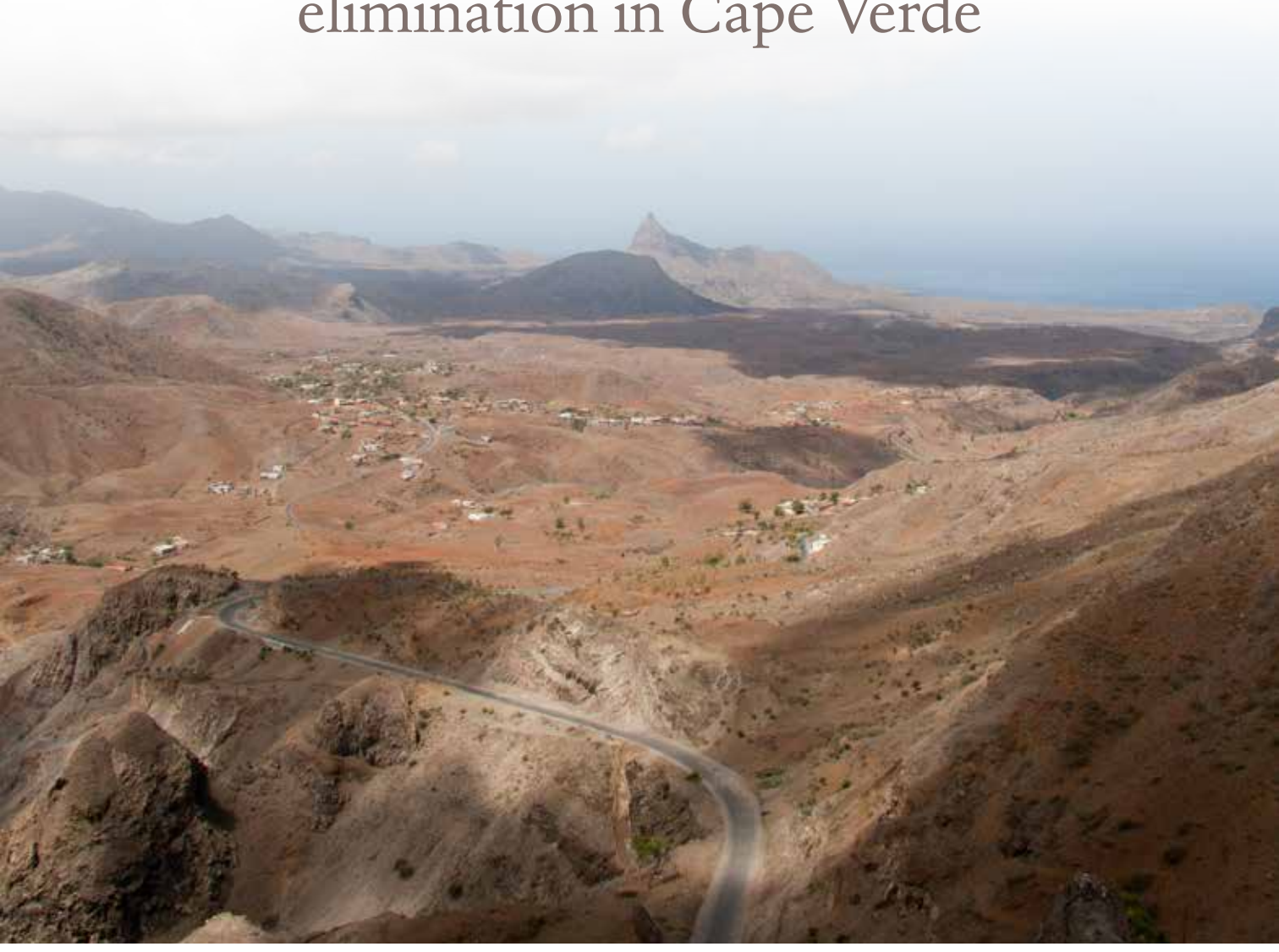
ELIMINATING MALARIA

Case-study 2

Moving towards sustainable elimination in Cape Verde



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From evidence to action

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CONTENTS

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Cape Verde's renewed efforts towards malaria elimination started in 2007 under former Minister of Health Dr Basilio Mosso Ramos, who included malaria elimination in the 2020 objectives of the National Health Policy. This gave rise to the development of the five-year National Malaria Strategic Plan for Pre-elimination, covering the period 2009—2013, and led to a successful Round 10 application to the Global Fund to Fight AIDS, Malaria and Tuberculosis – "Malaria: a step towards pre-eradication in Cape Verde". This case-study builds on the information that was generated and collected for these two important documents. The following WHO staff assisted the country in this process: Dr Barrysson Andriamahefazafy, Dr Magaran Bagayoko, Dr Andrea Bosman, Dr Socé Fall, Dr Carolina Gomes Cardoso Da Silva, Dr Jean-Olivier Guintran, Dr Georges Ki-Zerbo, Dr Jo Lines, Dr Shiva Murugasampillay, Dr Aafje Rietveld, Dr Pascal Ringwald, Dr Stephane Tohon, Dr Bokar Toure, Dr Luciano Tuseo and Dr Raman Velayudhan.

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ACRONYMS AND ABBREVIATIONS

ABER	annual blood examination rate
ACT	artemisinin-based combination therapy
API	annual parasite index
CFR	case-fatality rate
DDT	dichlorodiphenyltrichloroethane
EQAS	External Quality Assessment Scheme
GDP	gross domestic product
GMEP	Global Malaria Eradication Programme
G6PD	glucose-6-phosphate dehydrogenase
IDSR	Integrated Disease Surveillance and Response
IHMT	Instituto de Higiene e Medicina Tropical
IRS	indoor residual spraying
MSP	national malaria strategic plan
NGO	nongovernmental organization
NMCP	national malaria control programme
PCR	polymerase chain reaction
PPP	purchasing power parity (expressed in current international $)
RDT	rapid diagnostic test
SPR	slide positivity rate
WHO	World Health Organization

GLOSSARY

The terms listed in this glossary are defined according to their use in this publication. They may have different meanings in other contexts.

active case detection

The detection by health workers of malaria infections at community and household level in population groups that are considered to be at high risk. Active case detection can be conducted as fever screening followed by parasitological examination of all febrile patients or as parasitological examination of the target population without prior fever screening.

annual blood examination rate

The number of examinations of blood slides for malaria by microscopy per 100 population per year.

case-based surveillance

Every case is reported and investigated immediately (and also included in the weekly reporting system).

case definition (control programmes)

confirmed malaria – Suspected malaria case in which malaria parasites have been demonstrated in a patient's blood by microscopy or a rapid diagnostic test.

presumed malaria – Suspected malaria case with no diagnostic test to confirm malaria but nevertheless treated presumptively as malaria.

suspected malaria – Patient illness suspected by a health worker to be due to malaria. Fever is usually one of the criteria.

case definition (elimination programmes)

autochthonous – A case locally acquired by mosquito-borne transmission, i.e. an indigenous or introduced case (also called "locally transmitted").

imported – A case the origin of which can be traced to a known malarious area outside the country in which it was diagnosed**.**

indigenous – Any case contracted locally (i.e. within national boundaries), without strong evidence of a direct link to an imported case. Indigenous cases include delayed first attacks of *Plasmodium vivax* malaria due to locally acquired parasites with a long incubation period.

induced – A case the origin of which can be traced to a blood transfusion or other form of parenteral inoculation but not to normal transmission by a mosquito.

introduced – A case contracted locally, with strong epidemiological evidence linking it directly to a known imported case (first generation from an imported case, i.e. the mosquito was infected from a case classified as imported).

locally transmitted – A case locally acquired by mosquito-borne transmission, i.e. an indigenous or introduced case (also called "autochthonous").

malaria – Any case in which, regardless of the presence or absence of clinical symptoms, malaria parasites have been confirmed by quality-controlled laboratory diagnosis.

case investigation

Collection of information to allow classification of a malaria case by origin of infection, i.e. imported, introduced, indigenous or induced. Case investigation includes administration of a standardized questionnaire to a person in whom a malaria infection is diagnosed.

case management

Diagnosis, treatment, clinical care and follow-up of malaria cases.

case notification

Compulsory reporting of detected cases of malaria by all medical units and medical practitioners, to either the health department or the malaria elimination service (as laid down by law or regulation).

certification of malaria-free status

Certification granted by WHO after it has been proved beyond reasonable doubt that the chain of local human malaria transmission by *Anopheles* mosquitoes has been fully interrupted in an entire country for at least 3 consecutive years.

elimination

Reduction to zero of the incidence of infection by human malaria parasites in a defined geographical area as a result of deliberate efforts. Continued measures to prevent re-establishment of transmission are required.

endemic

Applied to malaria when there is an ongoing, measurable incidence of cases and mosquito-borne transmission in an area over a succession of years.

epidemic

Occurrence of cases in excess of the number expected in a given place and time.

eradication

Permanent reduction to zero of the worldwide incidence of infection caused by human malaria parasites as a result of deliberate efforts. Intervention measures are no longer needed once eradication has been achieved.

evaluation

Attempts to determine as systematically and objectively as possible the relevance, effectiveness and impact of activities in relation to their objectives.

focus

A defined, circumscribed locality situated in a currently or former malarious area containing the continuous or intermittent epidemiological factors necessary for malaria transmission. Foci can be classified as endemic, residual active, residual non-active, cleared up, new potential, new active or pseudo.

gametocyte

The sexual reproductive stage of the malaria parasite present in the host's red blood cells.

hypnozoite

The dormant stage of the malaria parasite present in the host's liver cells (limited to infections with *P. vivax* and *P. ovale)*.

incubation period

The time between infection (by inoculation or otherwise) and the first appearance of clinical signs.

intervention (public health)

Activity undertaken to prevent or reduce the occurrence of a health condition in a population. Examples of interventions for malaria control include the distribution of insecticide-treated mosquito nets, indoor residual spraying with insecticides, and the provision of effective antimalarial therapy for prevention or curative treatment of clinical malaria.

line list

Information on cases recoreded in columns, with data for each case in one line across the columns. Information may include case identification number; demographic factors (patient's name, address, age, sex); clinical factors (date of attendance, type of test, test result, treatment received); intervention factors (house sprayed, insecticide-treated net ownership, preventive therapy).

local mosquito-borne malaria transmission

Occurrence of human malaria cases acquired in a given area through the bite of infected *Anopheles* mosquitoes.

malaria-free

An area in which there is no continuing local mosquito-borne malaria transmission and the risk for acquiring malaria is limited to introduced cases only.

malaria incidence

The number of newly diagnosed malaria cases during a specified time in a specified population.

malaria prevalence

The number of malaria cases at any given time in a specified population, measured as positive laboratory test results.

monitoring (of programmes)

Periodic review of the implementation of an activity, seeking to ensure that inputs, deliveries, work schedules, targeted outputs and other required actions are proceeding according to plan.

national focus register

Centralized database of all malaria foci in a country.

national malaria case register

Centralized database of all malaria cases registered in a country, irrespective of where and how they were diagnosed and treated.

outpatient register

List of patients seen in consultation in a health facility; the register may include the date of consultation; patient's age, place of residence and presenting health complaint; tests performed; and diagnosis.

parasite prevalence

Proportion of the population in whom *Plasmodium* infection is detected at a particular time by means of a diagnostic test (usually microscopy or a rapid diagnostic test).

passive case detection

Detection of malaria cases among patients who, on their own initiative, go to a health post for treatment, usually for febrile disease.

population at risk

Population living in a geographical area in which locally acquired malaria cases occurred in the current year and/or previous years.

rapid diagnostic test

An antigen-based stick, cassette or card test for malaria in which a coloured line indicates that plasmodial antigens have been detected.

rapid diagnostic test positivity rate

Proportion of positive results among all the rapid diagnostic tests performed.

receptivity

Relative abundance of anopheline vectors and existence of other ecological and climatic factors favouring malaria transmission.

re-establishment of transmission

Renewed presence of a constant measurable incidence of cases and mosquito-borne transmission in an area over a succession of years. An indication of the possible re-establishment of transmission would be the occurrence of three or more introduced and/or indigenous malaria infections in the same geographical focus, for two consecutive years for *P. falciparum* and for three consecutive years for *P. vivax*.

relapse (clinical)

Renewed manifestation of an infection after temporary latency, arising from activation of hypnozoites (and therefore limited to infections with *P. vivax* and *P. ovale*).

sensitivity (of a test)

Proportion of people with malaria infection (true positives) who have a positive test result.

slide positivity rate

Proportion of microscopy slides found to be positive among the slides examined.

specificity (of a test)

Proportion of people without malaria infection (true negatives) who have a negative test result.

surveillance (control programmes)

Ongoing, systematic collection, analysis and interpretation of disease-specific data for use in planning, implementing and evaluating public health practice.

surveillance (elimination programmes)

That part of the programme designed for the identification, investigation and elimination of continuing transmission, the prevention and cure of infections, and the final substantiation of claimed elimination.

transmission intensity

Rate at which people in a given area are inoculated with malaria parasites by mosquitoes. This is often expressed as the "annual entomological inoculation rate", which is the number of inoculations with malaria parasites received by one person in one year.

transmission season

Period of the year during which mosquito-borne transmission of malaria infection usually takes place.

vector control

Measures of any kind against malaria-transmitting mosquitoes intended to limit their ability to transmit the disease.

vector efficiency

Ability of a mosquito species, in comparison with another species in a similar climatic environment, to transmit malaria in nature.

vectorial capacity

Number of new infections that the population of a given vector would induce per case per day at a given place and time, assuming conditions of non-immunity. Factors affecting vectorial capacity include: the density of female anophelines relative to humans; their longevity, frequency of feeding and propensity to bite humans; and the length of the extrinsic cycle of the parasite.

vigilance

A function of the public health service during a programme for prevention of reintroduction of transmission, consisting of watchfulness for any occurrence of malaria in an area in which it had not existed, or from which it had been eliminated, and application of the necessary measures against it.

vulnerability

Either proximity to a malarious area or the frequency of influx of infected individuals or groups and/or infective anophelines.

SUMMARY

This case-study examines the history of malaria in Cape Verde up to 2010, presents details of the successive interventions that have been carried out over the past 60 years to eliminate transmission and contain subsequent outbreaks, and highlights the programmatic steps that have been taken since the country decided in 2007 to eliminate local malaria transmission once and for all. Cape Verde is currently in the pre-elimination stage. Lessons for countries that are embarking upon elimination are distilled.

History of malaria and malaria control

Cape Verde, a lower-middle-income country of nine inhabited islands, has a total population of about 500 000. It has interrupted malaria transmission twice in the past. Before the 1950s, all islands were affected and severe epidemics occurred repeatedly on the most densely populated islands. The transmission was meso-endemic with an unstable seasonal transmission pattern and annual incidence rates above 100 per 1000 population.

The first elimination campaign, initiated in 1953, began by targeting the most affected areas for seven years. Operations were subsequently intensified and expanded in the context of the Global Malaria Eradication Programme. Indoor residual spraying (IRS) of the insecticide DDT (dichlorodiphenyltrichloroethane) was gradually applied to each island until interruption of transmission was achieved. Larviciding and active case detection were also carried out. Santiago, the largest island and the worst affected, was sprayed in its entirety twice yearly for four years. Elimination (zero local transmission nationwide) was achieved in 1967, and the IRS campaigns were stopped in 1969. Studies showed that the only malaria vector, *Anopheles arabiensis*, had been eradicated from all islands except Santiago.

Local transmission reappeared on Santiago in 1973 and a large epidemic occurred in 1977. Accordingly, widespread IRS operations were resumed for five years in 1978, and transmission was again interrupted for three years between 1983 and 1986. A new epidemic occurred in 1987–1988 in the known foci on Santiago and localized IRS operations were instituted for a further two years. Since then, the country has been unable to invest sufficient resources to implement a new elimination plan, and activities have been restricted to passive case detection, investigation with case-based surveillance on Santiago and early detection of imported cases elsewhere. Malaria case numbers have been maintained at low levels since 1989, but three localized outbreaks of about 100 cases occurred in distinct foci on Santiago in 1995, 2000 and 2001. In 2003 and 2009 smaller outbreaks also occurred on Boa Vista island, which had been considered non-endemic since the late 1960s. In total, 1293 malaria cases were reported nationwide between 1990 and 2009; 929 of these (all due to *P. falciparum*) have been classified as locally acquired, the remainder being imported.

In 2006, the country was at a critical stage, with an increasing malaria burden in Santiago and expansion of the area of malaria risk to Boa Vista at a time when major tourist developments were under way to attract visitors from Europe. The political decision was therefore taken to renew efforts to achieve nationwide elimination by 2020; this decision was included in the 2007–2020 national health policy document.

Gearing up for elimination

With the political decision taken, the country contacted WHO in February 2008 to assist in the development of a budgeted five-year pre-elimination strategic plan covering the period 2009–2013, and WHO mobilized staff from its Inter-Country Support Team for West Africa for this purpose. The intensive preparatory process started with a situation analysis, including a review of the malaria situation (parasites and vectors), the malaria control programme and national capacities.
The National Malaria Strategic Plan (MSP) was elaborated in a participative process lasting more than six months, with coordinated inputs from all the General Directions and services of the Ministry of Health together with representation from the Ministries of Agriculture, Transport, Decentralization, Defence and Foreign affairs and the participation of municipalities and nongovernmental organizations. Different strategic options were discussed and implementation of activities in several areas was planned jointly.

Consensus emerged that a countrywide phase of pre-elimination would be necessary in order to establish robust systems and operational capacities in advance of the elimination phase. Several important strategic choices were made during development of the MSP, including the following:

- A preparatory phase would be required to update the epidemiological profile and knowledge of parasites and vectors, refine operational plans and secure sufficient funding.
- A significant expansion of the workforce and of technical expertise would be required to achieve and sustain elimination.
- A consolidation phase covering the whole country would be necessary, although only two islands were reporting local transmission. Vector control operations would be restricted to foci but systematic diagnostic testing – regardless of travel history – would be needed on all islands, complemented by active case detection.
- Before the maintenance phase could begin, the consolidation phase would have to be sustained until there was strong evidence that every potential residual focus had been eliminated.

The plan has the following objectives:

- expand capacity for quality-assured diagnosis in all health facilities;
- provide early and efficacious treatment to all infected patients;
- report, investigate, classify and monitor all detected cases and foci;
- implement IRS and identify and control breeding sites in active foci; and
- reduce the risk of dissemination of parasites and vectors.

The cost was estimated at about €2.7 million for five years which, when added to current expenditure, resulted in a total of €2 per capita per year.

In 2010, 47 cases were reported nationwide, of which only 18 were locally acquired (compared with 62 local cases in 2006).

Outlook for the future

Every indication is that this archipelago, with half a million inhabitants, is one of the best candidates to achieve elimination within the next few years, now that resources dedicated to the control of malaria have reached records levels and a global fight against malaria is also underway. Nevertheless, while the goal of zero local transmission seems very close, considerable investment and flexibility of approach will be needed over the next 10 years. The epidemiological profile has to be completed and strategies modified accordingly, and operational capacities need to be upgraded. Adequate funding needs to be secured in addition to the resources that have already been committed by the national authorities and through the Global Fund to Fight AIDS, Tuberculosis and Malaria. Opportunities for intersectoral and international collaboration need to be maximized, and sustained efforts must be anticipated: history shows that, once success is achieved, substantial efforts must be continued indefinitely if reintroduction is to be prevented.

INTRODUCTION

The malaria elimination case-study series

If countries are to make well-informed decisions on whether or how to pursue malaria elimination, an understanding of historical and current experiences of malaria elimination and prevention of reintroduction in other countries – particularly those in similar eco-epidemiological settings – is critical. The Global Malaria Programme of the World Health Organization (WHO/GMP) and the Global Health Group of the University of California, San Francisco – in collaboration with national malaria programmes and other partners and stakeholders – are jointly conducting a series of case-studies on elimination of malaria and prevention of reintroduction. The objective of this work is to build an evidence base to support intensification of malaria elimination as an important step in achieving international malaria targets.

Ten case-studies are being prepared that, together, will provide insights into and lessons to be learnt from a wide range of elimination approaches and geographical settings.

Cape Verde was selected for a malaria elimination case-study because it is the most recent addition to the list of countries that are in the programmatic phase of pre-elimination, i.e. are making a nationwide transition to the elimination approach. In addition, details of Cape Verde's long fight against malaria have never before been widely available in the public domain.

Data collection and analysis methods for the case-study are elaborated in Annex 1.

Malaria elimination initiatives in Africa

In 1997, the five northern African countries (Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Tunisia) launched a subregional malaria elimination programme *(1)*, which is now almost achieved. Since the certification in 2010 of malaria elimination in Morocco *(2)*, transmission north of the Sahara now persists only in the south of Algeria *(3)*. As yet, there is no similar initiative to unite competencies and efforts to eliminate malaria from the southern edges of the Sahara.

In 2007, the African Union adopted elimination as a long-term goal for the continent *(4)*, and the ministers of health from the Southern African Development Community approved a new regional strategy that included a target of progressively eliminating malaria from six member nations by 2015 *(5)*.

Subregional collaboration can be a critical factor for success in elimination. Cape Verde is part of the Small Island Developing States (SIDS) initiative. During a meeting in Cape Verde in 2009, the ministers of health of the SIDS identified malaria elimination as a potential area for collaboration in this initiative (the Cape Verde Declaration)[1].

[1] See: http://www.afro.who.int/index.php?option=com_docman&task=doc_download&gid=2662 (accessed 29 August 2012).

Malaria elimination in Cape Verde

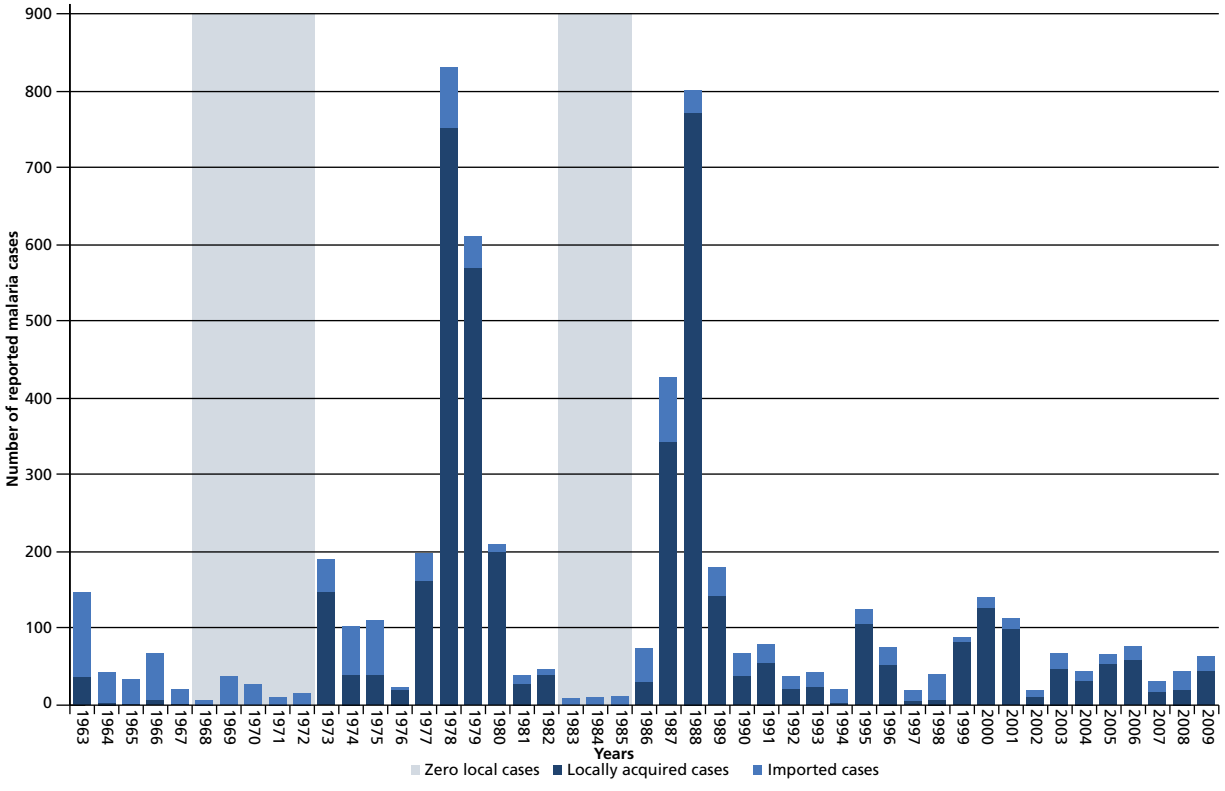
In Cape Verde, malaria transmission has already been interrupted twice in recent history (1968, 1983), suggesting that eliminating malaria from this archipelago is very feasible but that the disease returns when neglected (Figure 1). The arid climate is not favourable to transmission; despite the low intensity of control interventions for the past 20 years, transmission has remained minimal and is confined to just two islands – Santiago and, more recently, Boa Vista. The other seven previously endemic islands have remained malaria-free since the 1960s, either because the vector is present but no malaria transmission is being reported (Fogo, Maio, Santo Antão, São Nicolau and São Vicente) or because there are no vector mosquitoes (Brava and Sal).

After the success of elimination efforts in northern Africa, elimination in Cape Verde could be the next step towards making the fringes of the Sahara desert malaria-free. In 2006, WHO included Cape Verde on a provisional list of countries targeted for malaria elimination *(6)*. In 2007, the revised national health policy document of the Cape Verde Ministry of Health mentions the goal of malaria elimination by 2020 *(7)*. The country has developed a *National Malaria Strategic Plan for Pre-elimination, 2009–2013 (8)*. During the 2010 World Health Assembly in Geneva, the Minister of Health – having consulted with partners in the fight against malaria – decided to proceed with a Round 10 application to the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund), "Malaria, a step towards pre-eradication in Cape Verde". This has since been funded.

In 2010, WHO added Cape Verde to the list of countries that are in the pre-elimination programme stage *(9)*. The country is also listed as one of 34 "eliminating countries" by the Malaria Elimination Group.[1]

[1] http://www.malariaeliminationgroup.org/resources/elimination-countries (accessed 29 August 2012).

Figure 1. Reported malaria cases in Cape Verde, 1963–2009



COUNTRY BACKGROUND

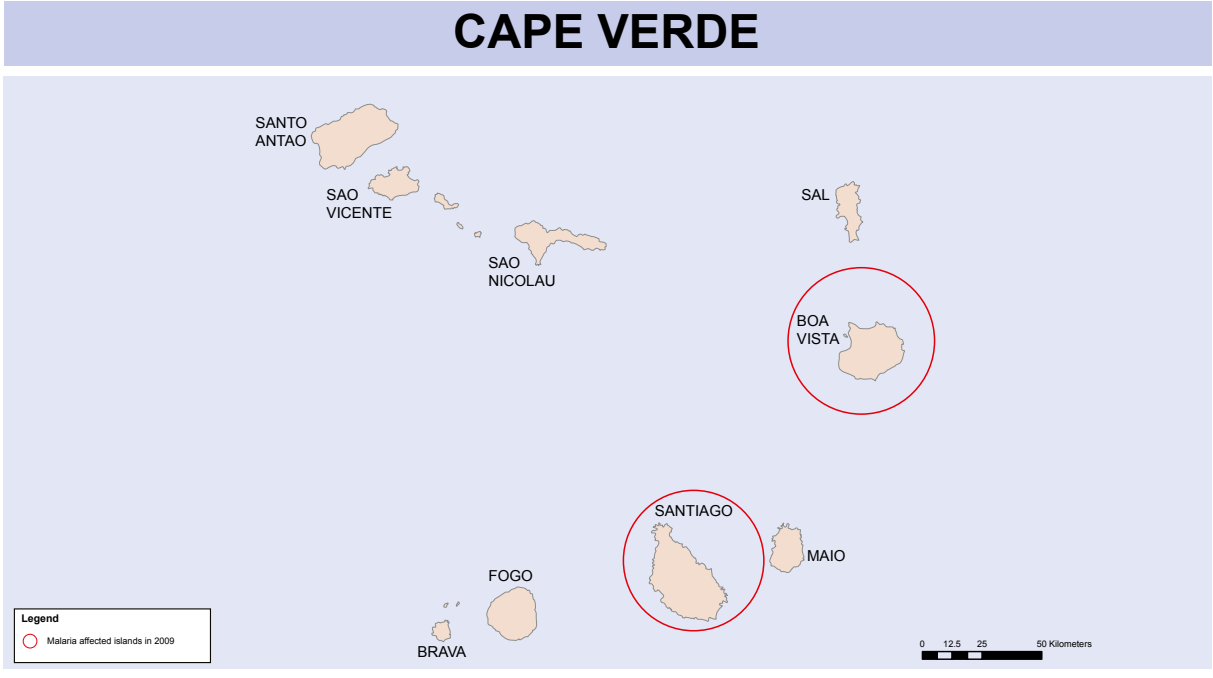
Geography, climate, population and economy

The Cape Verde archipelago is located 500 km west of the African continent off the coast of Senegal (Figure 2). The islands of the archipelago form two groups: the Barlavento islands (Santo Antão, São Vicente, São Nicolau, Sal, Santa Luzia and Boa Vista) and the Sotavento islands (Maio, Santiago, Fogo, and Brava). Only Santa Luzia is uninhabited.

The islands are of volcanic origin. The Sahelian-type climate (i.e. an unstable climate with frequent droughts) is defined by a completely dry season lasting about nine months (November to July). The wet season (August to October) is characterized by short and irregular rainfall with significant variation from year to year. Over the past 50 years, annual rainfall *(10)* has ranged from 17 mm in 1972 to 695 mm in 1986 (Figure 3). There are no permanent rivers or large natural water bodies on the archipelago.

The population of Cape Verde was estimated at 508 633 people in 2009, of whom about 35% are less than 15 years old (Table 1) and 61% live in urban areas *(11)*. About 60% of the population reside on Santiago, the largest island (991 km²) where the capital city Praia (population 127 000) is located. São Vicente is the second most populated island and its capital city, Mindelo, is the country's main port (Table 2).

Figure 2. Map of Cape Verde archipelago

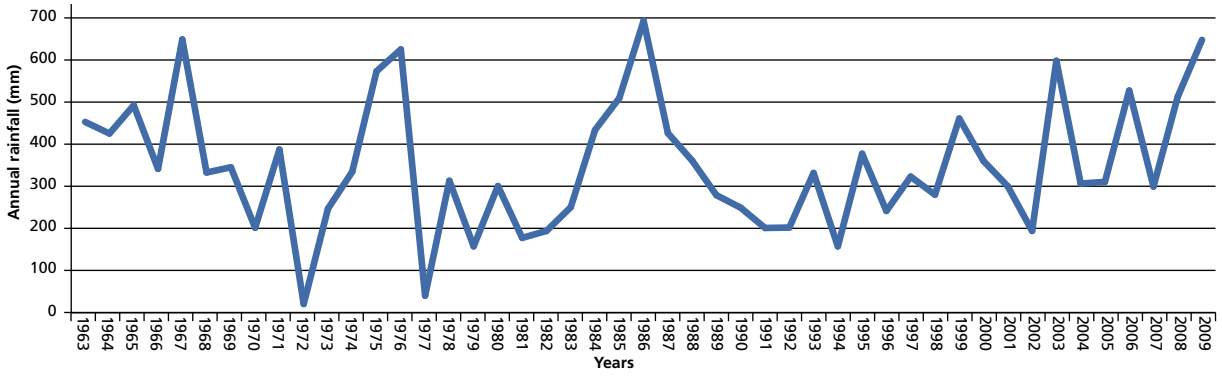


The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Global Malaria Programme (GMP)
World Health Organization

World Health Organization

Figure 3. Annual Cape Verde rainfall (in mm) between 1963 and 2009



Source: reference *10*.

Table 1. Partition of the population by age groups, 2009

Age group (years)	Number	%
<1	12 823	2
1–4	47 666	9
5–14	116 286	23
15–24	121 612	24
25–49	150 740	30
50–64	32 767	6
≥65	26 739	5
Total	508 633	100

Source: reference *11*.

Table 2. Partition of the population by island, 2009[a]

Island	Area (km²)	%	Population	%	Pop. density (per km²)
Barlavento islands					
Santo Antão	779	19	48 939	10	63
São Vicente	227	6	79 681	16	351
São Nicolau	346	9	12 810	2	37
Sal	216	5	20 041	4	93
Boa Vista	620	15	6 007	1	10
Sotavento islands					
Maio	269	7	8 132	2	30
Santiago	991	25	288 087	57	291
Fogo	476	12	37 804	7	79
Brava	65	1	6 141	1	94
Total	4 024	100	508 633	100	126

a. Santa Luzia, the 10th island, has an area of 35 km² and is uninhabited.

More than 90% of all food consumed in Cape Verde is imported. This is a consequence of the country's limited supply of fresh water: only four islands are able to support any agricultural production. The economy is service-oriented, with commerce, transport and public services accounting for 71% of gross domestic product (GDP). Agriculture and fishing contribute about 9%, and the remaining 20% consists of remittances sent by Cape Verde emigrants.

Cape Verde is a stable representative parliamentary republic. The Prime Minister, who is the head of Government, is nominated by the National Assembly, which is elected by popular vote for 5-year terms. Among African nations, the country is often praised for its stability and developmental growth, despite its lack of natural resources. Cape Verde's Human Development Index is 0.568, which gives the country a rank of 133 out of 187 countries *(12)*. It is one of the few African countries on track to achieve most of the Millennium Development Goals (MDG) by 2015. Adult literacy rates and primary school enrolment, as well as the proportion of the population using improved drinking-water sources, are all above 80%. The country has one of the fastest growing tourism industries in the world. Between 2000 and 2009, GDP increased on average by more than 7% per year, with notable improvements in living conditions and a reduction in poverty. The country graduated to Lower Middle Income country status in 2005 and in 2009 reached a gross national income per capita of 3530 PPP int. $ (purchasing power parity in international dollars) *(13)*.

Health system and population health profile

The central services of the Ministry of Health include the Minister's Cabinet, the offices of the General Inspection and of Research, Planning and Cooperation, and three General Directions: Administration, Health and Pharmacy. The General Director of Health supervises five Divisions: Health Promotion, Surveillance, the Direction of Disease Prevention and Control (subdivided into services for Non-Transmissible and Transmissible diseases), Laboratories, and the 17 Health Delegations (local health authorities).

At the operational level, the 17 Health Delegates are responsible for the management and operations in their respective Health Delegations and for managing the National Health Service. In 2006, the Health Region of Santiago Norte was created to supervise five of the six Health Delegations on the main island of Santiago and to administer the regional hospital.

In total, there are two national reference hospitals (in Praia on Santiago and in Mindelo on São Vicente) and three regional hospitals (on São Antão and Fogo and in Santa Catarina on Santiago). In addition, there is a network of primary health structures consisting of 30 health centres, 34 health posts run by nurses and 113 basic health units run by health assistants. In 2009, primary health care relied on a workforce of 87 general practitioners, 209 nurses and 168 health assistants *(11)*. The population and distribution of health structures by island and Health Delegation (2009) are presented in Annex 2.

A national health policy, established for the period 2007–2020, is being implemented through successive national health development plans; the first of these covered the period 2008–2011. Yearly operational plans are developed on the basis of this plan.

In 2008, spending on health was 176 PPP int. $ per capita; 73% of this was provided by the Government, which devoted 10% of its total expenditure to health. Only 14% of health expenditure came from external resources and 13% was paid for by the patients *(14)*. There is an almost universal national welfare scheme that provides consultations, investigations and medicines free of charge to the large majority of people. The private sector is concentrated in Praia and Mindelo and is limited to 60 medical practices (almost all of them specialized), 31 pharmacies and 15 laboratories. Recent years have seen remarkably positive trends in MDG health indicators, almost certainly as a result of the good functioning of the basic health services. Although the density of physicians is still relatively low (5.7 per 10 000 people in 2008), coverage by public health structures is much better: 85% of the population lives within 30 minutes' walk of a health centre, resulting in more than one consultation per capita per year *(11)*.

Annex 3 provides a summary of Cape Verde's development and health profile.

HISTORY OF MALARIA AND MALARIA CONTROL

Parasites and vectors

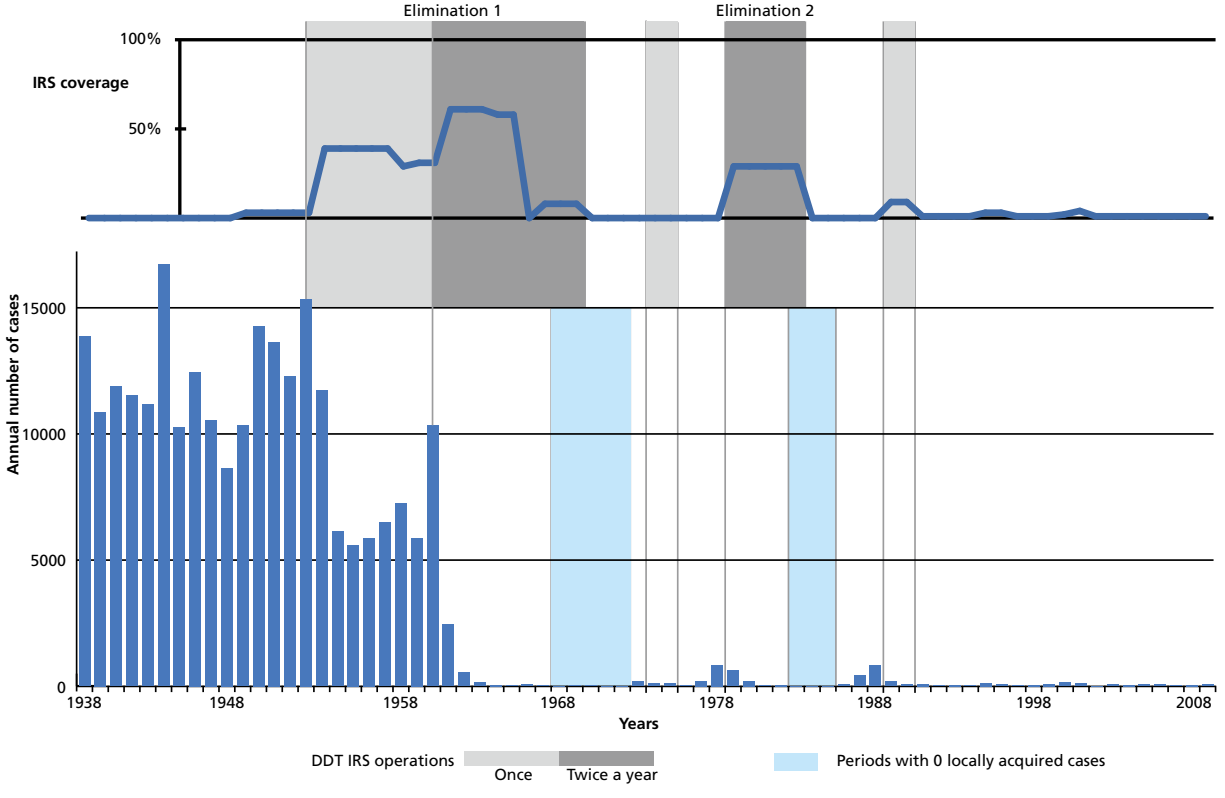
In the past, cases of *Plasmodium vivax*, *P. falciparum* and *P. malariae* were registered in Cape Verde, but since 1994 only *P. falciparum* has been described in the country. *Anopheles arabiensis* is the only member of the *An. gambiae* complex described so far in the archipelago and is considered the unique vector *(15)*. More details are provided in Annex 4.

Pre-control

The Cape Verde islands were uninhabited before being discovered by the Portuguese in 1460. It is not known whether the vector was present before the first seafarers arrived on the islands, but malaria transmission increased quickly after migrants brought parasites from both western Africa and Europe.

Malaria had a severe impact during the first half of the 20th century (see Figure 4): in the 1940s, it was responsible for half of all hospital admissions, with more than 10 000 cases and 200 deaths every year. In the early 1950s malaria was the leading cause of mortality, with a meso-endemic transmission described on Santiago. Fogo, Boa Vista, São Vicente and São Nicolau islands were also highly affected. In contrast, the other four islands (Maio, Brava, Sal and Santo Antão) were almost entirely spared. At the time, the disease was called *sezonismo* in Portuguese, reflecting its marked seasonality. Annual incidence exceeded 100 per 1000 population *(16)*.

Figure 4. Reported annual malaria cases and IRS operations and coverage, 1938–2009



Elimination campaigns

INTENSIVE AND SUCCESSFUL ELIMINATION CAMPAIGN, 1948–1969

In 1948, a successful pilot elimination project was set up on Sal, the most arid of the islands with a population of only 2700. A first phase of expanding the project to other islands was started in 1953, following a severe outbreak of more than 3000 cases in 1952, affecting about 20% of the São Vicente population *(17)*. Annual spraying campaigns with dichlorodiphenyltrichloroethane (DDT) were started in the four worst-affected municipalities; as a result, the number of cases fell from more than 10 000 in 1953 to about 6000 in 1959 (Figure 4), with annual incidence dropping to about 40 per 1000 population.

In 1961, in the context of the Global Malaria Eradication Programme (GMEP), indoor residual spraying (IRS) operations started, to cover the whole of Santiago island every six months. The annual parasite index (API)[1], which had been above 100 per 1000 population in the 1940s, dropped to 2 per 1000 population in 1962.

Using IRS with DDT as the main strategy, GMEP efforts were deployed gradually in seven of the nine inhabited islands. The attack phase lasted for four years and the programme subsequently shifted from blanket coverage with IRS to targeted IRS of residual foci. In 1967, elimination was achieved throughout the archipelago after the last autochthonous case was recorded on Santiago.

Unfortunately, operations ended when the GMEP was scaled down in 1969. Interruption of transmission lasted for five years until a resurgence in 1973 on Santiago, in the Santa Catarina and Santa Cruz municipalities.

RESUMED TRANSMISSION ON SANTIAGO FOLLOWED BY SECOND ELIMINATION SUCCESS, 1973–1982

In response to the 1973 reappearance of transmission on Santiago, annual rounds of IRS were carried out in the most active foci in 1974–1975. The reported autochthonous cases declined from 149 in 1973 to 20 in 1976. An extensive epidemic followed in 1977–1979. A total of 844 cases and 13 deaths were reported at the peak of the epidemic in 1978. Most of the cases originated from the well-known foci of Santa Catarina and Santa Cruz on Santiago. The seasonal peak of the epidemic occurred in November and almost one-third of locally acquired cases were due to *P. vivax (18)*.

Spraying teams were reactivated on Santiago and widespread IRS was performed twice a year for five years, from 1978 to 1982. As a result, local transmission was again interrupted for three years, from 1983 to 1985.

Outbreaks and their control, 1986 onwards

OUTBREAK ON SANTIAGO, 1987–1988

In 1986, renewed transmission on Santiago resulted in 30 autochthonous cases. It was followed in 1987–88, four years after the cessation of IRS operations, by a second epidemic. This epidemic was similar in magnitude to that of 1977–1979, with 434 reported cases in 1987 and a peak of 814 cases and 12 deaths in 1988, but it was different in nature: it was largely focused on the Santa Cruz Health Delegation on Santiago and only *P. falciparum* was reported *(19)*. In 1988, Santa Cruz reported an incidence of more 30 cases per 1000 people at Health Delegation level, equalling 4.2 and 2.1 per 1000 population for Santiago island and the whole of Cape Verde respectively.

Focalized IRS operations were reactivated in 1989 and 1990 on Santiago, and the reported number of locally acquired cases for the country dropped to 38 in 1990 (including 14 cases in Santa Cruz). Since then, there have been localized outbreaks in various foci but the number of locally acquired cases for any one Health Delegation exceeded 100/year only twice during the Santa Catarina outbreaks on Santiago, with 107 cases in 1995 and 118 cases in 2000 (see Table 3).

[1] The number of reported malaria cases per 1000 population per year.

FOCALIZED RESPONSE TO CONTINUED TRANSMISSION ON SANTIAGO AND OUTBREAKS ON BOA VISTA, 1990 ONWARDS

Since 1990, the level of transmission in Cape Verde has remained very low and malaria has ceased to be a major public health problem.

Between 1990 and 2009, a total of 1293 malaria cases were reported for the whole country, 94% of which were reported from Santiago. A total of 915 locally acquired cases were reported on Santiago and 14 on Boa Vista (see Table 3 and Annex 5). Since 1996, São Nicolau and Maio have not reported any cases, while the other five islands have together reported 45 imported cases only (Figure 5). The four local malaria cases that were detected in 2003 among inhabitants of Boa Vista island, who had no recent history of travel outside the country, confirmed the presence of active malaria transmission outside Santiago island for the first time in 30 years.

Since the year 2000, 20 malaria deaths have been recorded in Cape Verde, out of a total of 677 malaria cases over the same period. The reported case-fatality rate reached a peak of 10% in 2006 reflecting delays in adequate case managmenet for falciparum malaria in a non-immune population.

When calculated for the whole archipelago, the API has remained below 0.3 per 1000 population (Table 4). The incidence for Santiago exceeded 0.5/1000 only once, in 2000. At Health Delegation level, an API of more than 1/1000 was reached during the outbreaks in Santa Catarina district in 1995–1996 and 1999–2000, and on Boa Vista in 2009 when 10 cases were reported (Table 4).

Small-scale operations, combining a single round of focal IRS and active case detection, have been used to control localized outbreaks. There has been no sustained progress towards elimination and locally acquired cases are still recorded almost every year in the Health Delegations of Praia and Santa Catarina and frequently in Santa Cruz.

Table 3. Reported local cases, 1988–2009

	Reported local cases																					
Island	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Santiago[a]	784	144	38	56	21	32	2	107	56	6	14	84	132	102	11	46	34	55	62	2	20	35
Praia	24	5	10	25	21	32	2		2	5	7	27	6	95	11	38	25	47	49	2	20	27
Santa Catarina	34	7	13	6				107	49	1	7	57	118	3		2	3	3	10			5
Santa Cruz	722	132	14	6									8	2		6	6	5				3
São Domingo														2								
São Miguel																			3			
Tarrafal	4		1	19					5													
Boa Vista																4						10
Brava																						
Fogo																						
Maio																						
Sal																						
San Antão																						
São Nicolau																						
São Vicente																						
Nationwide	784	144	38	56	21	32	2	107	56	6	14	84	132	102	11	50	34	55	62	2	20	45

a. Santiago island is divided into six Health Delegations.

Source: National malaria control programme

Table 4. Annual Parasite Index by island or Health Delegation, 1988–2009

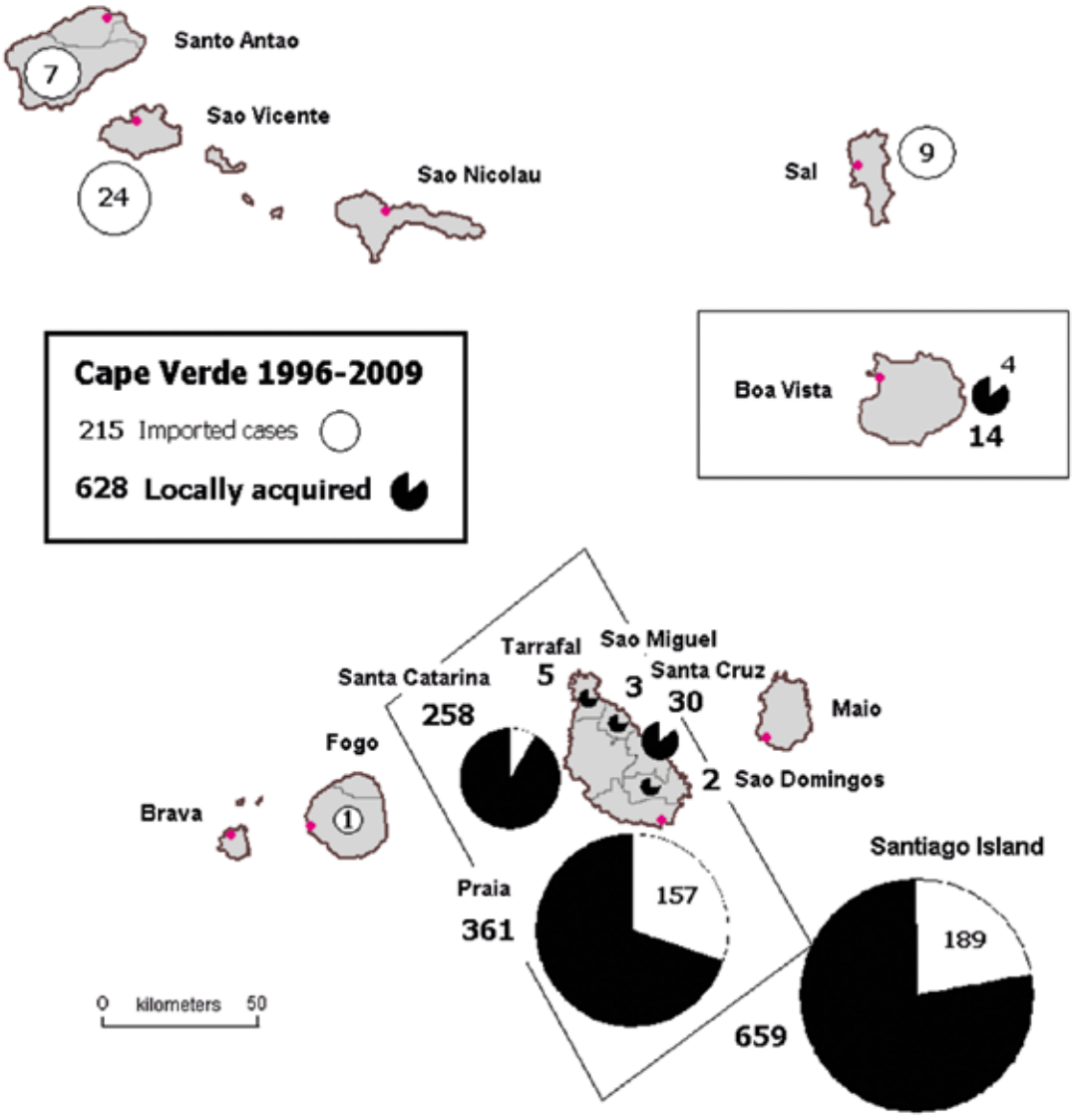
	Annual Parasite Index (API)[a] (locally acquired and imported cases per 1000 inhabitants)																				
Island	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Santiago:[b]	2.8	0.5	0.1	0.1				0.4	0.3		0.2	0.3	0.5	0.4	0.1	0.2	0.2	0.3	0.3		0.1	0.2
Praia	0.2	0.2	0.3	0.3	0.3	0.4	0.1	0.1	0.2	0.1	0.2	0.3	0.1	0.9	0.2	0.4	0.3	0.5	0.5	0.1	0.3	0.3
Santa Catarina	0.7	0.2	0.3	0.1		0.1		2.2	1.0		0.3	1.2	2.4	0.1		0.1	0.1	0.1	0.2			0.1
Santa Cruz	24.1	4.4	0.6	0.3					0.1				0.3	0.1		0.2	0.2	0.2				0.1
São Domingos														0.1								
São Miguel																						
Tarrafal									0.2													
Brava																						
Boa Vista																0.8						2.2
Fogo																						
Maio																						
Sal																						
São Nicolau																						
São Vicente																						
Santo Antão																						
Nationwide	1.6	0.3	0.1					0.2	0.2			0.2	0.3	0.2		0.1	0.1	0.1	0.2		0.1	0.1

a. API values lower than 0.1 per 1000 are not reported.

b. Santiago island is divided into six Health Delegations.

Source: national malaria control programme

Figure 5. Map showing distribution of malaria cases by island and Health Delegation, 1996–2009



FACTORS CONTRIBUTING TO CHANGES IN THE MALARIA SITUATION OVER TIME

Why does malaria transmission keep coming back?

The elimination successes of Cape Verde in 1968 and 1983 were short-lived and were followed by re-establishment of transmission in 1973 and 1986 respectively. Low-grade transmission has continued to occur since the last peak of cases in the late 1980s was controlled.

Malaria elimination aims at sustainable interruption of local malaria transmission despite a continued presence of malaria vector mosquitoes and importation of parasites from abroad through international travel and migration. As a rule, the malaria potential of an area and the probability of re-establishment of the disease after elimination are related to the area's receptivity (the likelihood that imported parasites will be locally transmitted) and vulnerability (parasite importation pressure). If either of these two factors is zero, transmission will not occur.

RECEPTIVITY

Cape Verde is part of the Afrotropic ecozone. The dry Sahelian-type arid climate, with nine dry months followed by irregular rainfall, usually of less than 500 mm/year, concentrated in a few months – is not favourable for transmission. The marked seasonality of the annual distribution of locally acquired cases, with few cases detected before August and almost half of all cases recorded in November, suggests a strong association with the Sahelian rainfall regime (Figure 6). The observed seasonality in imported cases may reflect seasonal patterns of travel and migration from endemic countries on the African continent. Annual rainfall is highly variable from year to year, but there is no obvious association between the number of locally acquired cases and the recorded rainfall during any given year (Figure 7). More careful analysis is needed to assess the role of longer-term rainfall patterns in the development of epidemics over the period 1977–1989.

Despite its very challenging climate for malaria transmission, Cape Verde had a long history of moderate to high levels of endemicity before the advent of massive IRS interventions n the 1950s. Epidemiological records show that twice in recent history, several foci on Santiago were reactivated only three years after relaxation of aggressive IRS operations. In addition, evidence from recent field observations suggests that receptivity might reach relatively high levels in some places:

- A longitudinal study performed during a localized outbreak in 1995 described a highly susceptible population and high transmission potential, with more than 40% of the inhabitants of a village having been infected in a period of a few months *(20)*.
- Another study investigated the importance of asymptomatic parasite carriers in four identified foci of Santiago island between 1998 and 2003. Active case detection using polymerase chain reaction (PCR) found prevalence of infection to be about 3%. The study also reported that prevalence measured by passive case detection could exceed 10% (among patients attending clinics for fever) during an epidemic period in Santa Cruz and Santa Catarina Health Delegations *(21)*.

The islands of the archipelago have specific topographies and display differences in terms of microclimate and vegetation cover. There is no obvious reason for local malaria transmission occurring exclusively on Santiago for 30 years or for a new focus appearing on the sandy

and flat island of Boa Vista in 2003. There is also no credible explanation of why Brava (the greenest island) and Santo Antão (the steepest) have never been favourable for malaria and why there has been no resurgence of transmission on São Vicente, an island that was heavily affected in the past. Similarly, there is no evidence of the construction of the Poilão Dam in Santa Cruz municipality in 2007 having had any impact on transmission. There have as yet been no entomological studies to look at vectorial capacity.

Santa Catarina on Santiago island, which has frequently been affected by local transmission, is an agricultural area also known as the "granary" of Cape Verde. Santa Cruz, the main focus of the 1987–1988 outbreak, also has an agriculture-based economy. Transmission in the capital city of Praia has been linked to the presence of breeding sites created by several small agricultural areas on the city's periphery. There is still a need to investigate the role of poverty and housing conditions in the transmission foci.

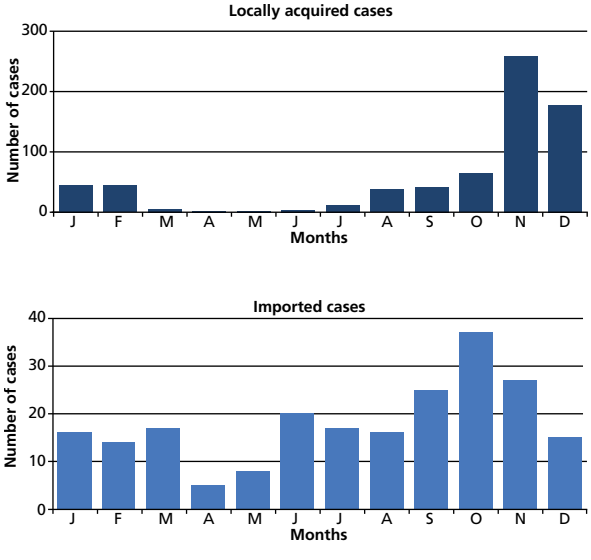
VULNERABILITY

Isolation and the distances between islands are certainly major factors limiting the importation of parasites and vectors into islands with no local transmission. The islands are relatively distant from one another – the two main cities of Praia and Mindelo are almost 300 km apart – and most domestic travel is now by air. It is likely that recent economic growth has considerably increased travelling and exchanges between the islands, and this may have affected the original distribution of vectors and parasites in the archipelago. Moreover, increasing air traffic and shipping from neighbouring endemic countries has the potential to boost the international importation of parasites:

- Significant structural improvements have led to increased international traffic at Mindelo and Praia harbours.
- In addition to the airport on Sal, new international airports have opened in Praia *(2005)* and on Boa Vista *(2007)* and São Vicente *(2009)*. All flights to Sal, Boa Vista and São Vicente bring passengers exclusively from Europe. The only incoming flights from endemic areas arrive in Praia by two distinct routes: Bissau – Dakar – Praia (six times weekly) and Luanda – Sao Tome – Praia (twice weekly).

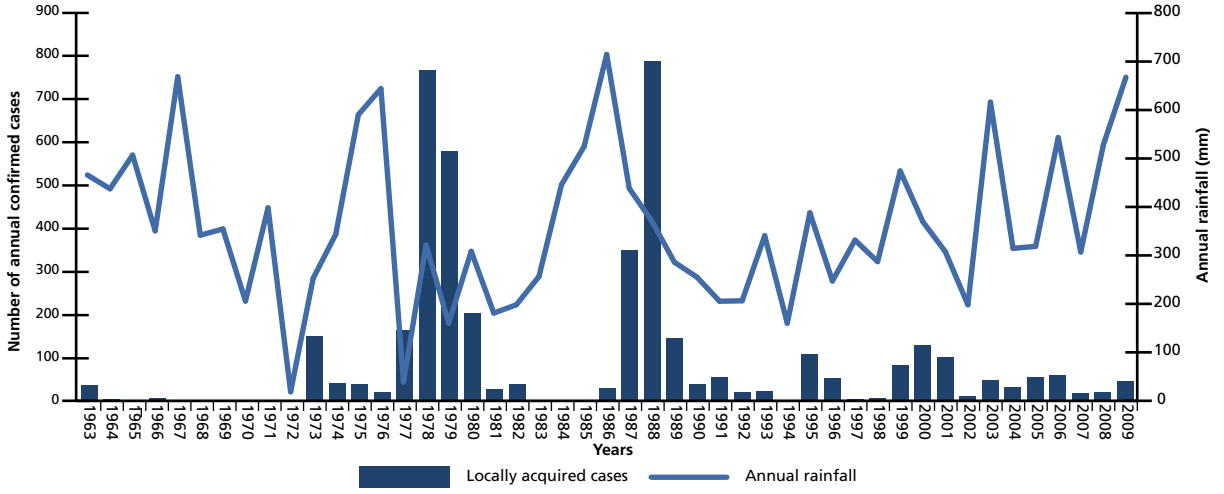
In total, 104 734 passengers entered the country at Praia airport in 2009 (Table 5); foreign visitors originated mainly from Europe and USA. That same year, 3517 visas were issued to nationals of endemic countries in Africa entering Cape Verde (Ministry of Transport data, 2010). The most numerous were 1235 arrivals from Angola. Thus, some 3500 travellers and migrant workers from Senegal and from former Portuguese colonies such as Angola, Guinea Bissau, and Sao Tome and Principe that are endemic for malaria (predominantly *P. falciparum)* come to Cape Verde by air every year. The resulting influx of potential parasite carriers appears quite low compared with the situation in other countries that are progressing toward elimination and that have neighbouring areas with high to moderate transmission.

Figure 6. Seasonality of transmission and importation: locally acquired and imported cases by month, 1994–2007



Source: reference *10*.

Figure 7. Annual locally acquired cases and rainfall, 1963–2009



Source: reference *10*.

Table 5. Passenger entries at international airport of Praia by nationality, 2009

Nationality	Passengers
Cape Verde	32 876
Europe	44 037
USA	20 786
Brazil	2 431
China	1 085
Angola	1 235
Senegal	1 123
Sao Tome and Principe	805
Guinea Bissau	354
Africa, elsewhere	1 006
Total	104 734

Cape Verde nationals travelling to and from endemic areas increase vulnerability. It is likely that most of the 32 876 Cape Verde nationals who re-entered their country arrived from Brazil, Europe or USA, but available data cannot distinguish them from those who arrived from endemic areas.

Between 1996 and 2009, 215 imported cases were reported –a yearly average of 15.8. Of these, 88% *(189)* were recorded on Santiago (see Annex 5). An unknown proportion of the 26 "imported" cases reported on other islands were actually acquired on Santiago. The impact of imported parasites on local transmission is difficult to gauge since "introduced" cases (first-generation local transmission subsequent to importation of parasites) are not counted separately.

TRANSMISSION DYNAMICS AND FOCI

Field observations during outbreaks suggest that receptivity might sporadically be high in the transmission foci despite the overall marginal ecological conditions. The transmission dynamic in an active focus in Cape Verde was documented during a localized outbreak in a small village of Santa Catarina municipality in 1995. Repeated active case detection showed that at least 83 of the 200 inhabitants (41%) had been affected over a six-month period and that all age groups were similarly affected. The only parasite species detected by microscopy and by PCR was *P. falciparum*. Apparently, parasites survive the long, dry and transmission-free periods as asymptomatic sub-patent infections, with 10% of the inhabitants still harbouring parasites and gametocytes one year after the outbreak (parasite prevalence 10%). Resurgences of transmission occur after rains and the resulting increase in the vector population *(20)*.

Table 6. Profile of Health Delegations including foci, 1990–2009

Health Delegation	Population 2009	Locally acquired cases (1990–2009)	Epidemic years	Maximum API[a]
Santiago				
Praia	123 654	451	2001	0.9
Santa Catarina	58 435	384	1995, 2000	2.4
Santa Cruz	37 625	50	1988	24.1
Tarrafal	23 103	25		0.2
São Miguel	17 449	3		<0.1
São Domingos	14 323	2		<0.1
Boa Vista	6 007	14	2009	2.2

a. Maximum API per 1000 population over the period 1988–2009.

Neither the residual foci on Santiago nor the newly active focus on Boa Vista have ever been properly explored, delimited and classified according to standard definitions. There are no recent data from parasitological surveys that could be used to provide better evaluation of the expansion of foci on Santiago. The only available data are locally acquired annual case counts disaggregated by Health Delegation. However, there are reliable incidence data for each Health Delegation between 1988 and 2009 (see Annex 5). Over the past 20 years, locally acquired cases have been recorded in each of the six Health Delegations of Santiago and on Boa Vista, but Praia and Santa Catarina probably include the largest and most active foci in the country, having reported almost 90% of all locally acquired cases recorded since 1988 (see Table 6).

Elimination of malaria in the 1950s and 1960s

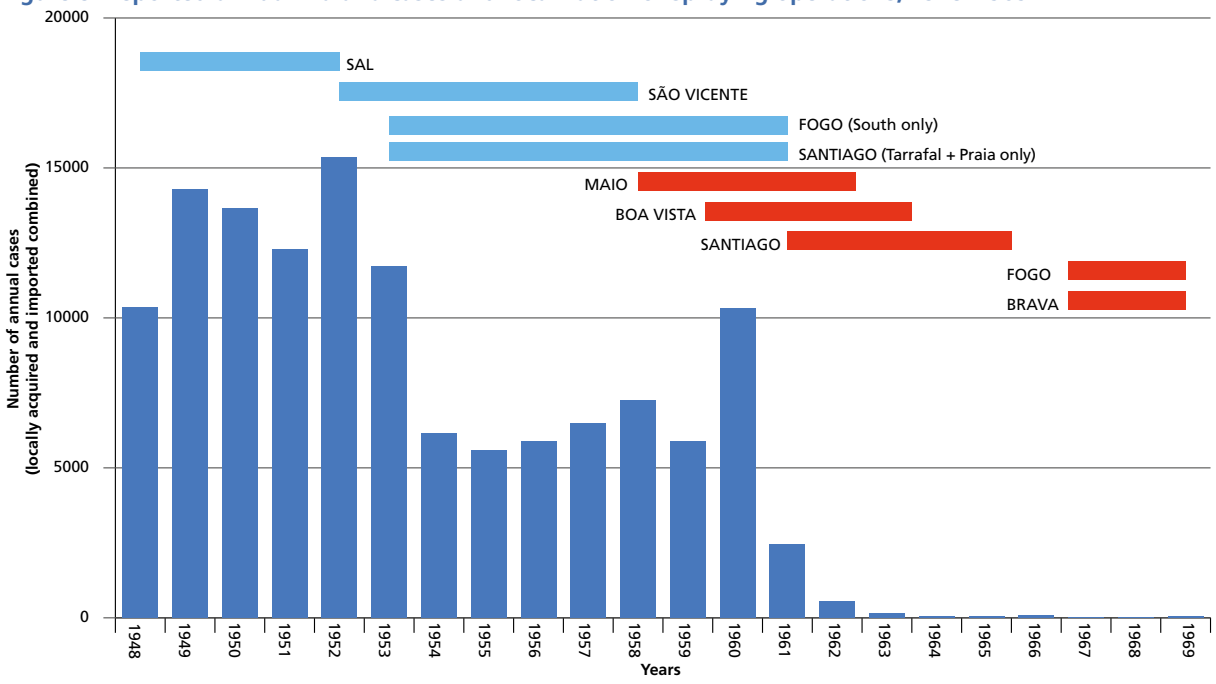
ACTION PLAN AND DETAILS OF THE OPERATIONS

In 1948, Lisbon's Instituto de Higiene e Medicina Tropical (IHMT) set up and supervised a pilot elimination project on Sal, the most arid of the islands with a population of only 2700. The project achieved eradication of the vector after only two years of annual rounds of IRS with DDT and treatment of breeding sites. That attack phase was followed by a maintenance phase, consisting of systematic antilarval operations and entomological surveillance *(22)*.

The first expansion of elimination efforts took place between 1953 and 1959. All operations were planned and monitored by IHMT. The main strategy was one of single annual rounds of IRS with DDT applied exclusively to the four most affected municipalities – Tarrafal and Praia on Santiago island, São Vicente and São Filipe (the southern part of Fogo) *(23, 24)*. A structured nationwide elimination plan was then introduced when the GMEP targeted Cape Verde with important strategic and technical guidance from WHO. In 1958, the attack phase was intensified with two annual IRS cycles plus larviciding and active case detection. Spraying began at this time on Maio island, which was severely affected by an epidemic, and was also initiated one year later on Boa Vista (Figure 8).

A second, more aggressive, period began in 1961 with the largest-ever campaign, covering the whole island of Santiago and its 92 000 inhabitants. The every six-months spraying cycle required more than 5 tonnes of DDT and 54 teams of sprayers to cover about 24 000 houses divided into 11 operational zones *(25)*. An extensive survey that measured parasite prevalence ranging from 1% to 16% was completed after the first cycle of spraying *(26)*. The attack phase lasted for four years. Passengers from the African continent were screened when disembarking in São Vicente and Praia harbours (with special attention to workers coming from Angola, Guinea Bissau, and Sao Tome and Principe). Incoming ships and aircraft were also sprayed to avoid importation

Figure 8. Reported annual malaria cases and localization of spraying operations, 1948–1969



Note: blue = annual IRS, red = biannual IRS. Trends of malaria cases disaggregated by geographical area over this same time period are not available.
Source: national malaria control programme

of vectors. In 1966, the programme shifted from blanket spraying to targeted IRS of residual foci.

In 1965, entomological surveillance, larviciding and extensive screening were carried out on Fogo and Brava, and five campaigns of DDT spraying were completed between 1967 and 1969. In 1967, careful exploration of São Nicolau and Santo Antão found no malaria infection or evidence of *An. gambiae,* and these two islands were not sprayed.

RESULTS ACHIEVED

During the period 1953–1959, through the targeting the most affected areas, the annual number of cases fell markedly from more than 10 000 to about 6000 and annual incidence dropped from more than 100 to approximately 40 per 1000 population. Spraying operations were particularly effective on São Vicente where elimination was achieved in 1958; entomological surveillance suggested the disappearance of the vector from the island in 1961 *(26)*.

The second period of intensified operations (active case detection, larviciding and biannual spraying) yielded dramatic results; transmission in the main active foci of Santiago island was eliminated in four years and in the smaller foci on Fogo and Brava in two years.

In 1967, elimination was considered to have been achieved throughout the archipelago after the last autochthonous case was recorded on Santiago. The vector had apparently disappeared from all islands except Santiago and Maio *(18)*.

Elimination of malaria after the resurgence on Santiago in the 1970s

ACTION PLAN AND DETAILS OF THE OPERATIONS

Focal IRS with a single annual cycle of DDT spraying was resumed for three years after reappearance of transmission on Santiago in 1973. It was restricted to about 30% of the island's population. Despite these efforts, 13 malaria deaths

Table 7. Objectives and strategies recommended by WHO in 1978

Objectives	Elimination of foci on Santiago Prevention of reintroduction of parasites on Maio Prevention of reintroduction of vector on other islands
Strategies	
Santiago (outbreak)	Biannual DDT IRS in Santa Catarina and Santa Cruz districts Passive and active case detection and radical treatment Case-based surveillance and investigation Control of passengers arriving from endemic countries Spraying of aeroplanes and ships from endemic countries Vector control around harbours and Praia airport Surveillance of breeding sites and larviciding
Maio (known vector presence)	Case-based surveillance Passive case detection and radical treatment Control of passengers from Santiago and endemic countries Spraying of aeroplanes and ships from Santiago Vector control around harbour and airport Surveillance of breeding sites and larviciding
Sal and São Vicente	Control of passengers from Santiago and endemic countries Passive case detection and radical treatment Spraying of aeroplanes and ships from endemic countries and Santiago Vector control around harbour and airport Surveillance of breeding sites
Other islands	Control of passengers from Santiago and endemic countries Passive case detection and radical treatment Spraying of aeroplanes and ships from Santiago and Maio Vector control around harbour and airport Surveillance of breeding sites

Source: reference *18*.

and 844 cases were recorded in 1978, which shocked the public and acted as a stimulus for an overhaul of the malaria control programme. A comprehensive set of recommended activities was developed jointly with WHO, with a human resources requirement of 90 people (Table 7) *(18)*[1]. This time, IRS was performed twice-yearly for five years and was extended to an area that included about 60% of the population.

RESULTS ACHIEVED

The annual spraying operations that were restricted to the most active foci in 1973–1976 failed to prevent the subsequent occurrence of a major epidemic in 1977–1979 in Santa Catarina and Santa Cruz Health Delegations. By contrast, the twice-yearly spraying of a larger area between 1979 and 1983 succeeded in preventing local transmission on Santiago for three years (see Figure 4).

[1] Unfortunately, only partial implementation of this ambitious operational plan was possible because of resource constraints.

Control of malaria after the resurgence on Santiago in 1986

ACTION PLAN AND DETAILS OF THE OPERATIONS

In 1989, focal annual IRS was again reactivated for two years and covered about 20% of the population; the number of locally acquired cases fell back below 50 in 1990. Since then, the fraction of the population protected by IRS has been less than 2–3% every year, increasing to about 5–10% in the few years when responses to small and localized outbreaks were organized (Santa Catarina in 1995 and 2000; Praia in 2001) (see Figure 4).

In the 1990s, the Health Delegations on Santiago lacked the necessary logistic and human resources for systematic field investigation and specimen collection. Nevertheless, the national malaria control programme (NMCP) managed to carry out field investigations and active case detection during the last outbreaks that affected Santa Catarina Health Delegation in 1995–1996. In 1996, more than 850 slides were collected and 29 of the 53 locally acquired cases recorded were detected by active case detection *(27)*.

Computerized monthly summaries by Health Delegation since 1988 are available, and accessible records suggest that systematic recording of individual cases was initiated in 1996. In 2003, Cape Verde adopted the concept of Integrated Disease Surveillance and Response (IDSR) and surveillance of all diseases, including malaria, came under the responsibility of the Servicio da Vigilancia Epidemiologica (epidemiological surveillance service). The IDSR technical guideline was revised in 2007 *(28)* and provides instructions for the detection and notification of malaria cases. The national case management guideline was updated in 2009 *(8)*.

RESULTS ACHIEVED

Since 1990, the level of transmission has remained very low. The annual number of locally acquired cases has exceeded 100 only three times, and localized outbreaks have been controlled by small-scale operations combining single-round focal IRS (using deltamethrin) with active case detection. Locally acquired cases continue to be reported every year on Santiago by some or all of the Health Delegations of Praia, Santa Catarina and Santa Cruz. Of greater concern, however, is the reappearance of transmission on Boa Vista since 2003, which points to a renewed expansion of the endemic areas in the country.

As shown in Table 8, the annual number of febrile patients tested for malaria has been relatively low since the year 2000, resulting in an annual blood examination rate (ABER) of 1–2%, except in 2009 when rapid diagnostic tests (RDTs) were introduced and the ABER in Santiago reached 4%, with 21 913 tests performed and 64 cases detected. The test positivity rate has remained below 1% since 2004. The relatively low ABER over the past decade indicates that systematic fever testing was not carried out outside Santiago island, and is consistent with the fact that active case detection was performed only exceptionally.

With a total of 20 malaria deaths recorded among 677 falciparum malaria patients since 2000, the case-fatality rates (CFR) are relatively high, often reaching or exceeding 3%. This may reflect delayed diagnosis and suboptimal treatment for a significant proportion of cases.

Events that have shaped the policy-setting process over time

In 1948, as part of the global malaria eradication efforts that followed the Second World War, Cape Verde was among the first countries to initiate a malaria elimination pilot project with IRS/DDT, on Sal island. Following a severe malaria outbreak in 1952 that affected about 20% of the population of São Vicente, IRS/DDT operations were expanded, eventually covering seven of the nine inhabited islands. The programme was particularly successful, and nationwide elimination of local transmission was achieved in 1967. Malaria transmission was interrupted for five years (1968–1972), but maintenance operations were terminated prematurely after the international community abandoned the GMEP in 1969.

Table 8. Malaria control parameters between 2000 and 2009

			Diagnosis			Cases					Mortality		
Year	Pop.	Consultations per inhabitant per year	Tested	ABER, Cape Verde (%)	ABER, Santiago (%)	Total	Locally acquired	Imported	Test positivity rate (%)	Incidence per 1000 population	Deaths	Deaths /100 000	CFR (%)
2000	436 821	0.99	6 843	2	3	142	132	10	2.08	0.33	1	0.21	1
2001	444 921	0.98	7 141	2	3	117	102	15	1.64	0.26	0	0.00	0
2002	452 835	1.01	8 022	2	3	19	11	8	0.24	0.04	1	0.21	5
2003	460 601	1.00	6 001	1	2	70	50	20	1.17	0.15	2	0.42	3
2004	468 164	0.99	9 833	2	4	47	34	13	0.48	0.10	2	0.42	4
2005	475 465	0.99	7 902	2	3	69	55	14	0.87	0.15	1	0.21	1
2006	483 090	0.99	8 729	2	3	80	62	18	0.92	0.17	8	1.67	10
2007	491 419	0.99	8 902	2	3	17	2	15	0.19	0.03	1	0.21	6
2008	499 796	1.02	6 033	1	2	45	20	25	0.75	0.09	2	0.42	4
2009	508 642	1.05	21 913	4	8	64	45	19	0.29	0.13	2	0.39	3

Source: national malaria control programme

Local transmission reappeared on Santiago in 1973, followed by a large epidemic in 1977–1979. The newly independent country reactivated the national NMCP with support from Lisbon's IHMT. At the time, the vector was thought to exist only on Santiago and neighbouring Maio; on the advice of a WHO consultant, the country added two further objectives to the malaria programme –prevention of reintroduction of the parasite to Maio and prevention of reintroduction of vectors to other islands *(18)*. Unfortunately, resource constraints meant that this ambitious operational plan could be only partially implemented. Biannual IRS was carried out in the most active foci on Santiago for five years but suspended as soon as transmission was interrupted again. This time transmission was interrupted for three years (1983–1985).

In 1986, local malaria transmission again appeared on Santiago, followed by an epidemic in 1987–1988. The programme responded with two annual rounds of IRS/DDT to control the epidemic, without aiming for renewed elimination. In subsequent years, coordinated malaria control efforts were restricted to episodic responses to small-scale epidemics. In 2005, the Ministry of Health together with the WHO Representative in Praia approached the Spanish Cooperation for support of a renewed effort to eliminate the residual foci of malaria transmission on Santiago and Boa Vista. The proposal highlighted the risk of resurgence of malaria transmission in Cape Verde in the absence of control measures, especially with the construction of the Poilão dam in Santa Cruz, which would increase the malaria potential, and with the imminent opening of the new international airport in Praia, which would increase population movements. The Spanish Cooperation agreed to support the project, which was gradually implemented over the next four years.

In 2006, public opinion and the authorities were shocked by the occurrence of eight malaria deaths, contrasting with the usual malaria mortality of one or two people per year. The quality of case management in Praia hospital was debated in the press and in parliament: the event had political implications because it coincided with elaboration of the 2007–2020 national health policy. The Ministry of Health ordered an official investigation and announced the inclusion of malaria elimination before 2020 as an objective in the policy document *(7)*.

Shortages of funding and of trained human resources for health and malaria control were severe constraints for the programme, and the Government asked WHO for support. One of the first steps taken was a thorough analysis of the parasite and vector situation. The ABER increased from roughly 1–2% in 2000–2008 to 4% in 2009, and entomological surveys found the vector *An. arabiensis* not only on Santiago and Boa Vista as expected but also on five other islands – Santo Antão, São Vicente, São Nicolau, Maio and Fogo – that had not reported local cases. Only two islands, Brava and Sal, had no apparent vectors and no malaria cases. Once the epidemiological status of the national landscape had been characterized, the next step was assessment of existing Ministry of Health/NMCP operational and financial capacities and exploration of potential additional resources, both national and external. A National Malaria Strategic Plan for Pre-elimination 2009–2013 was elaborated and formed the basis for the Global Fund grant "Malaria: a step towards pre-eradication in Cape Verde", which will complement the increasing national spending commitment.[1]

Which population groups were most affected by malaria in recent years?

The annual burden of malaria in Cape Verde, and thus for the various subgroups of its population, has been small over the past two decades. The disease is concentrated on Santiago. Praia, the densely populated capital city, accounts for a significant proportion of the cases registered every year in the country, including an average of 29 local cases per year over the period 2005–2009. This has been linked to the presence of breeding sites created by several small agricultural areas

[1] This paragraph has been adapted from: *Eliminating malaria: learning from the past, looking ahead*. Geneva, World Health Organization, 2011 (Progress & Impact Series, No. 8, available at: http://www.rollbackmalaria.org/ProgressImpactSeries/docs/report9-en.pdf).

on the city's periphery. There is no evidence at present to indicate that rural or deprived populations are more affected by malaria than others, although poverty and housing may play a role at local level through greater exposure to mosquito bites.

Disaggregated malaria data by age and sex for 2007–2009, covering imported and local cases combined, show that all age groups and both sexes were affected, with two-thirds of cases occurring in adult men (Table 9). Comparing the age and sex distribution of cases with the overall partition in the Cape Verdean population by age group as shown in Table 1 confirms the disproportionate number of adult men among the reported malaria cases. The explanation can most probably be found in a tendency of imported malaria to occur in this population group; as yet, however, this is poorly documented.

Table 9. Malaria cases by age group and sex, 2007–2009

Age groups (years)	Male	Female	Total
0–4	2	3	5
5–14	8	8	16
15–19	4	2	6
20 and over	81	21	102
Total	94	34	129

Source: reference *11*.

HOW IS THE PROGRAMME CHANGING TO ACHIEVE ELIMINATION?

Over the past decade, the health system of Cape Verde focused increasingly on the growing burden of noncommunicable diseases in the country. The pool of competencies in the domain of malaria control was very limited, a weakness that concerned not only technical expertise in relevant disciplines such as parasitology, entomology and epidemiology, but also the managerial capacities of public health professionals and the skills of health technicians at central and peripheral level. All professionals and technicians with experience of the "malaria eradication era" in the 1950s and 1960s have retired and are difficult to replace as Cape Verde is still fully dependent on expensive overseas training for all its physicians, scientists, public health professionals and health technicians. As yet, there is no national academic or research capacity for health, although Cape Verde University is developing and starting to attract some postdoctoral competency in the domain of microbiology. As in many countries, specialized medical practice is providing much more attractive working conditions than a career in public health.

A five-year National Malaria Strategic Plan (MSP) covering the period 2009–2013 was developed in 2008 (*Plano estrategico de pre eliminacão do paludismo* 2009–2013) *(8)*. The participative process lasted more than 6 months and involved coordinated inputs from all the General Directions and services of the Ministry of Health plus, in an intersectoral approach, representation from the Ministries of Agriculture, Transport, Decentralization, Defence and Foreign Affairs and participation by municipalities and nongovernmental organizations (NGOs). Different strategic options were discussed and implementation of activities in several areas was planned jointly.

Malaria incidence had remained below 0.3 per 1000 at national level, and below 0.5 per 1000 on Santiago, for the previous 20 years. Nevertheless, a consensus emerged that a countrywide phase of pre-elimination would be necessary in the five years to come in order to set up robust systems and operational capacities in advance of a subsequent elimination phase. This option was preferred to the prevailing approach of sequential elimination, which relied on stringent measures to prevent reintroduction on the unaffected islands. The recent re-establishment of transmission on Boa Vista was probably a major justification for the choice of nationwide pre-elimination.

The MSP is divided into four strategic components (diagnosis and treatment, vector control, surveillance, and programme management) and 22 activity domains. Its objectives are:

- to expand capacity for quality-assured diagnosis in all health facilities;
- to provide early and efficacious treatment to all infected patients;
- to report, investigate, classify and monitor all detected cases and foci;
- to implement IRS and identify and control breeding sites in active foci and;
- to reduce the risk of dissemination of parasites and vectors.

The following sections highlight the main components of the MSP against the background of the national malaria programme at the start of the pre-elimination period in 2009. The MSP has formed the basis for the Global Fund Round 10 grant "Malaria: a step towards pre-eradication in Cape Verde" and guides current programme activities.

Epidemiological surveillance and control activities

The MSP targets surveillance and programme monitoring for important investments. The aim is to ensure availability of all data needed to monitor quality and progress and react to unexpected events. A geo-referenced database will be set up to store, manage and analyse comprehensive data on case-based surveillance and interventions. Changes in the functional status of foci will be monitored, with an emphasis on detection of new potential or new active foci.

Major changes are planned in the detection of cases outside Santiago. In order to detect local transmission, every fever without obvious cause will in future be considered as a suspected malaria case regardless of travel history. Quality-assured malaria diagnosis will be made available in peripheral health facilities. Procedures for case investigation will be standardized and the algorithm for case classification will be modified to differentiate between introduced and indigenous cases.

Case detection is addressed in the 2007 technical guidelines on IDSR *(28)* and in the national case management guidelines that were revised in 2008 *(29)*. These documents make it clear that presumptive treatment must be avoided and every suspected case must be tested. A suspected case of malaria meriting laboratory diagnosis has been defined as "a person with isolated fever who has recently travelled to an area with transmission". The term "recently" was defined as a period of 6 months in the IDSR of 2007 but was increased to 12 months in the 2008 case management guideline. Santiago is explicitly mentioned as an area with transmission.

It is noteworthy that the strict application of these guidelines would have meant that the residents of Boa Vista who tested positive for malaria parasites in 2003 would not normally have been tested because they had not travelled outside their island. The reason why these patients were indeed tested in 2003 is not known. This event identifies a critical shortcoming in the surveillance system, resulting in most of the cases emerging from islands that are supposedly free of malaria remaining undetected. The 10 locally acquired cases recorded in 2009 on Boa Vista were detected during a survey among febrile patients as part of the exploration of an ongoing dengue epidemic.

In the 2008 case management guidelines, a confirmed case is defined as "a suspected case with positive RDT confirmed by a thick smear". This implies that microscopy confirmation is required only for cases with a positive RDT. The document mentions RDTs using *Plasmodium* lactate dehydrogenase for their capacity to detect non-falciparum species.

Classification of cases by origin of infection has thus far been dichotomous: cases could be either "imported" or "autochthonous". According to the 2007 IDSR guidelines, a case can be classified as "imported" if the patient has travelled into an endemic area within the previous six months; it will otherwise be considered "autochthonous". It should be noted that, because Santiago is considered an endemic area, some of the "imported" cases detected outside Santiago in recent years may actually have been autochthonous and acquired on the island. The definition of an imported case in the 2008 revision of the case management guidelines is much more restrictive: the disease has to appear within a maximum of 10 days after the return from an area with transmission.

Prevention of imported malaria and its consequences

Health education and easy access to free-of-charge diagnosis and treatment will be provided to international travellers and migrants to cope with the continuing importation of parasites. Nationals travelling to endemic countries will be better informed about chemoprophylaxis and prevention of mosquito bites.

A specially tailored programme of communication and information for migrants and incoming travellers from endemic countries will be implemented in the near future. An important malaria component related

to health education, information and communication is being developed by the Ministry of Health's General Direction for Health Promotion and the National Centre for Health Development.

Management of disease

Under the MSP, every malaria case – including asymptomatic infections – will be treated radically using a sequential administration of artemisinin-based combination therapy (ACT) and primaquine and then carefully followed up. Quality and effectiveness of case management and timeliness of case detection will be continuously evaluated. Testing and treatment will remain totally free-of-charge to the patient in all public health facilities.

In 2008, with the revision of the 1995 guidelines for malaria case management, Cape Verde shifted its policy from chloroquine to ACT for the treatment of uncomplicated falciparum cases and adopted RDTs for diagnosis as a complementary measure for where microscopy was not available. Uncomplicated malaria cases are treated with a standard three-day ACT regimen (artemether-lumefantrine or artesunate-amiodaquine). In addition, a single dose of primaquine (0.75 mg/kg) should be administered on the fourth day as a gametocytocidal drug for *P. falciparum* infection without screening for glucose-6-phosphate dehydrogenase (G6PD) deficiency. For *P. vivax* or *P. ovale* infections, primaquine (0.25 mg/kg) should be given daily for 14 days to avoid relapses. Severe cases of malaria must be treated with intravenous quinine; mefloquine is recommended for the prophylaxis of travellers to endemic areas. The frequency of G6PD deficiency has been measured in the population of Santiago and is low (0.6%) *(30)*.

The guidelines recommend that cases should be followed up for one month after treatment, with parasitaemia checks on days 3, 7, 14, 21 and 28. Although not explicitly recommended by the guidelines, malaria cases are frequently hospitalized: of the 402 cases recorded between 2001 and 2006, it is reported that only 23 (6%) were not hospitalized *(31)*.

Field (epidemiological) investigations, recording and reporting, flow of information, data processing, analysis and use

Field investigation and active case detection have been acknowledged in the MSP as critical for a significant and sustained impact on transmission foci. Substantial extra resources are planned for these activities. A central database will gather all information related to malaria with several linked computerized national registers. A case register will keep up-to-date information on all individual cases, allowing detailed analysis and synthesis of epidemiological information and trends to help guide the elimination programme over time. A patient register will include records on case management and investigation and any other pertinent information regarding individual cases. A laboratory register will contain all pertinent information regarding malaria diagnosis of the patient and will be linked to a parasite strain bank.

The 2007 IDSR guidelines had already recommended that detected cases should be systematically investigated by the relevant Health Delegation but they lacked standard procedures to guide the fieldwork and related forms. Tracing a case to its origin and carrying out active case detection in neighbouring houses are mentioned in the 2008 case management guidelines and appear on the individual case notification form (see Annex 6). However, clear procedures for this were not available at the time – they have now been developed as part of the Global Fund funding proposal preparations.

Individual case reporting forms were received and compiled after field investigation by Health Delegations. Weekly line list reports are sent by the Health Delegations to the Epidemiological Surveillance Service in Praia, where they are aggregated on a simple spreadsheet that is regularly shared with the NMCP. There is no proper malaria database, cases are not geo-referenced and individual case reports are not available at the central level. Data are displayed in five tables (cases/deaths by age, sex, Health Delegation) every year within the Ministry of Health's annual statistical report.

Vector (entomological) surveillance

As part of the MSP, breeding sites will be systematically mapped, monitored and treated throughout the year. Operations will be intensified during the rainy season in the suburbs of towns and peripheries of inhabited areas.

Surface water is not common in Cape Verde; there are no permanent rivers or large natural water bodies. As a result, almost all potential breeding sites are created by human activity and are thus relatively easy to access and control. Examples are water tanks created by communities for domestic purposes or constructions and small water collections around springs or boreholes used for agriculture. Systematic geographical reconnaissance, mapping and monitoring of permanent breeding sites for entomological surveillance were important activities during the eradication area. Recent renewed attempts at exhaustive localization and geo-referenced mapping of breeding sites have been very promising *(32, 33)*. Rainfall data from a network of 39 stations are recorded by the Instituto Nacional de Meteorologia e Geofísica and could be used to analyse and monitor the risk of weather-related exacerbated transmission in foci. Collaborative activities with the Ministry of Agriculture and Environment could be developed with the aim of improving agricultural practices and the management of water sources in rural areas.

Entomological surveillance is still performed routinely by a few health technicians in some limited parts of Praia and Santa Catarina municipalities *(8)*.

Vector control activities

As part of the MSP, the behaviour of the vector and its susceptibility to various classes of insecticides will be checked. Geographical reconnaissance of active foci will carried out before the reactivation of widespread IRS operations on Santiago and Boa Vista islands. Agricultural practices liable to create breeding sites will be addressed and improved.

After the intense IRS operation finished in the 1960s, vector control efforts in Cape Verde focused mostly on larval control. A mixture of different methods was applied, including the use of temephos insecticide or larvivorous fishes (such as *Gambusia affinis*) in known man-made breeding sites. The intermittent drying of water reservoirs is regularly promoted, as are protection of water tanks and the spread of petroleum derivatives over non-drinking-water.

Deltamethrin replaced DDT in 1999. Over the past 10 years, the control of adult vectors has been limited to occasional single annual rounds of IRS with deltamethrin. Not more than about 200 houses have been sprayed each year, except in 2001 and 2006 when additional rounds covered about 800 houses following the detection of case clusters in Praia *(8)*. Altogether, no more than 5% of the population of Santiago was ever covered by IRS. There is no evidence on the actual effectiveness of this approach. Outcomes of vector control operations such as IRS and larval control carried out through the year by Health Delegations were not systematically reported to the central level.

The use of insecticide-treated mosquito nets has never been promoted in Cape Verde.

Monitoring key social, demographic and behavioural risk factors

The Government of Cape Verde is actively promoting integration of information technologies in public administration through NOSI (Nucléo Operacional para e Sociedade de Informação) – its coordinating body for the promotion of the information society and e-governance. Several areas of public administration, including national civil identification, registration of economic operators, management of social welfare and pension system, are already computerized, with available services on-line. The aim is to build integrated information platforms between ministries and public institutions, and an ambitious health information system is currently being designed with collaboration between NOSI and the Ministry of Health.

Laboratory support for surveillance, external quality assurance/control

As part of the MSP, the laboratory component will be substantially strengthened with the objective of a quality-assured testing for every suspected case in the country. Health facilities without laboratory will be equipped with RDTs and material for preparing thick smears. Suspected cases will be tested using RDTs and slides will be sent to the nearest laboratory for examination. Specimens will be collected from positive cases for eventual genotyping and determination of drug resistance profile. A robust quality assurance system is planned for the 14 laboratories, as is an upgrading of the external quality control scheme for a malaria national reference laboratory. The latter will screen samples from surveys and active case finding and will be equipped to perform up-to-date DNA amplification techniques such as PCR for sub-microscopic infections.

For the time being, malaria testing on all islands but Santiago is restricted to patients with fever who have travelled to areas with transmission, with the result that about 95% of the tests are performed on Santiago. It is likely that an important fraction of the suspected cases seen elsewhere are not referred, so that some cases remain undetected. Up to 2009, malaria testing was accessible only in 14 laboratories (five hospitals and nine health centres) that were able to perform thick smears on a regular basis. In all, 23 laboratory technicians were employed in the nine peripheral laboratories in 2009 *(11)*. Each island had at least one laboratory equipped for the preparation and reading of thick smears but the actual proficiency of technicians was not certified and there were no processes for quality assurance of malaria microscopy.

In 2009, RDTs were deployed in health centres without laboratories and in health posts and the number of tests reached 21 913 compared with 7000–9000 previously, leading to the detection of 64 cases (including 45 locally acquired), compared with 45 (including 20 locally acquired) the year before (see Annex 5). Instructions for the use of RDTs state that only positive results must be confirmed by microscopy; negative results are not cross-checked for quality control.

Laboratories of the national hospitals of Praia and Mindelo are both considered as national reference centres. They are affiliated to the WHO External Quality Assessment Scheme and regularly receive sets of specimens from South Africa's National Institute for Communicable Diseases to assess proficiency. Surveys are conducted three times a year with 10 microscopy challenges for species identification and parasite quantification.

Supportive legislation and regulation

CONTROL OF THE ANTIMALARIAL MEDICINES SUPPLIES

In Cape Verde, the importation, distribution and quality assurance of pharmaceutical products are fully controlled by the Ministry of Health's General Direction of Pharmacy. Market regulation is based on a national list of medicines that are authorized in the country. This list was amended at the end of 2007 to include two ACTs: artemether-lumefantrine and artesunate-amodiaquine. Chloroquine and sulfadoxine-pyrimethamine have been removed from the list; mefloquine has been included for the prophylaxis of travellers. Artemisinin monotherapies are banned. Procurement for both the public and private sectors is the responsibility of a single body – EMPROFAC (Empresa Nacional de Produtos Farmacêuticos, SARL) – which is in charge of all imports and is also the unique wholesaler and distributor for the private sector. Antimalarial drugs are made available only in the public sector. A pharmacovigilance service is about to be created in partnership with the General Direction of Pharmacy under the responsibility of the Pharmaceutical and Food Product Regulation Agency.

NOTIFICATION OF CASES

Because malaria is classified as a disease with "epidemic potential", weekly summaries of case counts must be reported by the Health Delegations. Malaria is also subject to case-based reporting: every case must be immediately notified to the closest Health Delegation using an individual case notification sheet (Annex 6).

Programme management

The MSP foresees a substantial strengthening of human resources in the NMCP with the creation of four new positions intended to provide in-house expertise in malaria microscopy, entomology, epidemiology and database management. Deployment of additional operational capacity is also planned at regional level on Santiago and in each of the Health Delegations.

Until recently, the NMCP was a "virtual" entity with a single public health professional in charge of the whole unit of transmissible diseases. A staff position of Coordinator, entirely dedicated to malaria control, was filled in June 2010. Within the administrative structure of the Ministry of Health (see Annex 7), critical activities rely on units outside the Direction of Diseases Prevention and Control: surveillance, laboratory and pharmacy. Administrative and financial processes of the NMCP are managed by the General Direction of Human Resources and Administration.

The NMCP has no specific resources to supervise and operate malaria control activities in the periphery, where the 17 Health Delegates have full authority over the network of primary health structures and manage a small team of health technicians. The Health Delegates are physicians who usually have important clinical activities in addition to their assigned public health and administrative responsibilities. As senior practitioners, they must supervise health units and generally have an important role in ensuring the quality of medical care and disseminating updated protocols and practices. Most are overloaded with work, with insufficient human, logistic or financial resources to undertake the health activities required by the different programmes on a regular basis. The operational capacities of Health Delegations are also highly dependent on the number and qualifications of the available health technicians. In 2009, there were only 35 health technicians *(11)*.

In 2005, the Spanish Cooperation granted Cape Verde a total of €300 000 to be used over a three-year period for malaria control and elimination in residual transmission foci. The main components of the project were the establishment of an integrated vector control programme in malaria-affected areas of Santiago and Boa Vista; strengthening of human resource capacity in entomology, parasitology and epidemiological surveillance; and strengthening of national capacity for operational research. The grant has been administered by the WHO Representative. Further support for the national transition to elimination came in 2010 with the Round 10 Global Fund grant of US$ 1325,489[1]; the Executive Secretary of the Cape Verde Coordination Committee to Fight AIDS acts as its Principal Recipient.

Programme funding

The Ministry of Health budget does not mention a specific allocation to the NMCP, making the tracking of earmarked domestic engagement for malaria control difficult. The funding proposal for the Round 10 Global Fund grant tried to gauge recent expenditures on malaria control *(34)*. It found that the Cape Verde Government contributed the major share – €280 000 – towards malaria control in 2009; this was devoted mainly to the salaries of the NMCP coordinator and of malaria-dedicated staff in Health Delegations. Additional funding came from the Spanish Cooperation (€133 500), WHO (€58 500) and the United Nations (€27 300) (see Figure 9). Total public expenditure on malaria control in Cape Verde for 2009 was therefore about €500 000, or €1 per inhabitant.

The 5-year budget for the 2009–2013 MSP includes the following estimated costs of pre-elimination activities required in addition to current efforts *(8)*: case management (18% of the budget), vector control (26%), surveillance and monitoring (17%) and programme management (38%). Total cost was estimated at about €2.7 million for five years, or a further €1 per inhabitant per year in addition to current expenditures (see Figure 10 and Table 10).

[1] See: http://portfolio.theglobalfund.org/en/Grant/Index/CPV-011-G03-M (accessed 2 September 2012)

Figure 9. Financial contributions (euros) towards malaria control, 2009

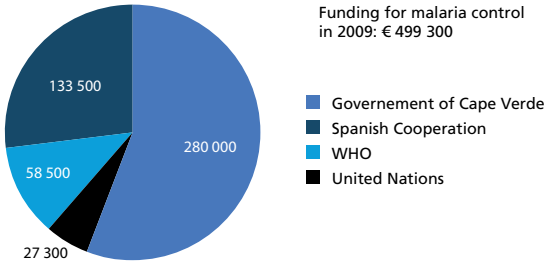


Figure 10. Budget distribution of additional funding needs (euros) to support the National Malaria Strategic Plan 2009–2013

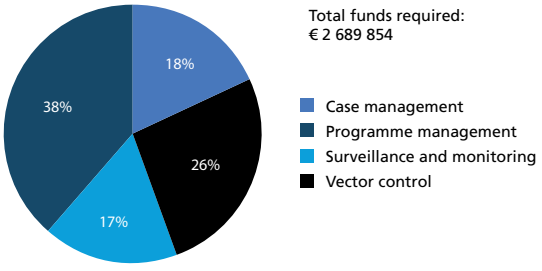


Table 10. Budget of the 2009–2013 National Malaria Strategic Plan for Pre-elimination

	Budget	
Activity	€	% of total
Case management	482 406	17.9
Baseline parasitological surveys	25 690	
Parasitological diagnosis	125 835	
Quality control of microscopy	64 013	
Treatment and follow-up of cases	94 087	
Prevention of parasite introduction	172 781	
Vector control	709 456	26.4
Baseline entomological studies	24 639	
Entomological surveillance	42 290	
Indoor residual spraying	596 237	
Larval control	46 290	
Surveillance and monitoring	463 798	17.2
Case notification, recording	44 404	
Active case detection and investigations	301 205	
Data management	14 805	
Supervision	85 904	
Epidemic preparedness and response	6 680	
Parasite genotyping and repository	10 800	
Programme management	1 034 194	38.4
Additional human resources	471 600	
NMCP management	395 075	
NMCP coordination	12 600	
Information, education, communication	118 469	
Monitoring and evaluation	36 450	
Total (€)	2 689 854	100%

Source: national malaria control programme

LESSONS LEARNED AND OUTLOOK FOR THE FUTURE

Two interruptions of local transmission within the last 50 years indicate that malaria elimination is technically feasible in Cape Verde.

Cape Verde has twice implemented successful attack phases. The first, between 1953 and 1969, relied initially on a single annual round of IRS. It resulted in the elimination of vector and transmission on São Vicente but had only partial impact on the targeted parts of Fogo and Santiago. Much more impressive results were achieved between 1961 and 1969. Over this period, IRS with DDT was carried out twice-yearly and complemented by larviciding and active case detection. Interventions were planned to gradually cover every island, each being completely sprayed. Elimination of the main active foci of Santiago was achieved in four years and of smaller foci on Boa Vista, Maio, São Nicolau, Fogo and Brava in two to three years. The second large-scale attack phase was restricted to Santiago and was implemented between 1979 and 1983. It consisted of biannual IRS campaigns, intensified surveillance, larviciding and active case detection inside foci. Transmission was again interrupted within five years.

Unfortunately, Cape Verde knows from experience that transition to the consolidation phase is a critical stage in preventing rapid re-establishment of local transmission after the scaling-down of IRS operations. Abrupt cessation of IRS and active surveillance of foci as soon as the last case was recorded has twice resulted in the reappearance of locally acquired cases within the following three years. It is likely that, in 1968 and 1983, the attack phases should have been followed by a careful consolidation phase to suppress the last potential foci on Santiago with focalized IRS guided by reinforced field investigations, surveillance and active case detection. A timely and intense response to the detection of initial cases of renewed local transmission in 1973 and 1986 might have avoided the subsequent epidemics and re-establishment of transmission.

Since the second failure of malaria elimination in 1983 and the control of the last large epidemic in 1988, Cape Verde has been unable to invest sufficient resources to develop and implement a new elimination plan. Malaria was not perceived as a threat either for the construction of a modern independent state or for its continuing fast economic development.

The ambition of the NMCP after the last epidemic in 1988 has been restricted to passive case detection and investigation with case-based surveillance on Santiago and to the early detection of imported cases elsewhere. Some more demanding interventions that could have had an impact on transmission in foci (active case detection with radical treatment, IRS, larviciding) or prevented the diffusion of parasites and vectors to other islands (control of harbours and airports) have been implemented only sporadically. These low-profile activities have been sufficient to react to small outbreaks (most recently, 118 cases in 2000) and to keep the API below 0.5 per 1000 population on Santiago. They also appear to have been effective in preventing the spread of malaria beyond Santiago. However, recent studies showed that the vector has quietly reinvaded at least four islands *(35)*, and the accidental detection of an active focus in Boa Vista in 2003 points to gaps in surveillance. Maio has apparently remained free of malaria.

The political decision to engage in renewed elimination efforts was taken in 2006. The country is now at a critical stage, with the expansion of transmission to Boa Vista, an island with recent important investments and the potential to attract thousands of tourists from Europe every year.

Important choices had to be made over the three years during elaboration of the MSP and the work plan of the Global Fund grant proposal. The first was driven by the need to modify the classical sequence of phases implemented during the GMEP era (preparation,

attack, consolidation, maintenance). A typical attack phase, with generalized intensive IRS operations, was unnecessary since incidence was already below one case per 1000 population at risk per year, and a large portion of the country was malaria-free. Nevertheless, there was consensus that the country needed a preparatory phase to refine analysis of the epidemiological context, strengthen the capacity of the programme – including the necessary infrastructure, logistics and human resources – and secure sufficient funding for every level of the programme.

The second important choice was to embark on a consolidation phase throughout the country even though only two of the nine inhabited islands have reported local transmission in the past 30 years. An alternative option was to maintain the strategy of prevention of reintroduction in seven islands and to implement a consolidation phase only on Santiago and Boa Vista. Although some aggressive vector control operations will be restricted to well-defined foci, the major change is that surveillance will be strengthened by a similar case definition of suspected cases (unrelated to travel history) for all islands, complemented by active case detection as required. This option is critical to ensure timely detection and accurate classification of all residual foci.

The third choice concerned the most cost-effective strategy for establishing an appropriate system of passive and active detection of all cases in the country. The major constraint was to balance the relatively low number of health facilities that have parasite-based diagnostic capacity with the coverage and quality assurance necessary for a successful elimination programme. It was decided that all suspected cases would be tested by both an RDT and a blood smear, the latter being sent to the nearest laboratory for reading. It was considered that this double check would compensate for the suboptimal sensitivity of RDTs (particularly for the detection of *P. vivax*). Slides would be examined using a network of 14 laboratories (at least one per island) where the proficiency of the microscopists would need to be upgraded and controlled by a national reference laboratory subject to external quality control.

The country expressed its determination to avoid past errors and acknowledged the critical need for the persistence of efforts after the achievement of elimination. It also acknowledged that a subsequent phase, for preventing reintroduction, would require the maintenance of a proactive and rigorous surveillance system, selected vector control operations and adequate awareness and skills in the health system.

Epidemiological profile to be completed and strategies adjusted

Resources for monitoring the epidemiological situation with sufficient precision have been lacking over the past 20 years. The surveillance system recorded individual cases but field investigations and active case detection were suboptimal; few of the fever cases presenting to clinics outside Santiago were tested. The identification of a new active focus on Boa Vista added to the suspicion of additional undetected potential or even active foci in the rest of the archipelago. Although a few studies have been done within Santiago foci, their actual expansion, receptivity and transmission dynamic are still imprecisely defined.

At present, knowledge on parasites is limited. The reported disappearance of *P. vivax* since 1994 is very surprising. Experience from other areas where both species coexisted showed that elimination of *P. falciparum* preceded elimination of *P. vivax* because of the persistence of hypnozoites and potential longer incubation period associated with *P. vivax*. Intrinsic development of *P. vivax* is also generally less constrained than that of *P. falciparum* in cooler and drier environments.

More precise information on the vector will also be required before larger IRS operations are initiated. Its distribution over the country has been assessed recently but may have evolved further. Recent attempts by entomologists to capture adult mosquitoes to ascertain the behaviour and susceptibility to insecticide of the local strains of *An. arabiensis* were unsuccessful. The insecticide and the frequency of IRS should be chosen very carefully

on the basis of evidence that still needs to be collected. The two previous interruptions of transmission resulted from IRS with DDT every six months. Evidence is lacking on the effectiveness of more recent focal IRS that was carried out only once a year using pyrethroids (deltamethrin). Vector behaviour also needs to be investigated: it is suspected that *An. arabiensis* has a particular ability to adapt when exposed to irritant insecticides, by feeding and resting partially outdoors. Larviciding is routinely implemented and its potential effectiveness repeatedly emphasized in the particular ecological context of Cape Verde. However, some operational research could probably select optimized vector control practices and ensure maximal cost-effectiveness.

Operational capacities to be upgraded

Programme management capacity and technical expertise rely on very few people at the central level. A single person currently runs the NMCP. Technical departments in other Divisions of the Ministry of Health that would have important roles in malaria elimination (Health Promotion, laboratories, pharmacy and surveillance) have a similarly limited workforce. Technical expertise must be reinforced with recruitment of national expertise in the domains of parasitology, epidemiology and entomology. Identification of such professionals and additional training in foreign institutions should be anticipated.

At the operational level, the network of public health structures performs well and is staffed and equipped to manage the few occasional malaria cases effectively. The proficiency of laboratory technicians in malaria diagnosis could probably be improved and reinforced by some recruitment to cope with an increased workload. By contrast, current resources would not allow the Health Delegations to cope with more demanding interventions requiring stringent planning and supervision and numerous operators. Time-consuming operations combining systematic field investigation, active case detection, surveys and focal IRS will be critical for the effectiveness of the elimination programme, and the 35 health technicians available in 2009, who were already busy with multiple tasks, will certainly not be sufficient. Adapted training and recruitment would be required before the interventions necessary for the suppression of transmission in foci could be implemented.

Adequate funding to be secured

Expenditure on health (176 PPP int. $ per capita in 2008) in Cape Verde is considerably higher than that in other African countries but still far below that of high-income countries. The partition of funding sources (86% from domestic resources including 73% from the Government) (Figure 9) seems favourable for sustained funding but the picture may change rapidly in the context of the current financial crisis. Moving to elimination would require additional funding. The estimated cost of the MSP (€2.7 million for 5 years, or €1.1 per capita per year) might underestimate the actual needs for the first five years of an elimination programme when compared with other countries (*37, 38*). The five-year Global Fund grant of US$ 1.325 million provides a fraction of the estimated cost (about US$ 0.53 per capita per year) and extra funding must be secured.

Opportunities for intersectoral and international collaboration to be maximized

The MSP 2009–2013 has been developed in cooperation with all the General Directions and services of the Ministry of Health, with representation from the Ministries of Agriculture, Transport, Decentralization, Defence and Foreign Affairs and the participation of municipalities and NGOs.

Approximately 80 development NGOs and almost 600 community groups are organized into a national platform for Cape Verde. Their continued involvement would be essential for a maximum and sustainable impact. Other opportunities for converging benefits exist with the tourism industry and some private sector companies.

All recent published papers on malaria research in Cape Verde have come from Lisbon's IHTM. Collaboration with the Pasteur institute, the *Université Cheich Anta Diop* and the *Institut de Recherche pour le Développement* based in Dakar may be possible, and the University of Cape Verde might develop some postgraduate curricula – with collaboration from Brazilian or European academic institutions – to foster the development of national research capacities related to malaria in the near future.

Sustained efforts to be anticipated

Twice in its history, Cape Verde has experienced a resurgence in malaria transmission when control efforts were ended abruptly after too short a consolidation period. Lessons based on the evidence of the past 50 years must be fully taken into account if past errors are not to be repeated. Informed engagement by decision-makers and politicians in sequential efforts of indefinite duration will be necessary but must be backed by dynamic intersectoral collaboration as well as the full cooperation of health professionals and civil society.

A meticulous phase of consolidation will need to last for as long as there is evidence of the persistence of small potential residual foci. The pressure to abbreviate such extensive operations, with no apparent immediate benefits, may be difficult to resist. Operational partners may also be reluctant to remain involved in subsequent efforts to maintain elimination.

It is unlikely that malaria will be eliminated in the near future in former Portuguese colonies such as Angola, Guinea Bissau, and Sao Tome and Principe, from where most of the travellers and migrants who carry parasites originate. Experience of cost-effectiveness from other island countries indicates that programmes designed to prevent reintroduction are difficult to justify in the long run *(38)*. Thus, the temptation to interrupt efforts will be great despite the fact that islands with competent vectors remain vulnerable as long as importation of parasites from malaria-endemic countries continues.

CONCLUSION

Cape Verde has interrupted malaria transmission in the past but has not succeeded in consolidating the achievement. Everything indicates that this archipelago of some half a million people is one of the best candidates to achieve elimination within a few years, now that global efforts and resources dedicated to the control of malaria have reached record high levels. However, while the goal of zero local transmission seems very close, there is a need for considerable adaptation and investment over the next 10 years. The epidemiological profile has to be completed and strategies adjusted; operational capacities need to be upgraded, and adequate funding needs to be secured in addition to what has already been committed by the national authorities and through the Global Fund. Opportunities for intersectoral and international collaboration need to be maximized. Above all, a sustained approach must be anticipated: history shows that, once success has been achieved, substantial efforts must be continued indefinitely to prevent reintroduction.

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ANNEX 1: DATA SOURCES AND METHODS APPLIED

The Cape Verde Ministry of Health contacted WHO in February 2008 to assist in the elaboration of a budgeted five-year pre-elimination strategic plan. WHO mobilized an entomologist and an epidemiologist from its West Africa Inter-country Support Team, each of them for 26 days. The process was supported by three successive missions between April 2008 and January 2009, beginning with a situation analysis that included a review of the malaria situation (parasites and vectors), malaria control programme and national capacities. The elaboration of the National Malaria Strategic Plan for Pre-elimination 2009–2013 was followed up at distance, and facilitated in-country by two further missions.

A literature review was carried out, using PubMed (United States National Library of Medicine) and the keywords "malaria" and "Cape Verde". Relevant documents and guidelines published by the Cape Verde Ministry of Health and by WHO were collected and reviewed. In addition, archives of the Instituto de Higiene e Medicina Tropical in Lisbon were searched for publications or reports relating to elimination operations in Cape Verde. Finally, epidemiological data were extracted from available sources and compiled in a spreadsheet file for analysis and for the preparation of diagrams and maps.

ANNEX 2: POPULATION AND DISTRIBUTION OF HEALTH STRUCTURES BY ISLAND AND LOCAL HEALTH AUTHORITY, 2009

The nine inhabited islands are divided into 22 municipalities and 17 Health Delegations (local health authorities), as summarized in Table A2.1 and A2.2.

Table A2.1 Partition of population by island, local health authority and municipality, 2009

Island	Health Delegation	Municipality	Population
Barlavento islands			
Santo Antão	Paul	Paul	8 730
	Porto Novo	Porto Novo	18 480
	Ribeira Grande	Ribeira Grande	21 729
São Vicente	São Vicente	São Vicente	79 681
São Nicolau	São Nicolau	Ribeira Brava de São Nicolau	7 946
		Tarrafal de São Nicolau	4 864
Sal	Sal	Sal	20 041
Boa Vista	Boa Vista	Boa Vista	6 007
Sotavento islands			
Maio	Maio	Maio	8 132
Santiago	Praia	Praia	127 524
		Ribeira Grande de Santiago	9 628
	Santa Catarina	São Salvador Mundo	10 754
		Santa Catarina	47 681
	Santa Cruz	São Lourenço Órgãos	9 120
		Santa Cruz	28 505
	São Domingos	São Domingos	14 323
	São Miguel	São Miguel	17 449
	Tarrafal	Tarrafal	23 103
Fogo	Mosteiros	Mosteiros	9 817
	São Filipe	São Filipe	23 176
		Santa Catarina do Fogo	4 811
Brava	Brava	Brava	6 141
Total			507 642

Source: Relatorio estatistico 2009. Praia, Cape Verde, Ministry of Health, 2010.

Table A2.2 Partition of population and distribution of health services by island and local health authority, 2009

Island	Health Delegation	Pop.	National hospitals	Regional hospitals	Health centres	Health posts	Basic health units
Barlavento islands							
Santo Antão	Paul	8 730			1	2	4
	Porto Novo	18 480			1	4	15
	Ribeira Grande	21 729		1		5	8
São Vicente	São Vicente	79 681	1		5		3
São Nicolau	São Nicolau	12 810			2	3	10
Sal	Sal	20 041			2		2
Boa Vista	Boa Vista	6 007			1	1	5
Sotavento islands							
Maio	Maio	7 541			1	2	3
Santiago	Praia	123 654	1		7	2	9
	Santa Catarina	14 323		1	2	4	9
	Santa Cruz	58 435			2	3	9
	São Domingos	37 625			1	1	10
	São Miguel	23 103			1	1	6
	Tarrafal	17 449			1	2	7
Fogo	Mosteiros	9 817			1		4
	São Filipe	27 987		1	1	2	6
Brava	Brava	6 141			1	2	2
Total			2	3	30	34	113

Source: *Relatorio estatistico 2009*. Praia, Cape Verde, Ministry of Health, 2010.

ANNEX 3: DEVELOPMENT AND HEALTH PROFILE

All data in the following table are taken from *World Health Statistics 2011* (Geneva, World Health Organization, 2011, available at: http://www.who.int/whosis/whostat/2011/en/index.html) except 2009 data on tuberculosis and HIV incidence and prevalence, which come from *Relatorio estatistico 2009* (Praia, Cape Verde, Ministry of Health, 2010).

Indicators	Value	Units	Year
Gross national product per capita	3 530	PPP Int US$	2009
Per capita total expenditure on health	176	PPP Int US$	2008
General government expenditure on health as % of total expenditure on health	73	%	2008
General government expenditure on health as % of total government expenditure	10	%	2008
External resources for health as % of total expenditure on health	14	%	2008
Human Development Index (rank)	118	/169	2010
Life expectancy at birth	71	years	2009
Density of physicians	5.7	/10 000 pop.	2010
Hospital beds	21	/10 000 pop.	2010
Millennium Development Goals			
U5 mortality rate	27	/1 000 live births	2009
DTP3 Immunization 1-year-olds	99	%	2009
Measles Immunization 1-year-olds	96	%	2009
Infant mortality rate	23	/1 000 live births	2009
Maternal mortality ratio	94	/100 000 live births	2008
ANC coverage	98	% 1+ visit	2010
Births attended by skilled personnel	78	%	2010
Fertility rate	2.7	per woman	2009
Contraceptive prevalence	61	%	2010
Net primary school enrolment rate	84	%	2008
Adult literacy rate	84	%	2008
Population with drinking water	84	%	2008
Population with improved sanitation	54	%	2008
Estimated prevalence of tuberculosis	227	/100 000 pop.	2009
Reported prevalence of tuberculosis	69	/100 000 pop.	2009
Reported incidence of tuberculosis	52	/100 000 pop.	2009
Reported treatment success rate	72	%	2009
HIV detection rate	63	/100 000 pop.	2009
HIV mortality rate	14	/100 000 pop.	2009
Estimated prevalence of HIV among adults 15–49 years	-	%	

ANNEX 4: PARASITES AND VECTORS

Parasites – major *Plasmodium* species

A survey carried out on Santiago in 1962 revealed that *Plasmodium vivax* accounted for up to 20% of infections in some districts; a few cases of *P. malariae* also occurred *(1)*. During the 1978 epidemic on Santiago, almost one-third of cases were due to *P. vivax (2)*. Surprisingly, *P. falciparum* has been the only species described since 1994, including in surveys performed during more recent outbreaks *(3–5)*.

Frequent chloroquine resistance was already suspected in 1995 during an isolated outbreak of *P. falciparum (4)*. It was later confirmed by the high frequencies of the molecular marker associated with chloroquine resistance that were found in isolates from Santiago *(5)*.

Vectors – major *Anopheles* species

The *Anopheles pretoriensis* species has been regularly found on every island of Cape Verde but has never shown any vectorial capacity *(6)*. The only member of the *An. gambiae* complex described so far on the archipelago is *An. arabiensis*, which is considered to be the only vector *(7)*; this is consistent with the Sahelian conditions prevailing in the archipelago, as *An. arabiensis* is the most tolerant member of the *An. gambiae* complex to aridity *(8)*.

It is likely that the distribution of *An. arabiensis* in the archipelago has varied considerably over time. After eradication efforts ceased in 1969, the vector was considered to be absent from all islands except Santiago. Since then, however, it has reinvaded other islands, as described in the notes from a 1977 countrywide survey of the mosquito fauna in Cape Verde *(6)*. In 1983 and 2006, routine surveillance operations were carried out in seven of the nine inhabited islands (excluding Santo Antão and Brava); *An. arabiensis* was detected on all islands except Sal *(9)*. The most recent entomological survey was carried out in 2007 on the four islands of the Sotavento group: Maio, Santiago, Fogo and Brava *(9)*. In this study, *An. arabiensis* was found only on Santiago (see Table A4.1). It can be concluded that, for the time being, only Sal and Brava are still free of vector and therefore not receptive to malaria *(9)*.

During the most recent entomological surveys on Santiago, *An. arabiensis* larvae were easily collected in both wet and dry seasons, which suggests that low-level malaria transmission might be possible throughout the year. By contrast, capture of adult mosquitoes proved very challenging, despite the use of a variety of collection methods *(10, 11)*.

Table A4.1 Distribution of the vector *Anopheles arabiensis* by island

Island	Presence of *An. arabiensis*[a]		
	1977 (ref. 6)	1983–2006 (ref. 9)	2007 (ref. 9)
Barlavento Islands			
Santo Antão	0	NA	NA
São Vicente	0	+	NA
São Nicolau	0	+	NA
Sal	0	0	NA
Boa Vista	0	+	NA
Sotavento Islands			
Maio	+	+	0
Santiago	+	+	+
Fogo	0	+	0
Brava	0	NA	0

Derived from reference 9.

a. + : presence of the vector is noted; 0 : absence of the vector is noted.

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ANNEX 5: NUMBER OF CASES BY ISLAND AND LOCAL HEALTH DELEGATION, 1996–2009

Island or Health Delegation	Annual number of cases reported [a]																												Total	
	1996		1997		1998		1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009			
	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I	L	I
Santiago[b]:	56	23	6	12	14	29	84	7	132	10	102	7	11	8	46	18	34	12	55	13	62	13	2	7	20	18	35	12	659	189
Praia	2	18	5	10	7	21	27	6	6	5	95	7	11	7	38	15	25	10	47	12	49	12	2	5	20	18	27	11	361	157
São Domingos											2																		2	0
São Miguel																					3	1							3	1
Santa Catarina	49	3	1	1	7	7	57	1	118	4	3				2	2	3	2	3	1	10			2			5	1	258	24
Santa Cruz		2		1					8		2			1	6	1	6		5							3		30	5
Tarrafal	5					1				1																			5	2
Boa Vista															4	1											10	3	14	4
Brava																													0	0
Fogo																													0	1
Maio																													0	0
Sal																1						3		1		3		1	0	9
Santo Antão																				1		1		3		1		1	0	7
São Nicolau																													0	0
São Vicente		1		2		3						8										1		4		3		2	0	24
Total	56	24	6	14	14	32	84	7	132	10	102	15	11	8	50	20	34	13	55	14	62	18	2	15	20	25	45	19	673	234

a. Cases were classified as Locally acquired (L) or Imported (I).

b. Santiago island is divided into six Health Delegations.

ANNEX 6: FORM USED FOR INDIVIDUAL CASE NOTIFICATION AND FOLLOW-UP

Note: Translations (in italics) have been added to the form for clarity.

<table>
<tr><td colspan="3">Nome: Name:</td><td>Registro: Register number:</td></tr>
<tr><td>Sexo: Sex:</td><td>Idade: Age:</td><td>Estado civil: Civil status:</td><td>Se mulher, está gestante?
If a woman, are you pregnant?</td></tr>
<tr><td colspan="4">Endereço completo: Full address:</td></tr>
<tr><td colspan="2">Local de nascimento: Place of birth:</td><td colspan="2">Local de procedência: Place of origin:</td></tr>
<tr><td colspan="2">Quantos paludismos já teve?
How many malaria attacks have you had?</td><td colspan="2">Quando foi o último paludismo?
When was the last time you had malaria?</td></tr>
<tr><td colspan="2">Medicamentos usados no último paludismo:
Drugs used for the last malaria attack:</td><td colspan="2">Há quantos dias se iniciaram os sintomas?
How many days is it since symptoms began?</td></tr>
<tr><td colspan="4">Sintomas antes do tratamento deste paludismo: Symptoms before treatment:
( ) febre fever ( ) dor de cabeça Headache ( ) calafrio chills ( ) vómitos vomiting
( ) urina escura dark urine ( ) diarreia ou disenteria diarrhoea or dysentery
( ) olhos amarelados jaundice (yellow eyes)</td></tr>
<tr><td colspan="3">Resultado do exame: Test results
( ) Plasmodium falciparum ( ) P. falciparum + P. vivax
( ) Plasmodium vivax ( ) Outro: Other:</td><td>Parasitemia: Parasitaemia:</td></tr>
<tr><td colspan="2">Data do início do tratamento: / /
Treatment start date: / /</td><td colspan="2">Medicamentos prescritos: Drugs prescribed:</td></tr>
</table>

Despistagem activa de contactantes ou pessoas próximas:
Active case detection among contacts or close relatives:

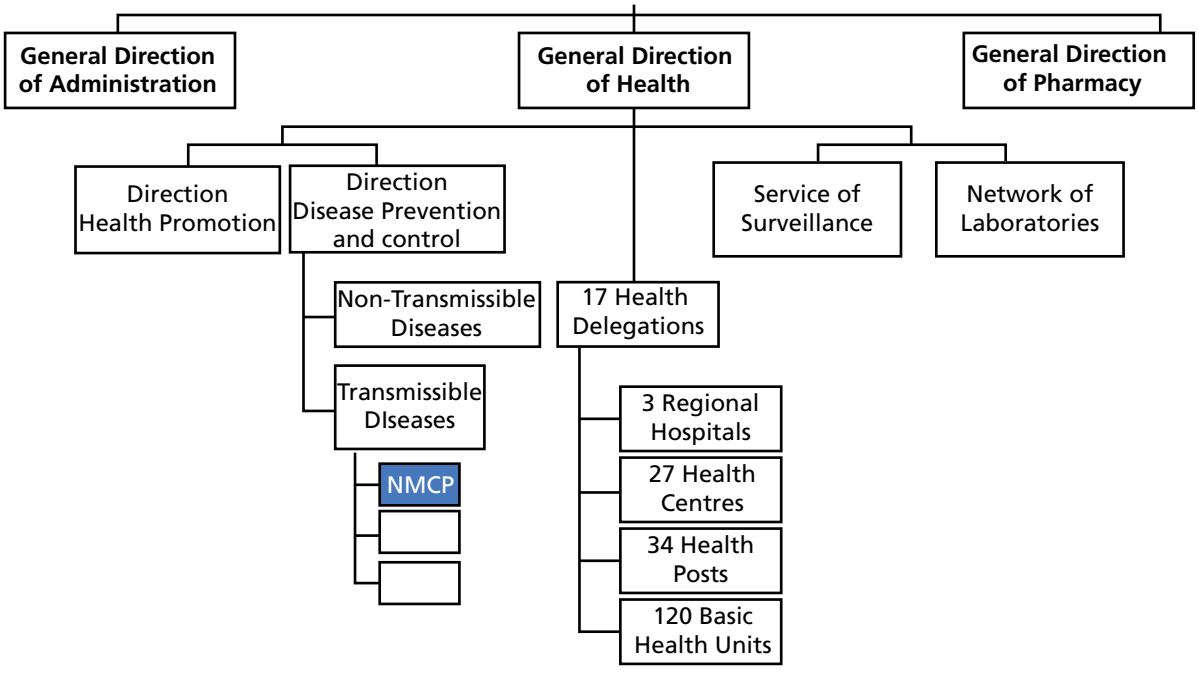
Nº de casas visitadas: **Nº de depistagens realizadas:** **Nº de casos positivos:**
No. of houses visited: *No. of tests performed:* *No. of positive cases:*

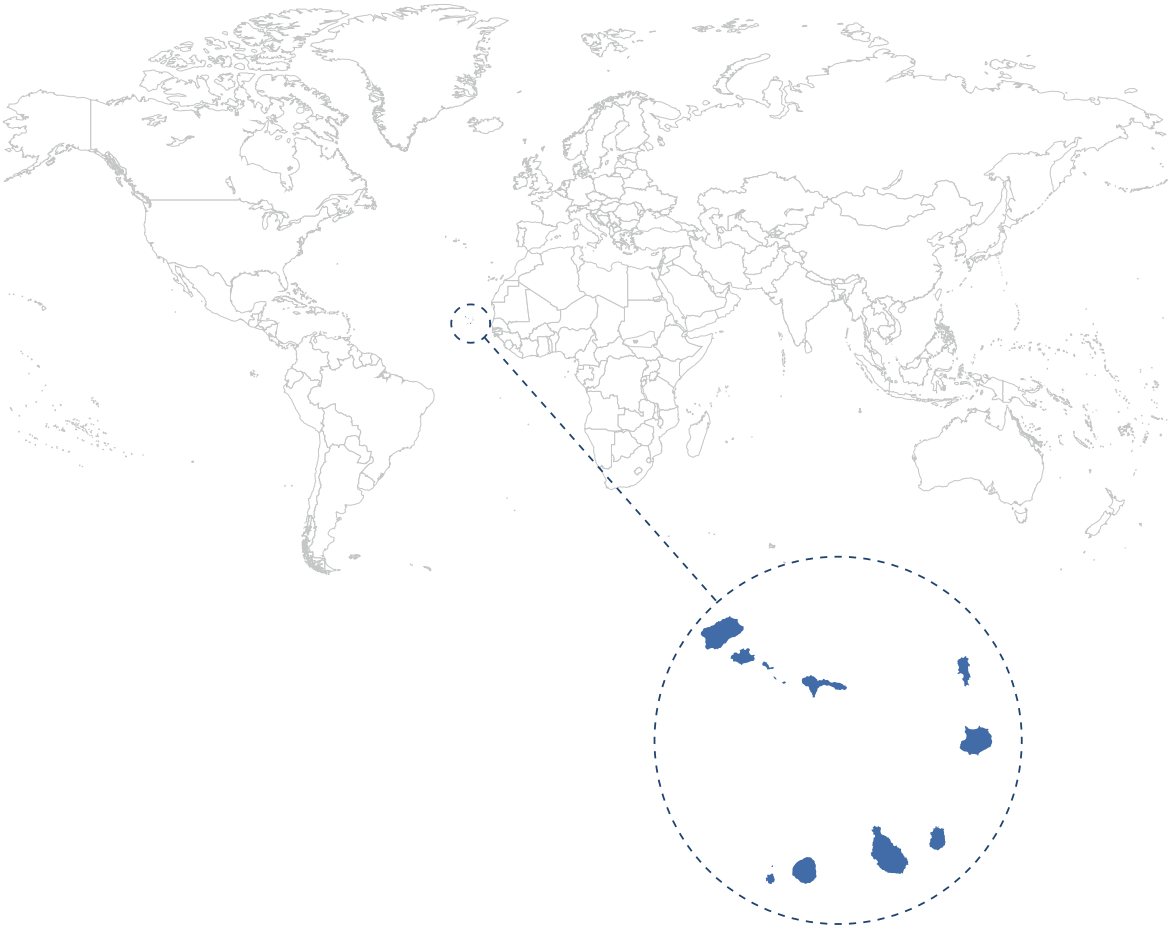
Delegacia de Saúde:
Health Delegation:

Aos: *Date of completion of form:* _____/_____/20___

O Responsável: *Responsible officer:*

ANNEX 7: STRUCTURE OF THE MINISTRY OF HEALTH





This case-study is part of a series of malaria elimination case-studies conducted by the World Health Organization (WHO) Global Malaria Programme and the University of California, San Francisco (UCSF), Global Health Group. The case-studies series documents the experience gained in eliminating malaria in a range of geographical and transmission settings with the aim of drawing lessons for countries that are embarking upon elimination.

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