpellait le ministre de la Santé à l'Assemblée nationale sur la question du paludisme. Elle soulignait alors la recrudescence des cas recensés en Guyane et réclamait la mise en place de mesures efficaces pour lutter contre le développement de la maladie. Onze ans plus tard, la situation n'a pas changé.

La France est désormais affublée d'un bonnet d'âne. Celui que portent les mauvais élèves. Un couvre-chef peu glorieux qui lui a été attribué par l'Organisation mondiale de la Santé (OMS), qui reproche à la France son incapacité à lutter efficacement contre le paludisme en Guyane. Donc, indirectement, de favoriser l'augmentation des résistances du virus au médicament (l'artémisinine, une substance active médicamenteuse extraite d'une plante chinoise). Soit le traitement le plus efficace, à cette heure, contre le paludisme. Dès 2011, l'OMS s'est publiquement inquiétée du renforcement des résistances au traitement. Un plan d'action a été publié afin de permettre à chaque pays directement touché par le paludisme d'agir efficacement. Un dispositif qui a permis de lutter contre la perte d'efficacité progressive de l'artémisinine. Sauf en Guyane. Principalement en raison des foyers infectieux situés en forêt. En l'occurrence, les sites illégaux d'orpaillage.

NI PRISE DE SANG, NI DIAGNOSTIC

« On est face à un vrai problème, affirme le docteur Mathieu Nacher, dermatologue et vénérologue au centre hospitalier Andrée-Rosemon, à Cayenne. En Amazonie, on a des indicateurs qui montrent que des résistances sont apparues. Mais on manque de données. On n'est pas loin du seuil où il faudrait faire des études complémentaires. » Ce qui s'avère impossible sur les sites clandestins. En Guyane, on recense environ 15 000 orpailleurs clandestins.

En effet, la loi dite Hurlet-Serusclat interdit toute recherche médicale sur les patients qui ne disposent pas d'une assurance santé. Ni prise de sang, ni diagnostic. « Pourtant, les recettes, on les connaît, on sait ce qu'il faut faire », assure le médecin, qui évoque principalement la méthode appliquée au Suriname. Le « bon élève » de la classe.

DÉLÉGUER ? ILLÉGAL

Dès 2012, le gouvernement surinamais a mis en place un programme baptisé « Looking for gold, finding malaria » (Chercher de l'or, trouver le paludisme). « Des volontaires sont formés par des professionnels de santé pour intervenir sur les sites, explique le docteur Nacher. On leur apprend à diagnostiquer et à doser le traitement. C'est ce qu'il faudrait faire en Guyane. Si le système de santé ne dispose pas des moyens pour intervenir, il faut déléguer. Mais en France, ce n'est pas légal. » Car, lorsqu'un non-professionnel administre un traitement médical, il s'agit tout simplement d'un exercice illégal de la médecine.

UNE QUESTION DE SANTÉ PUBLIQUE

« On sait que des choses mijotent en forêt, mais on est pieds et poings liés par ces obstacles légaux, peste le médecin. Pourtant on sait que le problème va évoluer. » Pour le praticien, il n'existe pas de contradiction entre le fait de lutter contre l'orpaillage illégal et intervenir sur les sites pour empêcher le développement du paludisme. « Dire qu'en soignant les orpailleurs on va leur permettre de détériorer davantage la forêt, c'est avoir une vision à court terme, insiste-t-il. Car il faut traiter, pour une question de santé publique. Si un feu se déclare dans un bidonville où n'habitent que des clandestins, on envoie quand même les pompiers. Sinon, le feu risque de s'étendre à toute la ville… »

UNE BAISSE DES CAS RECENSÉS

Le docteur Nacher précise que la faute n'est pas à mettre au passif des autorités locales, « puisque le paludisme a diminué ». Harpie, moustiquaires, traitement ? Quoi qu'il en soit, en 2012, 900 cas ont été recensés en Guyane. Contre plusieurs milliers en 2002. « Mais actuellement, un tiers de la population touchée reste en dehors de l'action publique, souligne le spécialiste. Or, l'objectif de l'OMS est l'élimination du paludisme. » Un objectif impossible à atteindre si un seul des pays touchés rechigne à agir efficace-

Un scénario répétitif depuis les années 1950

Avec l'arrivée des traitements, les résistances ont fait leur apparition. « Toujours selon le même scénario », selon le docteur Nacher. Elles apparaissent d'abord en Asie du sud-est avant de s'étendre à l'Afrique et enfin, de s'immiscer en Amazonie. Ce fut le cas dans les années 1950 avec la chloroquine, puis avec le fansidar. Les années 1990 et 2000 ont permis de faire d'énormes progrès, principalement avec l'artémisinine. Mais à la fin des années 2000, une diminution de l'efficacité des médicaments a été relevée à la frontière cambodgienne. Ce qui a fait naître la crainte, au sein de l'OMS, d'une extension des résistances