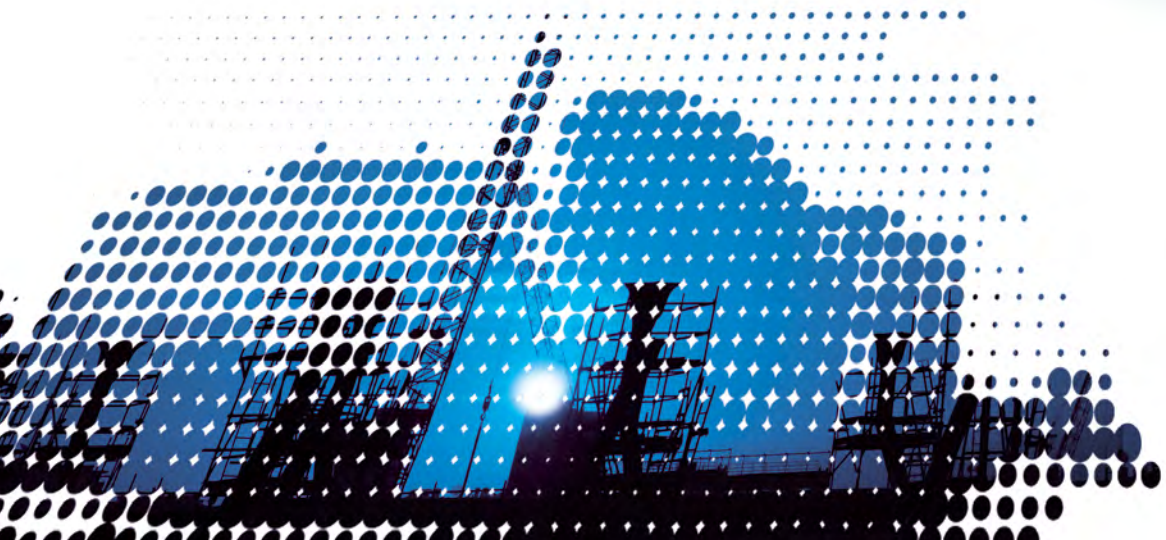
MALARIA

TAKING ACTION,

IMPROVING LIVES WHERE WE WORK



ONAMET

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Editorial

Sonamet's most valuable assets are its employees. That's why safety in the workplace and the welfare of our employees have always been among our top priorities. Protecting our staff from malaria and ensuring they are treated if they become infected are just two of the ways we put this policy into practice.

This brochure explains the remarkable work done by Sonamet over the last ten years to prevent its staff from catching malaria and to diagnose and treat those already infected with the disease. You'll also discover how, after initially focusing on our production yard, we have extended these services to include the families of our employees and, more generally, the communities who live around us.

This is all part of our role as a responsible enterprise, and it's something we care deeply about - as our health and education initiatives and awareness-raising on a wide range of issues demonstrate.

The interest shown in our work on malaria by the Angolan and international authorities, including the World Health Organisation (WHO), and our various partnerships with the Angolan Ministry of Health, underline the importance of our role in society. - a role we are extremely proud to play.

José Barroso
Sonamet General Manager

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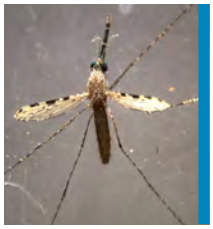
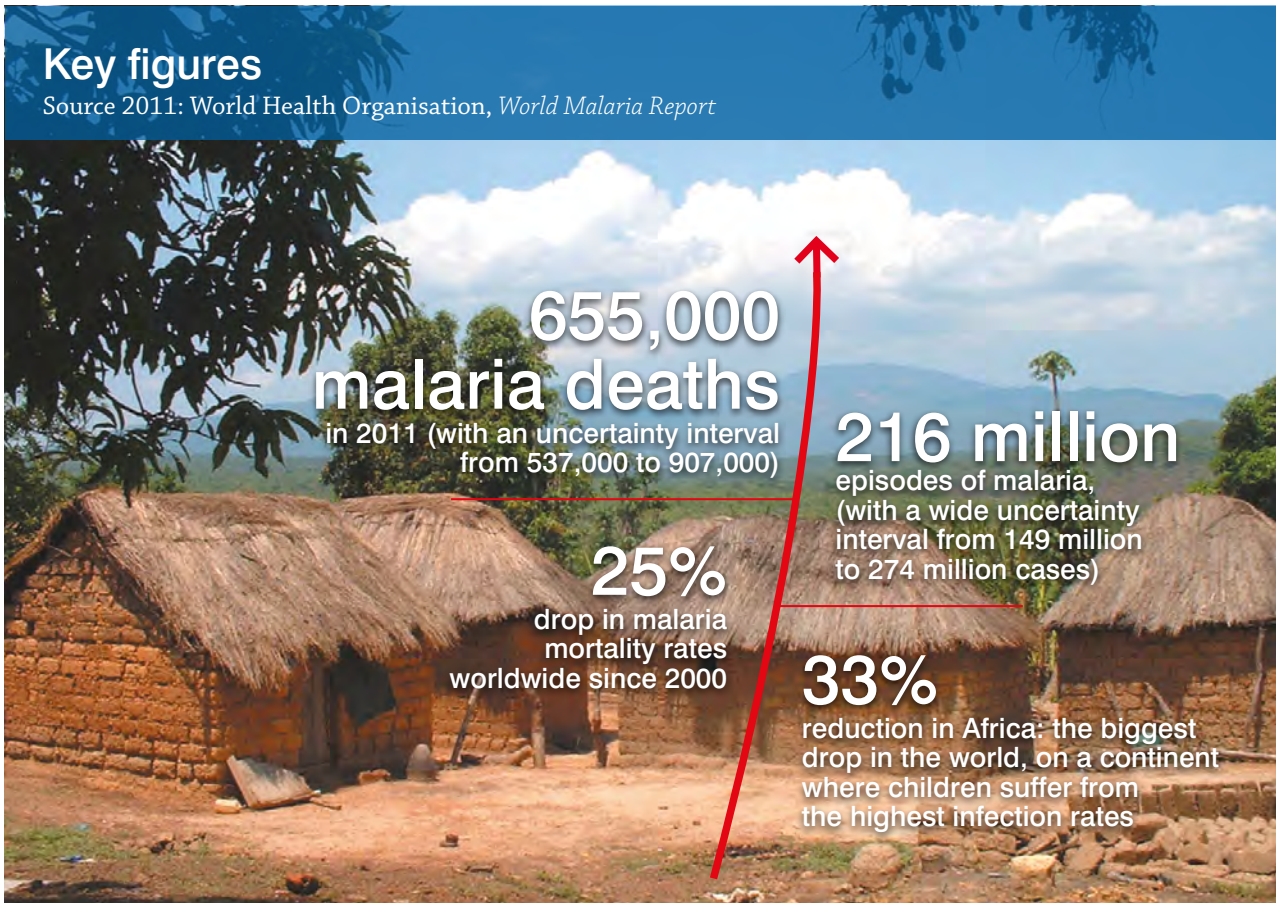


Malaria is an infectious disease caused by a type of parasite called *Plasmodium*, which is spread to humans by female *Anopheles* mosquitoes. The parasites grow first in the liver cells and then in the red cells of the blood.

There are some 500 species of anopheles worldwide; around sixty are good vectors and some thirty are excellent biological vectors of *Plasmodium* in humans. The most virulent biological vectors, such as *Anopheles gambiae, Anopheles funestus and Anopheles arabiensis* are found in Africa South of Sahara. They have different larvae breeding sites, biting behaviours and susceptibilities to insecticides. These Anopheles can spread four species of parasites: *Plasmodium vivax, P. malariae, P. ovale and the potentially lethal P. falciparum*.

The symptoms of malaria appear on average 10 to 15 days after the infecting bite and include fever, vomiting, diarrhea and muscular pain; the delay between the infecting bite and the onset of the symptoms can take much longer depending on the Plasmodium species, and up to several months or even years in the case of *P. vivax, P. ovale and P. malariae*. The current "record" for *P. falciparum* is 26 months. The signs and symptoms are not specific to the disease and, depending on the situation, may be confused with the start of a cold or dengue fever. If left untreated, *Plasmodium falciparum* malaria can cause "severe complications" and lead to fatal anaemia or capillary blockage, including blockage of the cerebral capillaries, known as "cerebral malaria" or "pernicious malaria". In practice, any fever occurring after travel to a *P. falciparum* endemic zone should, until proven otherwise, be assumed to be malaria.

Chemoprophylaxis and antimalarial treatments are generally effective but in some regions parasites and vector mosquitoes can become resistant - one to treatment, the other to insecticides - and present a serious obstacle to malaria control. Since there is no operational vaccine against malaria, vector control, based on what we know about Anopheles vectors - their specific determination, biology, susceptibility to insecticides, etc. – offers one of the most effective ways of preventing malaria by limiting the risk of mosquito bites.



Malaria control

Sonamet takes on one of Angola's biggest health challenges

In early 2003, Dr Jean-François Foucher, the director of our medical service in Suresnes, approached Dr Patrick Besnard, a specialist in tropical medicine, to discuss a serious problem: the steady rise in malaria infections among Sonamet's employees. They needed to find a solution, and fast.
Appointed manager of the Lobito yard's medical service in Angola, and charged with malaria control on behalf of Sonamet, Dr Besnard set about his task.

Improving malaria control through research

To effectively control malaria, it's important to start by gaining a clear picture of the situation on the ground, before drawing up a programme adapted to local ecological and socio-economic conditions, for optimal impact.

Developed in conjunction with the Angolan authorities, the malaria control programme was rolled out in three stages:

- the first step was to set up a **parasitology laboratory** within the medical service to obtain fast and reliable data **in order to diagnose cases of malaria and to treat them in an appropriate way**;
- a team of Angolan agents was then set up as part of the **Malaria Control Programme** (MCP), assisted by outside consultants, to work on malaria control projects in Lobito and Balombo;
- lastly, the company set up a network of **external partnerships** to improve the training of these agents and our scientific knowledge of the vectors and parasites causing the infections.

Dr Besnard's first task was therefore to establish the actual malaria prevalence rate among feverish patients attending consultations, with a view to improving their diagnosis and the treatment of the disease.

Importance of a correct diagnosis

In 2002, around 20% of patients seen by the Lobito yard's medical service were diagnosed with "malaria". Faced with such a high level of infection, Dr Patrick Besnard started by setting up a parasitology laboratory within the medical service. The aim was to perform fast and reliable blood tests in order to correctly diagnose malaria. *"You can't diagnose malaria on the basis of symptoms alone. The only sure way is to examine a drop of blood under a microscope*," explains Dr Besnard.

A correct diagnosis is obviously essential to treat the patient and to understand both the actual epidemiological situation in the area concerned and other infectious diseases. *According to Dr Besnard "The diagnoses we used to receive from outside laboratories included a large number of false-positive results, leading an exaggeration of the actual number of malaria cases and many patients were treated inappropriately for undiagnosed diseases which had been mistakenly diagnosed as malaria."* Once the parasitology laboratory had been set up, the medical service was able to obtain reliable diagnoses, and each case was systematically recorded.

At the same time, the MCP team used GPS technology to identify the houses of all company employees and analysed the data using a geographical information system (GIS) acquired by the medical service. Each case of malaria was georeferenced and computer maps revealed that these cases were distributed in clusters, which were likely to coincide with the presence of a highly effective vector.
"*This system also highlighted a major paradox: the concentration of malaria cases was as high in rural areas as in the upper town, in the neighbourhood of Bela Vista* ," continues Dr Besnard. There was nothing surprising about the cases in a rural area like Catumbela, where the ditches used to irrigate the fields were breeding sites for larvae from eggs laid by female Anopheles attracted to the clean water. But what was happening in the urban area, where the dry, arid conditions were extremely hostile to the Anopheles? *"We decided to focus our entomological research on the clusters which had been parasitologically and clinically identified*," adds Dr Besnard.

Eliminating false-positive results

It quickly became apparent that the conditions in which the disease was diagnosed were of vital importance. Without specific clinical signs, only a parasitological blood test can confirm or rule out the presence of ***Plasmodium***. *"We realised that the residents had decided that their region was a malaria hotspot. They didn't come to the laboratory to find out what they were suffering from - they came to get confirmation that they had malaria,"* says Dr Besnard. In fact, this tendency to interpret any fever as a bout of malaria introduced a detrimental bias into the diagnosis process - and the patient was partly responsible. To correct this bias, Sonamet provided the Lobito yard with a microscope, slides and reagents to conduct blood tests, and trained laboratory assistants in the "thick blood films" technique to obtain a reliable diagnosis.

Although the Bela Vista infestation zone was dry and arid, the ladle Jean-Claude Toto dipped into the poorly-sealed drinking water tanks came back with dozens of mosquito larvae.

An integrated approach...

The following stage consisted in assessing the transmission of the parasite responsible for the disease. *"We knew that the workers weren't contaminated in the yard, but at night, when they got home. So we needed to focus our response on their houses,"* says Dr Besnard.

"Thinking outside of the box": although basic procedure in the public health sector, the approach taken by Sonamet diverged sharply from standard industry practice. Rather than fumigating the yard during the daytime, the operation was carried out in people's homes, leading to the development of a much wider programme of social action! Some opposed the complexity, risks and difficulty of this - in reality, very simple - method. Nonetheless, Nicolas Monnot, then director of Sonamet, decided to break with convention and gave the doctor total freedom of action. Monnot decided to ask the opinion of three medical entomology and parasitology experts: Professor Carnevale[1], Jean-Claude Toto[2] and Vincent Foumane[3]. Together, they formed Sonamet's "MCP" team, studied the situation and developed appropriate prevention strategies.

Entomological approach

Since 2003, the MCP team, in conjunction with Professor Carnevale and Jean-Claude Toto, conducted a large-scale entomological survey of the malaria clusters, in other words, the at-risk zones. The team needed to establish which species of Anopheles were responsible for the infections, their biology, reproduction sites, and susceptibility to insecticides in order to select the most effective. The entomological field surveys revealed numerous larvae breeding sites created by the residents themselves, including ponds to store water for domestic use close to houses. This finding explained why the malaria clusters were located close to these ponds, which represented "hotspots" to address as a priority.

These findings were passed on to the national authorities and a water distribution network was set up to improve the situation. The water storage ponds fell into disrepair without any specific action needing to be taken, eliminating a host site for the Anopheles.
The MCP team continued to regularly report its entomological discoveries to the public health service in the province of Benguela, which was involved, with its Cuban colleagues, in a vast malaria control programme based on larva control (using a biolarvicide, *Bacillus thuringiensis*). In addition, light traps were installed in people's homes to catch hundreds of adult anthropophilic mosquitoes, which were examined and determined.

Dr Besnard's team systematically searched the area around the homes of Sonamet workers to find the mosquitoes responsible for transmitting malaria.

1. Emeritus Director of Research at the Institut de recherche pour le développement (IRD) in Montpellier.
2. Entomologist at a leading regional institute in Yaoundé, Cameroon.
3. Technician and engineer at the Organization for the Coordination of Endemic Disease Control in Central Africa (OCEAC).

Use of light traps to capture and identify malaria vector mosquitoes in the region.

The specific determination of the Anopheles revealed that the main species was *Anopheles gambiae*, the principal vector of *Plasmodium* in Sub-Saharan Africa. Other species of mosquito were captured, including:

- *Culex quinquefasciatus*, a major nuisance in urban areas due to its larvae, which can develop in waste water containing organic matter; the mosquitoes are resistant to insecticides. Fortunately *Cx. quinquefasciatus* is not a vector for pathogenic agents for humans in the region;
- *Aedes aegypti*, a major vector for several viruses, including yellow fever, dengue fever and chikungunya; the risk of epidemic outbreaks of these viruses is therefore extremely high.

Mosquito insecticide resistance tests based on the WHO protocol revealed that *Anopheles gambiae*, the malaria vector, was still susceptible to pyrethroids, a type of insecticide used to treat mosquito nets.

Based on the results of these studies, mosquito nets treated with Deltamethrin were systematically provided and installed free of charge in the homes of all company employees and their families by the MCP team. An entomological, parasitological and immunological assessment was conducted, with follow-up assessments in several "Sonamet" families living in Bela Vista over a two-year period. These assessments confirmed the effectiveness of mosquito nets in reducing mosquito bites among inhabitants protected by this system.

All of the studies were conducted as part of an on-going partnership with the national sanitary authorities (Benguela public health service) and the results were published in international journals and presented at national and international conferences.

Insecticide resistance tests pinpointed the most appropriate product to treat mosquito nets prior to distribution.

MCP - a team of local experts

In addition to these studies, an integrated malaria control programme was developed and Sonamet's agents were trained to implement it. The three experts ran a comprehensive training course for Red Cross volunteers, with one major factor in common: the desire to make themselves useful.

The MCP team has been trained in basic microscopy techniques.

Demanding and on-going technical training

During the intensive training courses run by Professor Carnevale, Jean-Claude Toto and Vincent Foumane, the future technicians were given the basic knowledge and methodological skills they needed to implemented the planned activities. After three months of training delivered in two stages, five of the thirty-five applicant agents were selected, and became Sonamet's intervention team for the Malaria Control Programme (MCP). Vincent Foumane trained the team members in basic parasitological techniques, including taking blood samples, producing and dyeing thick blood films, identifying *Plasmodium*, determining the parasite count and expressing the results, as well as maintaining the equipment. Sonamet has also implemented a quality control process, and Vincent Foumane conducts audits every four months along with basic and continuous training sessions for Angolan microscopists working in several health centres in Lobito and the surrounding area who have been supplied with new microscopes by Sonamet.

Jean-Claude Toto and Professor Carnevale were responsible for the medical entomological training of the MCP's officers, which included identifying larvae breeding sites, various methods for capturing mosquitoes, insecticide spraying techniques, and mosquito insecticide resistance tests based on WHO standards, among other topics. They also perform regular assignments to assess the progress made by the programmes and develop complementary activities.

The MCP's members, who have taken dozens of continuous training courses since 2003, are now able to independently conduct malariometric surveys and insecticide spraying operations, and train their Angolan colleagues at the request of the national authorities, etc.

The MCP has been given computers and an internet connection to stay in touch by email with the three experts and their external national and international colleagues.

Gametocyte or the sexual form of the parasite - the origin of mosquito contamination.

Pierre Carnevale, world renowned scientist, attracted in supporting a responsive and motivated team.

The families of all yard workers were given mosquito nets installed by the MCP team. Regular visits are paid to the families to ensure they are using the nets correctly.

Our prevention strategy in Lobito

With its MCP team now up and running, the medical service has been able to implement a malaria control strategy targeted at Lobito yard workers and their families, based on three complementary actions.

Free home installation of treated mosquito nets

In line with the World Health Organisation's recommendations on universal access to treated mosquito nets, Sonamet provided each agent and their families with treated mosquito nets designed to last three to five years. The MCP team is responsible for installing these mosquito nets and regularly checks their use and maintenance in order to change them if necessary (if the mosquito net has a hole) and to ensure they continue to provide effective protection against mosquito bites.

Ongoing entomological surveys

Regular entomological surveys are conducted in different neighbourhoods of Lobito - upper (Bela Vista) and lower (Liro, Sao Joao, etc.) - to identify the vectors and their main larvae breeding sites. This data is fed back to the national authorities as a basis for appropriate vector control operations (biolarvicide spraying).
The MCP and its consultants conduct regular insecticide resistance tests; the latest tests, based on the WHO protocol, confirmed that *Anopheles gambiae* is resistant to DDT but still susceptible to Deltamethrin, the product used to treat mosquito nets provided to Sonamet's agents.

A scientific analysis (entomological, parasitological and immunological, using a highly innovative technique) of 21 families of Sonamet workers living in Bela Vista, based on regular follow-up assessments over a two-year period, confirmed that these mosquito nets provide effective protection. This survey, which led to the discovery of a new biomarker (see page 10), was published in the *American Journal of Tropical Medecine and Hygiene* (AJTMH). The immunological technique was initially transferred to the Angolan authorities.

In addition, the entomological surveys confirmed the presence of *Aedes aegypti*, a major arbovirus vector, with the risk of a dengue epidemic requiring a specific response, including the identification and destruction of breeding sites, fumigation, etc.

Elisa dosage technique for Anopheles anti-saliva antibodies transferred to the National hygiene laboratory in Luanda, Angola.

The mechanical destruction of several large mosquito breeding sites

Entomological surveys conducted in two neighbourhoods regularly flooded by rain water - Canata and Lobito Velho - identified several larvae breeding sites producing particularly large numbers of mosquitoes; Sonamet implemented a vast operation to mechanically destroy these sites.

Under the responsibility of the MCP, and with the help of residents, lorry loads of sand were used to fill ponds and expanses of stagnant water in the streets and the surrounding area. This community action was warmly welcomed by residents: *"They turned out in large numbers to help us, which showed how determined they were to eliminate malaria*," explains Carla Matos, the company's head nurse.

With help from people living in at-risk areas, Sonamet used tipper equipment, managed by the MCP team, to conduct a vast operation to fill in expanses of water and ponds.

Decisive discovery of a new biomarker

"Working in accordance with strict scientific protocols, we have been able to gather relevant statistical and epidemiological data. The aim is to work effectively, but also to measure and assess what we do, to see what lessons can be learned," explains Dr Besnard.

The longitudinal tracking of 21 Sonamet families who have been given treated mosquito nets and their neighbours, who are not company employees and who do not have these mosquito nets, enabled us to build up a serum bank, which is carefully conserved on the MCP's premises. These blood samples were subject to specialised biological analyses conducted by IRDs* in Dakar and Montpellier to reveal, and proportion correctly, the antibodies developed by patients against the proteins injected with the saliva by mosquitoes when bitten. A low level of these antibodies suggests a low level of exposure to Anopheles bites, while a high level suggests a high level of exposure to Anopheles bites. Using this new biomarker, the Senegalese researcher Papa M. Dramé was able to assess the extent to which humans had come into contact with the malaria vector mosquito according to the level of protection (use or non-use of treated

Sonamet encourages screening among local residents

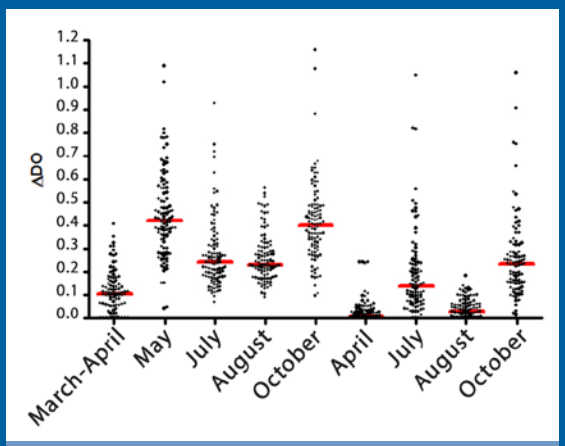
As the Fronteira medical centre can testify, the regular donations of equipment and the training provided by Sonamet have had a very real impact on the local population. *"Before, we felt that these families, even people who were ill, didn't dare come to our centre, because they had to pay 100 kwanzas for the consultation, 150 for the analysis and as much again for the hemoglobin test, which was a lot of money for them. Now, based on Sonamet's recommendations to provide these services for free, and as a result of public information campaigns, the number of patients has increased and we need two teams in our laboratory now - one in the morning, and one in the afternoon*," explains Teresa Alberto, the centre's manager.

Papa M. Dramé (IRD), Maria Chilombo (Sonamet) and Jean-Claude Toto (OCEAC Yaoundé) sharing their discoveries with technicians from the National Hygiene Laboratory in Luanda.

mosquito nets), and showed the effectiveness of the vector control strategy deployed by Sonamet. The results were praised in international publications (including journals such as *PLOS One* and *American Journal of Tropical Medecine and Hygiene*) and presented at international meetings (Rio, Paris and Cotonou).

This method was transferred to the national authorities and used to conduct dried filter paper blood spot analyses in villages in Balombo by partners of the IRD in Montpellier (Professor Sylvie Manguin et al.), as part of longitudinal surveys, to assess the effectiveness of new vector control measures.

* Development research institute.



The exposure of humans to the malaria vector is closely matched by the presence of antibodies. Sonamet's study of 21 families correlates the distribution of long-lasting mosquito nets treated with insecticide and a drastic reduction in the index of endemicity. The new biomarker, internationally recognised as a result of the work performed by Papa M. Dramé and Franck Remoué – based on Sonamet's study – was used to conduct vector control analyses involving people living in Balombo region. Funded by Subsea 7, the laboratory of Professor Sylvie Manguin from the IRD in Montpellier carried out analyses and studied the presence of antibodies.

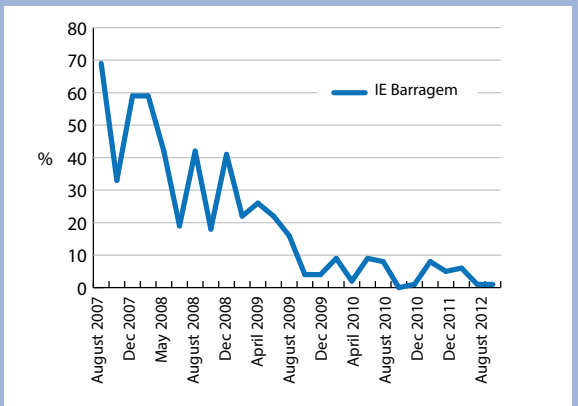
Building national capacities

In addition to its actions in the field, Sonamet has agreed to help build the capacities of national services in two areas: human resources and diagnostic parasitological equipment. The following three examples demonstrate how this policy is being put into practice:

- **Continuous training** of health staff in taking, dyeing and interpreting blood samples (thick blood films) using the same protocol as that implemented in the parasitological laboratory and the MCP. By standardising our methods, we can now compare the results obtained from various health facilities to improve our knowledge of the malaria situation in the region and its development. To date, 180 people have been trained in these techniques.
- **Supply of microscopes**: 30 microscopes were given to health centres, along with thick blood film equipment (glassware and dyes) and advice on maintaining this equipment.
- **Supply of solar panels**: Sonamet installed several large solar panels in Asseque, near Benguela, to supply electricity for the refrigerator and microscope.

Regularly visited by agents from the MCP, these health centres form part of the first network of sentinel sites set up as part of a malaria control pilot project run by Sonamet in conjunction with national bodies, including the Benguela public health service.

Sonamet fitted the Asseque health centre with solar panels to supply electricity to the refrigerator and microscope.



Balombo: national prevention pilot project

At the request of Professor Filomeno Fortes, the MCP developed a comparative protocol for four vector control methods, in eight villages around Balombo. Around 5,000 people benefited from this operation which, while drastically reducing the prevalence of malaria– as measured at the start of the programme in 2007 (from 80% on average in 2007… to under 5% in 2011!) –, provided remarkable comparative data on methods that were still experimental, compared with classic and already official methods. This programme fully reflects Sonamet's MCP strategy: a highly effective operational control combined with sound scientific reasoning and an innovative approach.

Changes in the index of endemicity in Barragem, in the region of Balombo, reveal the results of the MCP team's malaria control operations. A similar trend has been observed in seven other villages covered by the Balombo programme.

Sonamet - a key public health partner for Pr Filomeno Fortes

The manager of the WHO's international "Roll back malaria" programme in Angola, Filomeno Fortes is a supporter of Sonamet's actions.

Filomeno Fortes, the head of Angola's malaria control programme, asked Sonamet's MCP team to extend its operations to Balombo, an area with high levels of malaria, 150 km to the east of Lobito.

In 2005, the MCP received a surprise visit from a group of Portuguese scientists. They were led by a cheerful man with an open manner who introduced himself with an outstretched hand - Pr Filomeno Fortes. Head of the national malaria control programme and manager, for Angola, of the WHO's international "Roll Back Malaria" programme, he had recently been informed, by the Benguela public health service, of the studies conducted by Sonamet and was keen to express his interest.
Convinced of the soundness of the method developed by Sonamet, Pr Fortes went so far as to suggest forming a partnership with the company: his own studies had revealed that the region of Balombo had the highest prevalence of malaria in the province, and suggested the MCP work with the public health teams to set up studies and an operational control to protect people living in this region. The MCP team immediately looked into the proposal and, under the leadership of Pierre Carnevale, developed an original action and research protocol that quickly led to valuable recommendations being made for the national programme.

Why did the Angolan public health service and Sonamet initially decide to join forces against malaria?

In 2005, a presentation on the results of Sonamet's approach to protecting its workers from malaria caught my eye. I initially encouraged them to expand their public health activities to the area around the Lobito yard. In partnership with provincial public health managers, their teams oversaw three health centres in 2005 in Asseque, Fronteira and Alto Liro. Sonamet also provided the paediatrics department at Balombo hospital with treated mosquito nets.

How is this approach advancing research into malaria?

Research still isn't always the default position in Angola. During a meeting that we'd arranged with the French delegation of the IRD and Sonamet, we discussed the idea of a global malaria vector control project.
Since 2006, at my request, Sonamet's MCP team has been taking part in an international programme of vector control tests, supported by the WHO. They conducted a prevalence survey in eight villages in Balombo, a rural area with a high level of malaria infection, located 150 kilometres from Lobito.

The campaign compared the impact of four methods: treated mosquito nets (Llin PermaNet 2.0), a system of treated plastic sheeting lining the walls of people's homes (wall lining), a combination of the two (Zero Fly + PermaNet) and, lastly, the treatment of the walls by spraying insecticide every six metres, following the official WHO method. The results provided added value for Angola, as well as all infested regions. We hope that they will adopt the same technique. We expect that, by forging closer ties with Sonamet, the area covered by the programme will now be extended.

What are the next stages of your operation?

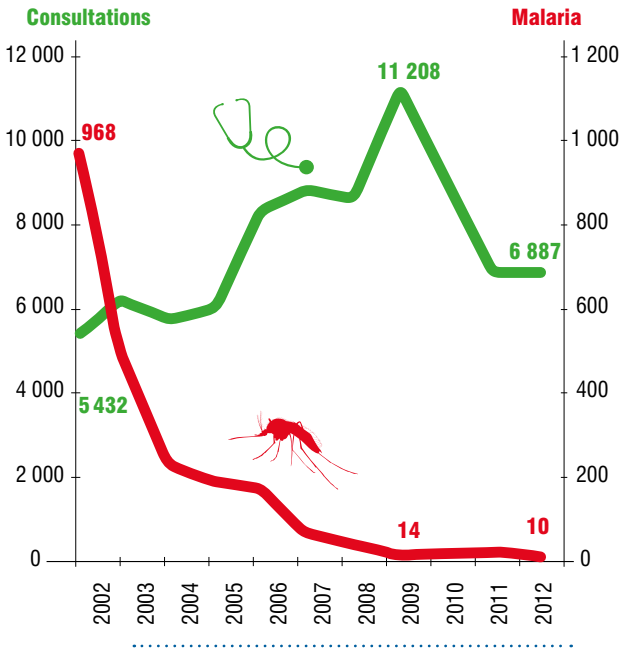
The strategy we have outlined consists in defining a national policy to engage the support of communities, and to raise their awareness of prevention and malaria control.
We are targeting areas with a high epidemic risk and are working to improve the quality of diagnoses and treatments and to step-up prevention measures, the large-scale distribution of mosquito nets, and the destruction of the vector.

Continuing and diversifying malaria control

The MCP team and its consultant colleagues are continuing to study the Lobito area, particularly by performing regular insecticide tests to determine the most appropriate products. For the time being, the main malaria vector is still susceptible to Deltamethrin and the mosquito nets treated with this insecticide and distributed to workers are just as effective as ever.

The many entomological surveys conducted by the MCP to locate larvae breeding sites for malaria vectors have had an impact on national prevention strategies. In partnership with the national malaria control programme, a Cuban team has launched a vast Anopheles larvae control programme which involves spraying the breeding grounds with a bio-insecticide, *Bacillus thuringiensis* var. H14.

The MCP is willing to supply this team with all of the information necessary to locate these breeding sites, thereby enhancing the effectiveness of their operation.
All of these preventive measures - entomological and parasitological - and improvements in diagnostic and care services, has led to a drastic reduction in malaria cases observed by Sonamet's medical service; this disease now represents just 1% of recorded diseases (compared with around 20% in 2002).



Number of consultations and cases of malaria handled by Sonamet's medical service in Lobito, from 2002 to 2012.

Campaign against dengue fever

Recently, another vector-borne disease has resurfaced, posing a threat to the sector: dengue fever. The MCP's entomological surveys have revealed the presence, in Lobito, of very large numbers of breeding sites for *Aedes aegypti*, one of the vectors of the yellow fever, dengue fever and chikungunya viruses. The assignment reports issued by the MCP's teams and their consultants also drew attention to this high-risk situation, which was confirmed by the appearance of numerous cases of dengue fever in Luanda. Lastly, the setting up of *Aedes aegypti* traps in the Lobito yard highlighted the dangers posed by this vector, which bites at night, when the workers are still present.
With the MCP, Sonamet has fortunately all of the resources it needs to control the vector: a team of experts trained to determine the mosquito spreading the disease, to recognise and mechanically destroy these breeding sites, and to correctly spray insecticides, in order to reduce to a minimum the risk of workers being contaminated by the viruses transmitted by *Aedes aegypti* which, just like the *Anopheles* malaria vector, needs to be constantly controlled.



Glossary

Anopheles
A species of mosquito. The female transmits malaria by biting humans at night: this insect is the malaria vector.

Indoor residual spraying
Residual spraying of the walls of a person's home.

Hyperendemic
A particularly persistent disease in a given region.

Entomology
The science of studying insects. Medical entomology is the study of disease-vector insects.

Biological vector
An arthropod vector in whose body the infecting organism develops or multiplies before becoming infective to the recipient individual.

Fumigation
Aerosol dispersion of air-borne insecticides.

Larvae breeding site
Water collection breeding site where mosquitoes lay their eggs to reproduce.

Thick blood films
The placing of a drop of blood on a slide to study it under a microscope and search for parasites, subsequent to dyeing.

Vector control
Supervision, control and protection against insects which transmit, by biting, infectious diseases to humans and vertebrates. Control may target the destruction of the insect or the reduction of transmission, that is, contact with humans. The techniques used to control vectors may be chemical, biological or genetic and involve actions related to the environment, sanitary education and social campaigns.

Dried blood spot filter paper
Filter paper on which dried blood spots are conserved.

Serum bank
A facility for the storage of frozen samples of blood serum.

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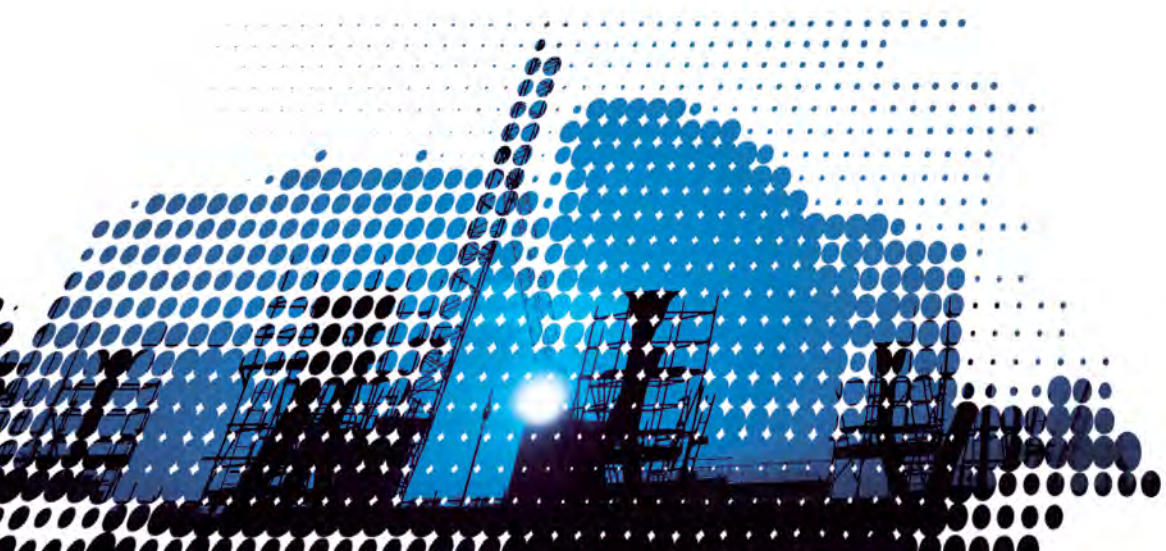

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