ELIMINATING MALARIA

Case-study 5

The long road to malaria elimination in Turkey

UCSF GLOBAL HEALTH SCIENCES
THE GLOBAL HEALTH GROUP
From evidence to action

Republic of Turkey
Ministry of Health

World Health Organization

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The authors remain responsible for any errors and omissions.

ACRONYMS AND ABBREVIATIONS

ABER	annual blood examination rate
ACD	active case detection
CFR	case-fatality rate
CISID	Centralized Information System for Infectious Diseases
GDP	gross domestic product
DDT	dichlorodiphenyltrichloroethane
GMEP	Global Malaria Eradication Programme
IRS	indoor residual spraying
MDA	mass drug administration
MEP	malaria eradication programme
MOH	Ministry of Health
NMCP	national malaria control programme
NMES	national malaria eradication service
OECD	Organisation for Economic Co-operation and Development
PCD	passive case detection
PPP	purchasing power parity
QA	quality assurance
RBM	Roll Back Malaria
SAP	Southeastern Anatolian Project
SPR	slide positivity rate
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
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.

attack phase

In malaria eradication terminology, the phase during which antimalarial measures applicable on a large scale and aiming at the interruption of transmission are applied on a total coverage basis in an operational area. The phase is sometimes called the period of total-coverage spraying.[1]

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 whose origin 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.

1 *Terminology of malaria and of malaria eradication*. World Health Organization, Geneva, 1963

induced – A case whose origin 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.

consolidation phase

In malaria eradication terminology, the phase that follows the attack phase; it is characterized by active, intense and complete surveillance with the object of eliminating any remaining infections and proving the eradication of malaria. It ends when the criteria for eradication have been met.[1]

elimination

Reduction to zero of the incidence of infection by human malaria parasites in a defined geographical area and 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.

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1 *Terminology of malaria and of malaria eradication: report of a drafting committee* Geneva, World Health Organization, 1963.

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 infection with *Plasmodium 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.

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 focus

A defined and circumscribed locality situated in a currently or formerly malarious area and containing the continuous or intermittent epidemiological factors necessary for malaria transmission: a human community, at least one source of infection, a vector population and the appropriate environmental conditions.

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.

radical treatment

Treatment adequate to achieve radical cure. In *vivax* and *ovale* infections, this implies the use of drugs that destroy the hypnozoites (usually a combination of chloroquine for 3 days and primaquine for 14 days).

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*).

relapsing case

A case contracted locally some time ago (maximum admissible period is equal to the natural life-span of *P. vivax* or *P. ovale* in the human host) or a recrudescence of *P. falciparum* or *P. malariae* after a period of unrecognized latency.[1]

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 for *Plasmodium* 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 identification, investigation and elimination of continuing transmission, prevention and cure of infections, and final substantiation of malaria 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.

1 *Guidelines on the elimination of residual foci of malaria transmission.* Cairo, WHO Regional Office for the Eastern Mediterranean, 2007 (EMRO Technical Publications Series, No. 33).

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 describes the history of malaria in Turkey up to 2011 and evaluates the policies and strategies used for malaria control and elimination. It highlights the successive interventions that have been applied to achieve a dramatic reduction in the malaria burden, to control epidemics, and to limit malaria transmission to a very low level in a few foci in the south-east of the country. It also analyses the challenges that have prevented a sustainable interruption of malaria transmission. Turkey is now in an elimination stage, and reported only four relapsing cases in 2011. The case-study pays particular attention to current policies and operations. Lessons for countries that are embarking upon elimination are distilled.

History of malaria and malaria control

In the past, three *Plasmodium* species – *P. vivax*, *P. falciparum* and *P. malariae* – could be found in Turkey, with *P. vivax* predominating. Since 1970, *P. vivax* has been the only parasite species transmitted locally. Efforts to control malaria in Turkey, where the disease was once common and widespread, began early. The first nationwide malaria control campaign was launched in 1926 but achieved no significant results, largely due to the lack of efficient anti-mosquito tools at that time. The outbreak of the Second World War also hindered the campaign.

In 1946, the Directorate of Malaria Control was set up under the Ministry of Health and Social Assistance to coordinate activities nationwide. This led to the creation of a vertical national malaria network and to significant human capacity building to meet the needs of a large national programme. Following the introduction of dichlorodiphenyltrichloroethane, commonly known as DDT, in 1946, malaria control operations were scaled up and expanded. The use of this insecticide in a massive residual spraying campaign throughout the country radically reduced the malaria burden and, by 1956, it had achieved interruption of local transmission in a large part of the country. Well-organized and comprehensive interventions nationwide were the key to these positive results. Residual spraying with DDT was probably the most important contributor to the decline in malaria incidence in Turkey, dramatically lowering transmission levels. However, it is probable that population screening and active case detection, via household visits in rural areas, did much to reduce sources of infection and to provide information on the malaria situation in endemic areas.

The effectiveness of these malaria control activities encouraged the formation of a national malaria eradication programme in 1957[1] and it was expected that malaria eradication would be achieved by 1966. From 1958 to 1962, 7.2 million people were targeted in an attack phase. The programme benefited greatly from an integrated approach that prioritized vector control, but which combined this with surveillance operations conducted in line with WHO recommendations *(1)*. Turkey established malaria surveillance in 1957, with the start of the eradication programme – and more than

1 While the terminology in use at the time resulted in the programme in Turkey being called the national malaria eradication programme, this term is currently reserved to mean 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. In today's terminology, the word "elimination" would have been used instead.

17 million of the population were under surveillance by 1962. Having surveillance agents included in the programme allowed active case detection (ACD) through house-to-house visits, as well as investigation of cases and foci, and treatment of infected individuals. In addition, all malaria cases were laboratory confirmed. Together, these activities succeeded in improving case detection and eliminating sources of infection. Notification of cases (made obligatory in 1930), recording and reporting provided a good supply of information, which could subsequently be used for analysis and decision-making.

An ambitious insecticide spraying campaign achieved coverage of 93–96% of the population by 1963, and between 1966 and 1969 many provinces shifted to a consolidation phase with only residual foci being sprayed. Insecticide spraying was complemented by intensive larviciding and environmental management. These interventions led to a substantial reduction in both the mosquito population and transmission.

The progress made by the malaria eradication programme in dramatically reducing the disease burden meant that, by the end of 1974, 93% of the country was in a consolidation phase. Transmission of *P. vivax* had been limited to focal areas in the south-east of the country and that of *P. falciparum* and *P. malariae* had been interrupted completely. The programme, however, had not met its goal of eliminating malaria in Turkey by 1966 and the programme was therefore extended. Failure to interrupt transmission in the south-eastern parts of the country was primarily a consequence of high receptivity. Various irrigation schemes in those areas had created good breeding places for mosquitoes, and local vectors showed early resistance to the insecticides applied. In addition, understaffing in some areas compromised the coverage and performance of spraying and surveillance operations.

In the following years, a number of important changes in receptivity and vulnerability in southern and south-eastern Turkey took place. These were not addressed with sufficient urgency and contributed to the outbreak of two serious *P. vivax* epidemics in southern Turkey, the first in 1977 and the second from 1993-1996. A number of conditions developed that favoured these malaria epidemics by increasing the parasite reservoir including: an intensive agricultural development scheme, whose allied irrigation projects (the Southeastern Anatolian Project) created good breeding sites for mosquitoes; the wide use of pesticides that led to early vector resistance; and the massive influx of labourers (who functioned as parasite carriers). Agricultural and industrial expansion led to mass migration of the population from remote, often rural, endemic south-eastern areas to the Adana region (1977 epidemic) and to provincial and district towns in Anatolia (1993–1996 epidemic). In addition, there was continual migration and importation of cases from neighbouring countries, notably from Iraq (1977 epidemic) and subsequently, as a result of political instability and the Gulf War, from the Islamic Republic of Iran, the Syrian Arab Republic, and again from Iraq (1993–1996 epidemic). Factors related to implementing the malaria eradication programme also had a negative impact on results. In the 1970s, for example, attack measures were carried out on a reduced scale in some areas, and a shortage of health facilities, coupled with inadequate staffing, especially in large rural areas of south-east Turkey, seriously limited access to medical care.

Control of the epidemics

Containment of both the 1977 and the 1993-96 epidemics required complex interventions, coordinated by the national malaria network, and with mobile teams of specialists assigned to the affected areas. Elements of the efficient, integrated approach included the following measures.

- Vector control operations designed to rapidly reduce the mosquito population density using a combination of:
  - indoor residual spraying (IRS);
  - thermal fogging and ultra-low volume applications;

- chemical larviciding operations, primarily in and around urban centres;
- large-scale distribution of larvivorous fish (*Gambusia affinis*);
- environmental management (cleaning of drainage canals).

- Surveillance operations designed to reduce sources of infection by:
  - prompt identification of cases through both active case detection (two-weekly household rounds with screening of febrile persons in high-risk areas and among resettlers and immigrants, as well as household visits and mass blood surveys among residents of affected villages and co-workers of identified malaria cases), and passive case detection (malaria examination of febrile patients seeking medical attention);
  - prompt and comprehensive investigation of every case enabling the detection and timely treatment of further cases linked to the index case, as well as the definition of the population at risk of malaria transmission;
  - notification of each case to (NMCP);
  - radical treatment of malaria patients (with chloroquine and primaquine), with inter-seasonal retreatment with primaquine (15mg/day for 14 days) of all positive cases microscopically confirmed in the previous year (possible clinical relapses).
- Malaria prevention measures among receptive populations in the foci and in the most receptive areas – mass drug administration (chloroquine and pyrimethamine at two-week intervals) plus intensive health education.

Programme transition to malaria elimination

In 2005, the decision was taken to interrupt indigenous transmission of all human *Plasmodium* species within the country by 2015, in line with the Tashkent Declaration target of interrupting malaria transmission throughout the WHO European Region by 2015.

While the first eradication campaign (1956–1974) started with an ambitious attack phase, with interventions covering the whole country and priority given to IRS, elimination operations from 2005 were directed at limited areas in south-eastern Turkey where the last active foci were located. Priority was given to scaled-up, epidemiological, case-based surveillance, while IRS was limited largely to active foci. Countrywide vigilance was maintained. These renewed efforts led rapidly to a reduction in the number of autochthonous cases and active foci: the last indigenous cases were officially reported in 2009.

The malaria elimination programme adopted a comprehensive and integrated approach, directing interventions to the main components of the epidemiological process – source of infection, mode of transmission and receptive population. Its principal strategies, used both in the past and currently, can be summarized as follows:

- Particular focus on timely detection of malaria cases in high risk areas, with pro-active case detection through household visits to undertake fever screening every two weeks, including reactive screening of contacts of newly detected cases;
- Prompt treatment for all malaria patients (*P. vivax* malaria with chloroquine and primaquine, and of imported *P. falciparum* malaria with artemisinin-based combination therapy, mefloquine or a quinine/tetracycline combination);
- Inter-seasonal retreatment of *P. vivax* cases identified the previous year with primaquine (15mg/day for 14 days)

These interventions contribute significantly to the early detection of cases and thus to timely elimination of sources of infection and limitation of local transmission. Comprehensive case investigations, which lead to early identification of all new active and potential foci, allow appropriate planning and implementation

of control measures. Processing of information by the national malaria control programme network provides timely case registration and notification of laboratory-confirmed malaria cases and a regular flow of information.

- Integrated vector control activities are guided by the results of foci investigations and programme staff focus on reducing and preventing transmission in residual or new active foci by full IRS coverage. There is widespread use of larviciding and environmental management, with the latter being of particular significance in large irrigation scheme areas. Entomological surveillance is particularly focused on the risk areas of south-east Turkey.

The national malaria control programme network plays a leading role in all malaria interventions. Primary health care services and other institutions play an integral part in programme interventions and the existence of this specialized network appears to have been a critical factor in achievement of the goals.

The malaria programme has strong laboratory support, which is crucial for achieving elimination. Every clinical malaria case is confirmed by testing in quality-controlled laboratories, supervised by a national reference laboratory.

There is high-level political commitment to the national malaria programme. Malaria control and elimination interventions are supported and endorsed by the Ministry of Health, and have been adequately funded, primarily by the Government. There has also been substantial and longstanding international support. Continuing financial and technical assistance was provided by WHO to help Turkey move towards its declared elimination goals, including periodic evaluations of programme progress and the development of strategies, plans and guidelines. Other international organizations, including the United Nations Children's Fund (UNICEF) and the European Economic Community, also provided substantial financial support for the fight against malaria over the years.

Outlook for the future

Turkey has made enormous progress towards malaria elimination. In addition to strong political commitment and sustainable governmental financial support, the country has the operational and technical capacity required to maintain results and achieve elimination of the disease. From its past experience, Turkey has learnt that any neglect of malaria interventions going forward could still result in a rapid resurgence of malaria, requiring huge renewed effort and substantial financial support.

Going forward, continued monitoring of receptivity and vulnerability will be a prerequisite for the prevention of a resurgence of malaria in Turkey, notably in the area covered by the Southeastern Anatolian Project. In certain areas of the country receptivity remains high, as does vulnerability. As such, there will be a clear need to maintain a robust level of malaria vigilance. Maintaining epidemiological surveillance of malaria to ensure the prompt detection and treatment of cases, as well as a timely response to any emergency, will also be important. The significance of these antimalarial activities was demonstrated in 2012 when, as a result of *P. vivax* importation by lorry drivers coming to Turkey from endemic countries, and of a delay in the recognition of index cases, a malaria outbreak was registered in the province of Mardin, with 208 introduced and indigenous cases. By mobilizing the malaria network and general health services, and by conducting a massive scale-up of control and surveillance interventions, the national malaria programme achieved a prompt containment of the outbreak.

Finally, the sustainability of the results achieved thus far remains highly dependent on continued financial support for malaria activities, as well as on maintaining the skilled personnel required to prevent resurgence of malaria in Turkey in the coming years.

Maintaining stable results in the fight against malaria and achieving elimination of the disease will contribute to the economic and social development of Turkey, especially in the south-eastern part of the country.

INTRODUCTION

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 regarding progress towards the goal of zero local transmission from a wide range geographical settings and approaches to elimination.

Turkey was selected for a malaria elimination case-study because of its tremendous progress in malaria control and elimination in recent years, and because details of the country's successful fight against malaria have not hitherto been available in the public domain. The main authors of the case-study have been closely involved in Turkey's national malaria elimination efforts over the past two decades.

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

Malaria in the WHO European Region

After the remarkable success of the WHO Global Malaria Eradication Programme that was launched in 1955, including the achievement of malaria-free status in almost all countries of the WHO European Region, the malaria situation deteriorated in the 1990s. There was a massive resurgence of malaria in areas of Central Asia and the Transcaucasian countries of the WHO European Region; the disease assumed epidemic proportions in Tajikistan and Turkey. The deterioration in the countries of Central Asia and the Caucasus was the result of changes in political and economic conditions, the post-Soviet economic collapse, military conflicts, mass population migration, extensive development projects, degradation of the public health system, and the near or complete discontinuation of malaria prevention and control activities (2–7).

The malaria-affected Member States of the WHO European Region joined the Roll Back Malaria (RBM) initiative launched by the United Nations Children's Fund (UNICEF), the United Nations Development Programme (UNDP), WHO, and the World Bank in 1998; with rapid scale-up and sustained efforts, they achieved a marked reduction in the levels of transmission and of malaria morbidity *(8, 9)*. In 2005, these countries all endorsed the Tashkent Declaration, *The Move from Malaria Control to Elimination (10)*. A new regional elimination strategy was put in place, with the ultimate goal of interruption of *P. falciparum* malaria

transmission in Central Asia by 2010 and elimination of local transmission of malaria in the entire WHO European Region by 2015 *(11)*.

In 2007, the WHO European Region held a meeting in Ashgabat, Turkmenistan, to assess the progress achieved towards malaria elimination *(12)*. Steady progress was reported for the entire Region, including a 14-fold reduction in the reported overall number of malaria cases – from 37 173 to 2679 – during the period 1999–2006, and a reduction in *P. falciparum* transmission, with the annual number of local cases in Tajikistan falling from a peak of 831 in 2000 to 28 in 2006 *(12, 13)*. It was concluded that all countries affected by autochthonous malaria would be able to proceed with malaria elimination as planned and that, by 2010, Armenia and Turkmenistan would be able to achieve elimination of *P. vivax* transmission, and Tajikistan elimination of *P. falciparum* transmission.

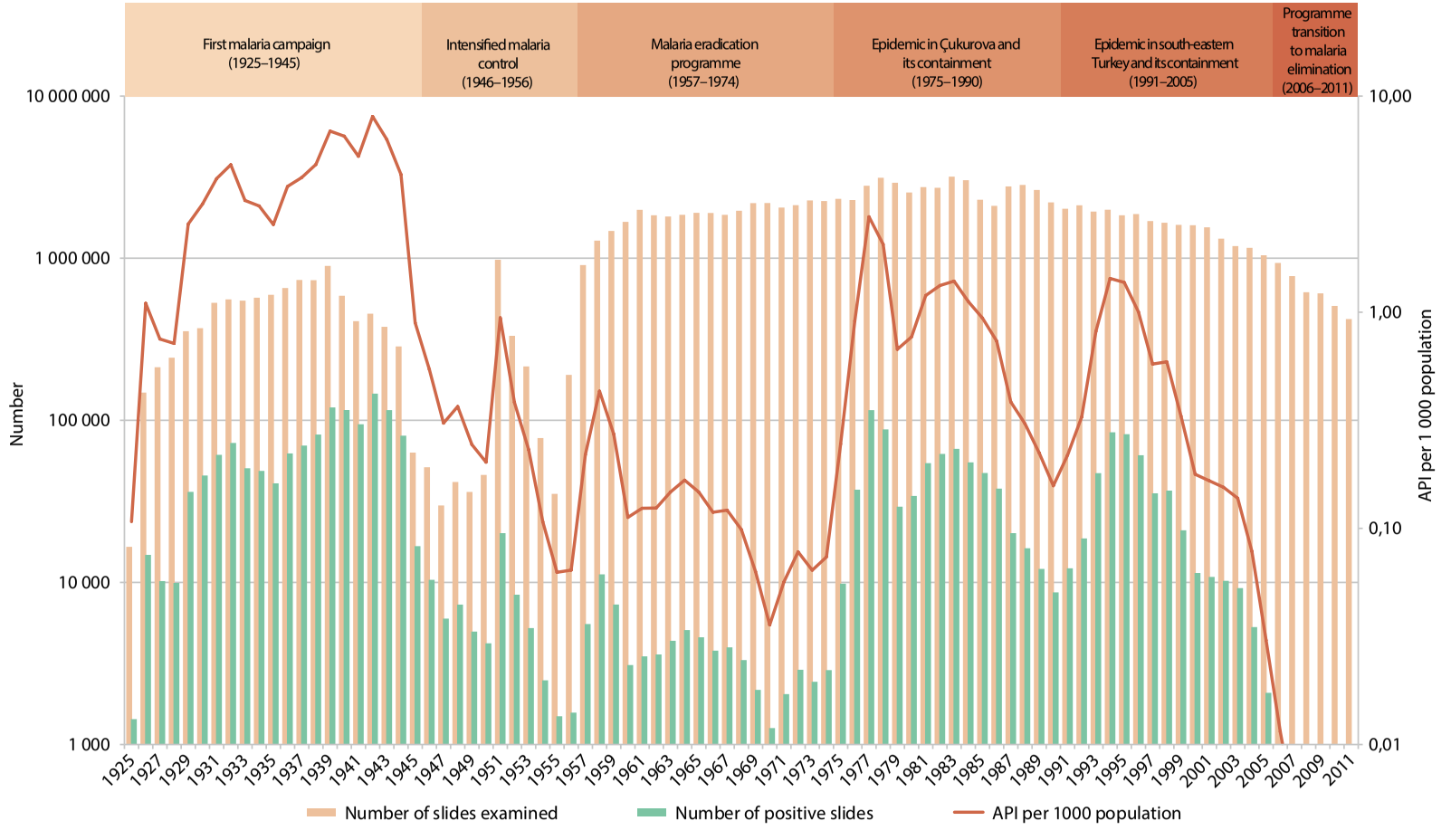
The scaling up of malaria control efforts in the WHO European Region has indeed resulted in progress towards malaria elimination as planned, made possible by long-term and reliable funding, close cross-border collaboration, and wide-scale coverage with interventions, including strengthened surveillance and monitoring. Only 58 indigenous malaria cases were reported in 2011, down from the peak of 90 712 cases in 1995. Armenia and Turkmenistan have achieved WHO certification of their malaria-free status, and the last case of autochthonous *P. falciparum* malaria in the Region was reported in 2008 *(13, 14)*.

Malaria in Turkey

Malaria in Turkey used to be highly endemic, and the country has a long history of fighting the disease, launching its first malaria control campaign in 1926 (Figure 1). Following the Second World War (1939–1945), malaria control interventions were intensified and expanded based on the use of new tools – especially DDT. This led to a dramatic decline in the malaria burden by the 1950s (Figure 1). A national malaria eradication programme was launched in 1957 and succeeded in reducing the area affected by local malaria transmission to a few provinces in south-east Turkey. However, the final goal of eliminating local transmission nationwide was not yet achieved, and major epidemics ensued in the 1970s and 1990s. In 2005, the decision was taken to engage in renewed elimination efforts, in line with other endemic countries in the WHO European Region. Turkey's strong political commitment was backed up by the necessary operational and technical capacity to achieve interruption of transmission and maintain results. In 2011 Turkey officially reported only four relapsing cases.

This case-study presents an analysis and evaluation of the malaria situation in Turkey over the course of almost a century. It covers the country's periods of malaria control and malaria eradication, when there were dramatic falls in the burden and geographical distribution of malaria. It also covers the containment of outbreaks and the process of transition to malaria elimination. It analyses the reasons for the deterioration of the malaria situation in the late 1970s, evaluates the strategies, policies and main interventions used over time, and distils best practices in epidemiological surveillance and control, and lessons learnt. The case-study describes an example of contemporary, evidence-based elimination strategies and policies designed to achieve zero indigenous malaria cases. It highlights the strong political commitment and the mobilization of human resources needed for such progress in malaria elimination.

Figure 1. A century of malaria control in Turkey



Sources: national malaria control programme; EURO, Centralized Information System for Infectious Diseases (CISID), available at: http://data.euro.who.int/cisid/?TabID=266677

COUNTRY BACKGROUND

Geography, population and economy

Turkey is a Eurasian country that stretches across the Anatolian peninsula in western Asia and Thrace in the Balkan region of south-eastern Europe. Asian Turkey (made up largely of Anatolia) includes 97% of the country, and European Turkey (eastern Thrace or Rumelia in the Balkan Peninsula) just 3% *(15)*.

Turkey has land borders with eight countries: Bulgaria; Greece; Georgia; Armenia; Azerbaijan (the enclave of Nakhchivan); the Islamic Republic of Iran; Iraq; and the Syrian Arab Republic. The Mediterranean Sea and Cyprus are to the south, the Aegean Sea to the west and the Black Sea to the north. The Sea of Marmara, the Bosporus and the Dardanelles (which together form the Turkish Straits) demarcate the boundary between eastern Thrace and Anatolia; they also separate continental Europe and Asia. Turkey's location at the crossroads of Europe and Asia gives it significant geostrategic importance *(16)*.

Turkey covers 783 562 km^2, making it the world's 37th largest country in terms of area, The Asian part of the country, Anatolia, consists of a high central plateau with narrow coastal plains. Almost the whole of eastern Turkey is covered by high mountains; only at the border with Iraq and the Syrian Arab Republic are there lowlands – the Tigris/Euphrates basin. Typical of the landscape are small, short rivers, originating in the mountains and flowing down to the sea.

The country's climate varies between regions: the Aegean and Mediterranean coasts have a temperate Mediterranean climate; the Black Sea coast has a temperate oceanic climate and is the only region of Turkey to get high precipitation throughout the year; and the Sea of Marmara and its coastline has a transitional climate. Conditions can be much harsher in the more arid interior. Mountains close to the coast prevent Mediterranean influences from extending inland, giving the central Anatolian plateau of the interior of Turkey a continental climate with sharply contrasting seasons. Temperatures of −30°C to −40°C can occur in the winter in eastern Anatolia, while summer temperatures generally exceed 30°C *(17)*.

Turkey's population was estimated at 73 640 million in 2011 and has an annual growth rate of 1.3% (18,19). Some key characteristics of the population of Turkey are presented in Annex 2, while Annex 3 details the country's administrative divisions and political organization.

Turkey is an upper-middle-income country *(19)*; it has the world's 15th largest gross domestic product (GDP) by purchasing power parity (PPP) and 17th largest nominal GDP Economic reforms that were started in 1983 resulted in Turkey becoming one of the fastest-growing economies in the world in 2002–2007 with an average GDP growth rate of 7%. In 2010, GDP growth rate was estimated to be 8% *(20)*. The country is among the founding members of the Organisation for Economic Co-operation and Development (OECD) and the G20 major economies. More details on Turkey's economy are presented in Annex 4.

Health system and population health profile

Health care and related social welfare activities are the responsibility of the Ministry of Health, which is responsible for medical care and preventive health services. This includes hospitals, pharmacies and other public health care centres, as well as private health facilities. It regulates drug prices, controls drug production and supervises all medical and

health care personnel in the public sector *(21)*.

The Health Transformation Programme launched in 2003 strengthened governance of the health system, introduced universal coverage, and expanded and streamlined service delivery *(22)*.

Health system and economic indicators for 2008–2010 are presented in Tables 1 and 2. The WHO population health profile for Turkey is presented in Table 3. Annex 5 provides more information on the health system and population health profile of Turkey.

Table 1. Main indicators of health economics in 2008-2010

Indicator	Values by year		
	2008	2009	2010
General government expenditure on health as a percentage of total government expenditure	12.8	12.8	12.8
Per capita government expenditure on health at average exchange rate (US$)	455	432	510
Per capita government expenditure on health (PPP int. $)	909	957	1029
Total expenditure on health as a percentage of gross domestic product	6.1	6.7	6.7
Private expenditure on health as a percentage of total expenditure on health	27	25.9	24.8
Out-of-pocket expenditure as a percentage of private expenditure on health	64.4	64.4	64.4
Social security expenditure on health as a percentage of general government expenditure on health	60.1	60.1	60.1

Source: reference 18

Table 2. Health system indicators, 2008-2011

Indicator	Values by year			
	2008	2009	2010	2011
Number of physicians	110 482	118 641	123 447	126 029
Physician density (per 10 000 population)	14.31	15.38	16.7	16.9
Number of nursing and midwifery personnel	144 229	49 357	165 115	176 887
Hospital beds (per 10 000 population)	24	25	27.1	26.0
Dentistry personnel density (per 10 000 population)	2.36	2.67	2.9	2.8

Source: reference 18, 24-25

Table 3. Health indicators according to WHO (2009 and 2010)

Indicator	Values by year	
	2009	2010
Life expectancy at birth (years)	75	–
Infant mortality rate (probability of dying between birth and age 1 year per 1000 live births)	–	12
Under-five mortality rate (probability of dying by age 5 years per 1000 live births)	–	13
Adult mortality rate (probability of dying between 15 and 60 years per 1000 population)	104	–

Source: reference 18

HISTORY OF MALARIA AND MALARIA CONTROL

Parasites and vectors

In the past, three *Plasmodium* species – *P. vivax*, *P. falciparum* and *P. malariae* – could all be found in Turkey, with *P. vivax* being the prevailing species. Since 1970, however, *P. vivax* has been the only parasite species transmitted locally (Farid, Choumara & Bosci, 1968, unpublished report[1]) (Annex 6).

Eleven *Anopheles* species can potentially transmit malaria in Turkey. *An. sacharovi* and *An. superpictus* are the two principal vectors. *An. maculipennis*, *An. pulcherimus*, *An. algeriensis*, *An. claviger*, *An hyrcanus*, *An. marteri*, *An. multicolour*, *An. plumbeus* and *An. sergenti* may be considered as secondary or possible vectors of malaria in the country *(26)* (Annex 6).

Pre-control

Malaria used to be common and widely distributed in Turkey. The first description of quartan malaria (*P. malariae*) was provided by Hippocrates (c. 460 BC – c. 370 BC), who lived in Kos (now Kas), near Antalya. Since mediaeval times, malaria has been considered to be hyper-endemic in southern and western coastal areas, while along the northern coast and in the highlands malaria was hyper-endemic in some places, meso-endemic in others and epidemic in yet others according to some authors (27; WH Wernsdorfer, 1958, unpublished report). Only a few mountainous regions remained consistently malaria-free.

Malaria was widespread in the Ottoman Empire during the years of the Balkan Wars (1912–1913) and the First World War (1914–1918). The intensive population migrations into Anatolia in southern Turkey at the end of the Balkan Wars resulted in the spread of a number of infectious diseases, including malaria. Soldiers returning from the First World War, especially those returning from Iraq, maintained malaria in Turkey in epidemic proportions *(28)*. Malaria also spread among civilians, and according to Koylu & Doğan *(27)* an estimated 75% of the population in the country was infected after the First World War; many parts of the country were affected by epidemics.

Cinchona was introduced for malaria treatment in the 18th century and quinine sulfate was used as early as the 19th century. In 1913–1914, 2000 kg of quinine sulfate were imported from Germany and distributed free of charge to the public by the Ziraat Bank, in accordance with new Government regulations.[2] Despite these efforts, malaria was not effectively controlled; many factors contributed to its epidemic spread, including the protracted war period, inadequate preventive measures and a shortage of quinine *(27)*.

First malaria control campaign, 1925–1945

Key dates 1924–1945

1924	Malaria Commission established
1925	First nationwide malaria control activities launched
1926	Malaria control campaign launched
1939–1942	Peak of malaria cases during Second World War

After the epidemics of the First World War, the Government of Turkey resolved to start a campaign against malaria. A national Malaria Commission was

1 Details of all unpublished WHO reports cited in the case-study are presented in Annex 1.

2 22 Cemaziye'l-End 1331/29.05 1913 and 24 Cemaziye'l-End 1331/31.05 1913, followed by an order 2 Ramadan 1334/3.07 1916 related to the implementation of regulations.

established in 1924 to coordinate and conduct the antimalarial activities (Figure 2). The Ministry of Health and Social Assistance launched the first malaria control activities in 1925, with antilarval operations and distribution of antimalarial drugs as the main control measures. A national malaria institute and a 20-bed hospital were established in order to train medical specialists (29, 30; Farid, Choumara & Bosci, 1968, unpublished report), and malaria has been a notifiable disease since 1930 (Umumi Hihzisıhha Kanunu – Public Hygiene Law number: 1593, accepted on 24/24/1930).

Figure 2. Minutes of the Malaria Commission meeting, 1924

Source: reference 29

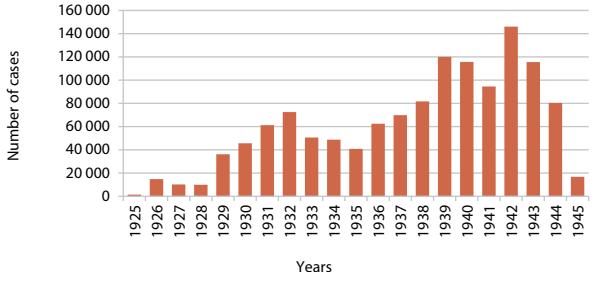
The areas covered by the control interventions expanded as time went on, yet there was no reduction in the country's reported malaria burden. In fact, the opposite was true: after an initial slight fall, the number of registered cases started to rise from 1929 onwards (Figure 3), as did the reported spleen index rising from 13.4% to 19.5% in 1929–1932 and parasite index, 10.2–14.4%, respectively *(30)*. This could have been due to improved case detection through blood examination of the at-risk population, as well as a lack of efficient anti-mosquito tools capable of dramatically reducing the vector density.

Available information on the epidemiology of malaria in Turkey during the period 1925–1944 is incomplete. In the 1930s, malaria incidence was estimated to be especially high in coastal regions characterized by high average temperatures, abundant rainfall and many pools of stagnant water. Here also agricultural workers were constantly moving from place to place, wherever labour was required. In the interior of the country, transmission intensity varied with the nature of the terrain (lakes, marshes, rice fields, etc.) *(30)*. In 1932, the highest spleen rates were detected in some south-eastern and southern provinces.

The malaria situation became critical during the Second World War, when 120 060–146 077 cases were reported annually over the period 1939–1942. Around 80% of all reported malaria cases were caused by *P. vivax* and 20–30% of treated patients experienced relapses. During the Second World War, many health staff from the first malaria campaign were conscripted for active duty in the army. The consequent decline in coverage with malaria control activities resulted in several outbreaks, especially in 1944 and 1945. Reporting of aggregated data on malaria in Turkey began in 1945 (Kouznetsov, Gratz & Espinoza, 1995, unpublished report).

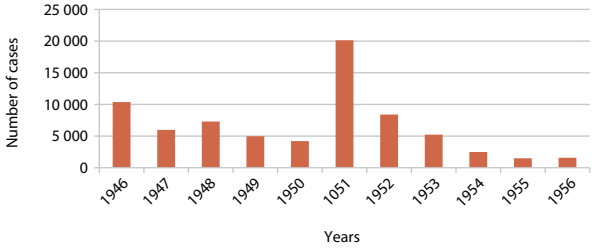
The first malaria control campaign resulted in better knowledge and understanding of the magnitude of the malaria problem and of the distribution of parasites and vectors in the country, and yielded valuable malaria control experience.

Figure 3. Malaria cases in Turkey, 1925–1945



Source: national malaria control programme

Figure 4. Officially registered malaria cases in Turkey, 1946–1956



Source: Farid, Choumara & Bosci, 1968 (unpublished report)

Intensified malaria control operations, 1946–1956

Key dates 1946–1956

1946	Directorate of Malaria Control set up under Ministry of Health and Social Assistance
1946	DDT introduction
1950	DDT residual campaign started
1951–1956	Significant reduction in malaria burden

Turkey faced a serious malaria situation during the Second World War with local epidemics and an unprecedented numbers of malaria cases reported nationwide. The situation called not only for urgent measures but also for strengthening of the malaria network. DDT, for use in indoor residual spraying (IRS) had just become available, and was introduced in Turkey in 1946. Subsequent expansion of malaria interventions led to a significant improvement in the epidemiological situation (Figure 4).

A dramatic decline in the number of reported malaria cases was achieved and the total number of cases registered for the period 1946–1956 was 72 149– a number that had previously been registered annually (Figures 3, 4). Reported cases decreased to 4211 by 1950. However, in 1951, a peak of 20 132 cases were reported, probably as a result of increasingly vigorous case detection; this reflected a slide positivity rate (SPR) of 2% among some 1 million blood slides taken from a population of 9.9 million living in the 34 provinces included in the intensified control programme. Of these cases, 80% were due to *P. vivax*, 18% to *P. falciparum* and 2% to *P. malariae* (Farid, Choumara & Bosci, 1968, unpublished report). The combination of parasite source reduction activities (case detection and treatment) and vector control interventions resulted in a reduction in the malaria burden. The SPR had been 32.1% in 1943; by 1956 the SPR was less than 1%, with only 1573 cases detected among 190 065 blood slides taken (see Figure 6).

Beginning in 1946, malaria surveys were carried out every autumn in the 34 provinces involved in the control programme. These surveys at the end of the transmission season showed a consistent decrease in the main epidemiological parameters *(32)*:

- Spleen enlargement (as an indication of malaria infection) was checked in 70.3–90.9% of the population of all ages in control areas[1] (5 307 420–6 403 475 people) and indicated a decreasing trend, from 25.9% in 1946 to 1.1% in 1954 (Figure 5) *(32)*. The only two provinces where spleen rates exceeded 10% during the 1950s were Diyarbakır (10.8%) and Siirt (15.9%) in 1951.
- The slide positivity rate fell from 13.7% in 1949 to 0.8% in 1956 (Figure 6) (Farid, Choumara & Bosci, 1968, unpublished report).

With the impressive results achieved by the malaria control programme in just 10 years, Turkey decided to expand the activities and transform the control programme into an eradication programme. Political will was strong, as evidenced by the Government's steady and growing financial support for the malaria eradication programme and malaria legislation International assistance was also made available following adoption of the WHO Global Malaria Eradication Programme (GMEP) in May 1955 (Farid, Choumara & Bosci, 1968, unpublished report).

1 Geographical location of the control areas is presented in the section "Factors that contributed to changes in the malaria situation over time" under the heading "Interventions during the initial malaria control campaign, 1925–1945".

National malaria eradication programme, 1957–1974

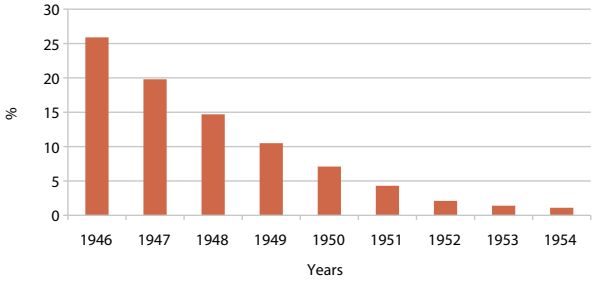
Key dates 1957–1974

1957	National programme transition from control to malaria eradication
1957	Surveillance established
1960–1974	Dramatic reduction in morbidity and maintenance at a low level
1969	Last indigenous case of *P. falciparum* malaria reported

In 1957, based on the success of previous malaria control activities, and encouraged by the availability of substantial international assistance, Turkey established its national malaria eradication programme. This coincided with a period of great economic development in Turkey, particularly the reclaiming of marshy land and construction of dams for large-scale irrigation of cash crops (rice and cotton).

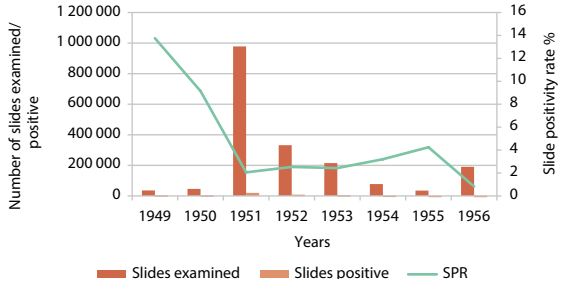
A tripartite plan of operations for malaria eradication was signed in 1957 by the Government of Turkey, WHO, and UNICEF, the supporting agencies. It was expected that the goal of malaria eradication would be reached by 1966 (see Box 1). The original plan of operations was modified in response to annual programme evaluations of the programme. The National Malaria Eradication Service (NMES) at the Ministry of Health and Social Welfare was responsible for malaria eradication operations (Annex 7). Planning of the Turkish Malaria eradication programme (MEP) followed the established GMEP approach – an attack phase based on IRS and active case detection, followed by a consolidation phase when few cases of malaria remain and at which point IRS is discontinued and case detection and treatment continue. Finally there is a maintenance phase when malaria surveillance responsibilities are transferred to the normal health services.

Figure 5. Spleen index recorded in Turkey, 1946–1954



Source: reference 30

Figure 6. Malaria case detection in Turkey, 1949–1956



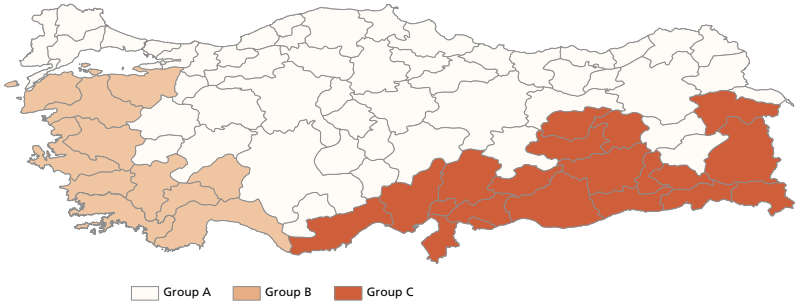
Source: Farid, Choumara & Bosci, 1968 (unpublished report)

Box 1. Area of Turkey covered by MEP activities, 1957–1974

In accordance with the plan of operations, MEP activities in Turkey were conducted in the same 34 (out of 67) provinces that had previously been targeted by intensified control efforts, covering a population of 9.9 million people. To facilitate the planning and execution of the operations, these provinces were classified into three groups on the basis of geographical, climatic, epidemiological and other features, as well as the planned duration of the attack phase (Figure B1.1):

- Group A – plateau provinces; planned duration of attack phase 3 years.
- Group B – coastal provinces bordering the Marmara and Mediterranean Seas; planned duration of attack phase 3 years.
- Group C – south-eastern provinces; planned duration of attack phase 4 years.

Figure B1.1 Groups of provinces covered by the national malaria eradication programme, 1957



Source: Farid, Choumara & Bosci, 1968 (unpublished report)

The activities of the MEP were supported by steady Government funding and by contributions from WHO and UNICEF. The approach was based on widespread and strictly controlled use of:

- DDT for indoor and outdoor spraying against mosquitoes;
- larvicides for treating mosquito breeding sites;
- case detection; and
- antimalarial treatment of infected persons to eliminate the parasite in humans *(31)*.

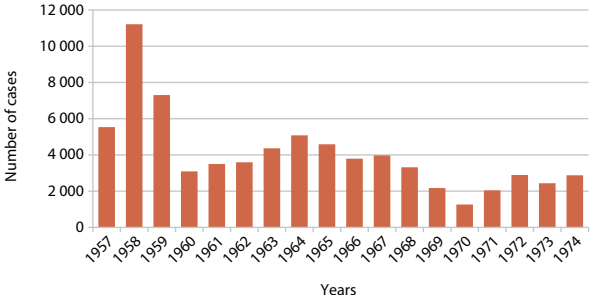
The MEP made an excellent start. In 1958, the number of detected cases initially increased to 11 213, but dropped the next year to 7305; incidence fell from 1.26 to 0.74 per 1000 population and the parasite index from 0.87% to 0.51% (Figures 7, 8). Over the next 15 years (1960–1974), reported malaria cases remained at a low level: an average of 3266 annually, with an SPR ranging from 0.06% to 0.27% (average 0.17% - see Figure 9). In 1968 the main reservoir of infection seemed to be confined to the south-eastern provinces (Farid, Choumara & Bosci, unpublished report), which were still under the attack phase of the MEP. SPR ranged from 0.06% to 0.27% (average 0.17% – see Figure 9). The last case of locally transmitted *P. falciparum* malaria was reported in 1969 (national malaria control programme, 2001, unpublished results).

As malaria became a less visible health problem, other aspects of public health were putting ever-greater demands on the limited resources available. As a result, some activities of the malaria services were reduced,

even though receptivity and vulnerability remained high in many areas. Consequently, there was a resurgence of malaria in some areas of the country that had previously moved into the consolidation phase *(34)*. Between 1970 and 1974, the annual number of cases gradually doubled, from 1263 to 2877 (Figure 7).

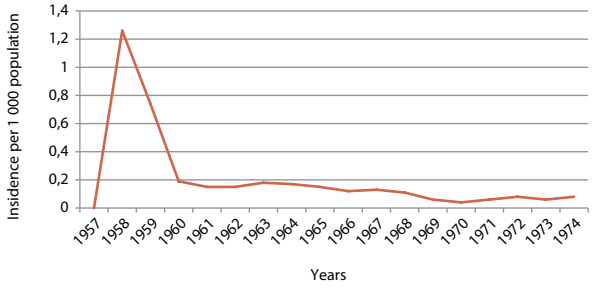
In summary, the national MEP succeeded in eliminating *P. falciparum* and *P. malariae* transmission in Turkey and in limiting the geographical spread of *P. vivax* transmission to limited foci in the south-eastern part of the country. By 1973, only a small area of the south-east, inhabited by less than 3% of the population, was still in the attack phase of the programme. By the end of 1974, 93% of the country was under consolidation.

Figure 7. Officially registered malaria cases, 1957–1974



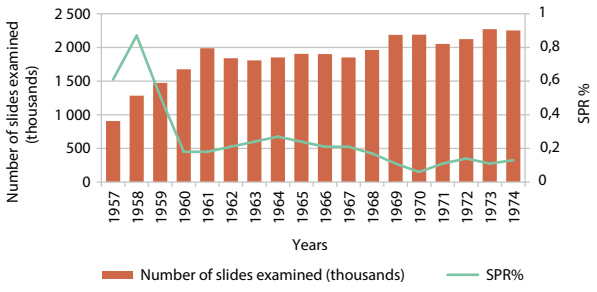
Source: national malaria control programme

Figure 8. Malaria incidence per 1000 population, 1957–1974, adjusted for national population growth



Source: national malaria control programme

Figure 9. Slide positivity rate (%), 1957–1974



Source: national malaria control programme

Epidemic in Çukurova and its containment, 1975–1990

Key dates 1975–1990

1977	Vivax malaria epidemic in Çukurova area
	Programme transition back to attack phase
1979	Containment of the epidemic
1979–1990	Maintenance of malaria morbidity at a low level

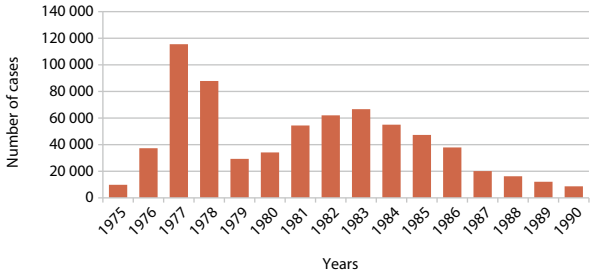
The epidemiological situation in Turkey began deteriorating from 1970 onwards, culminating in malaria epidemics of alarming proportions in the southern and eastern parts of the country (*35*; Sharif et al., 1978, unpublished report). A variety of factors appear to have led to an increase in malaria cases in 1975. This included an extensive irrigation project in the Çukurova plain resulting in an increase in mosquito breeding sites and vector density, as well as in a rise in seasonal labour force migration from the highly endemic south-eastern provinces. In addition to the extensive agricultural and industrial development, coverage by the surveillance system in 1970–1975 was inadequate. In 1976, a *P. vivax* malaria outbreak that had started the year before in the Çukurova and Amikova plains (areas previously in the MEP consolidation phase) reached epidemic proportions, resulting in 37 320 reported cases nationwide; the number of cases rose to a peak of 115 512 in 1977 (Figure 10).

At the height of this epidemic, malaria incidence was 2.78 per 1000 population. Worst affected were the provinces of Adana, Hatay and Icel, which reported a total of 101 867 cases, i.e. 88.1% of the cases registered nationwide, with a sharply increased parasite index (Stratum 1A in Figure 11) and an SPR of 33% – many times the national average (Figure 12) (Sharif et al., 1978; Trigg, 1994; Kouznetsov, Gratz & Espinosa, 1995; unpublished reports). The in-country movement of seasonal workers and residents of the Çukurova region in the 1970s resulted in a spread of the malaria problem across the entire national territory *(34)*.

In order to contain the epidemic promptly, the programme reverted to an attack phase in the affected areas, and the country was stratified to allow targeting of interventions (Box 2). This stratification is still used by the national malaria control programme today.

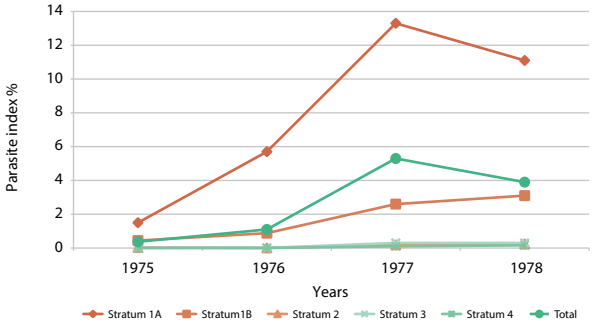
The reinforced malaria interventions, backed by international support, brought about a swift containment of the initial epidemic. In just two years, by 1979, the number of laboratory-confirmed cases had declined to 24 196 in the Çukurova area and 29 324 nationwide. In subsequent years, the epicentre of malaria transmission gradually shifted from the Çukurova–Amikova plain to Southeastern Anatolia, where a new major irrigation project attracted many people. After another peak of 66 881 cases in 1983, malaria incidence declined to just 8680 reported cases in 1990 (Figure 10) (Trigg, 1994, unpublished report).

Figure 10. Officially registered malaria cases, 1975–1990



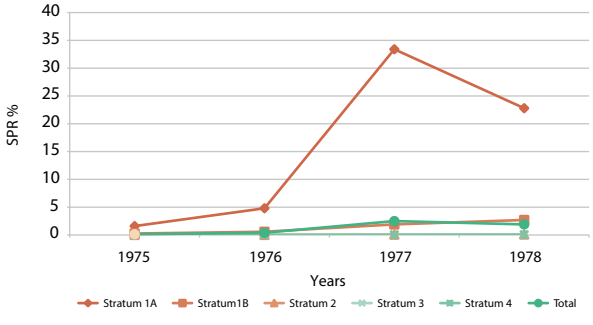
Source: Sharif et al., 1978 (unpublished report)

Figure 11. Parasite index by epidemiological strata, 1975–1978



Source: Sharif et al., 1978 (unpublished report)

Figure 12. Slide positivity rate by epidemiological strata, 1975–1978



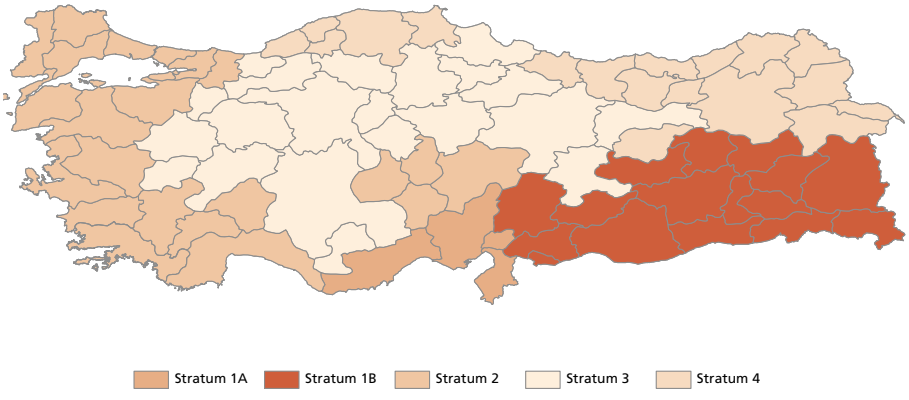
Source: Sharif et al., 1978 (unpublished report)

Box 2. Stratification of the country territory, 1977 onwards

With the aim of improving the planning of malaria interventions during the 1977 epidemic, the country was divided into four epidemiological strata (Figure B2.1) based on the distribution of reported malaria cases and transmission patterns:

1. *Stratum 1,* divided into two substrata:
   - *Stratum 1a:* the provinces of Adana, Hatay and Icel (including Çukurova area, where a major epidemic occurred in 1977).
   - *Stratum 1b:* Southeastern Anatolia, the site of two major irrigation projects – the Seyhan and Ceyhan rivers, completed in 1970; and the Southeastern Anatolian Project (SAP), initiated in 1980. Transmission occurred in many areas of Stratum 1b.
2. *Stratum 2:* the western part of the country plus the provinces of Niğde, NevŞehir and Kayseri where the major tourist centres were situated. Malaria was considered a risk with possible focal transmission.
3. *Stratum 3:* mainly the high plateau Stratum 1 of central Anatolia.
4. *Stratum 4:* north-eastern Turkey and the provinces of Zonguldak, Kastamonu and Sinop on the Black Sea coast.
5. The risk of malaria in both Stratum 3 and Stratum 4 was very low.

Figure B2.1 Strata of Turkey based on malaria risk



Source: national malaria control programme

Epidemic in south-eastern Turkey and its containment, 1991–2005

Key dates 1991–2005

1993–1996	Vivax malaria epidemic in south-eastern Turkey
1997	Containment of the epidemic
1999–2005	Stable decline in malaria cases

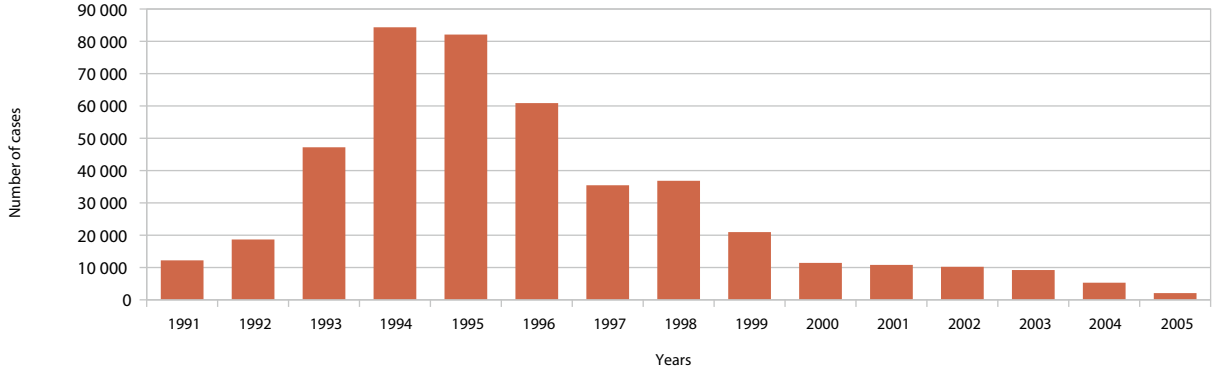
From 1990 to 1996, coinciding with the refugee crisis and malaria epidemic following the first Gulf War in neighbouring Iraq (1990–1991), there was a rapid increase in the number of malaria cases in Turkey and the malaria situation again became critical. The highest number of cases (84 345) was registered in 1994 (Figure 13). The rise in incidence was particularly significant in Stratum 1b (Southeastern Anatolia) areas where the Southeastern Anatolia Project (SAP) was being implemented. The contribution of the SAP area to the national malaria burden increased from 51.6% in 1991 to around 80% in 1993–1994. The worst affected areas were Diyarbakır, Batman, Mardin, Mus, Siirt, Şırnak and Şanlıurfa (Figure 14). In 1993–1994, the peak years of the epidemic, cases reported from Adana (the epidemic area of the 1970s) accounted for less than 10% of the national malaria burden, and those from the rest of the country for less than 5% (Table 4) (Kouznetsov, Gratz & Espinoza, 1995, unpublished report).

There was also some rise in the number of malaria cases reported in other regions, probably as a result of dispersion of malaria by migrant workers from the endemic areas within the country.

In 1995–1996, the situation was further complicated by a sharp rise – by as many as 342 annually – in the number of imported cases registered in the country, largely as a result of the migration of seasonal workers from neighbouring countries – Iraq, the Islamic Republic of Iran and the Syrian Arab Republic (Figure 15).

Only in 1997 did the situation begin to improve, when case numbers were reduced by almost 50% compared with the previous year. Since 1999, the number of registered cases of malaria has shown a pronounced downward trend (Figure 13): locally acquired cases fell and there was also a significant reduction in annual incidence. In 2000–2004, the overwhelming majority of malaria cases and foci were located in Southeastern Anatolia (Stratum 1B, Figure B2.1). A substantial number of malaria infections occurred among young children.

Figure 13. Officially registered malaria cases in Turkey, 1991–2005



Source: national malaria control programme

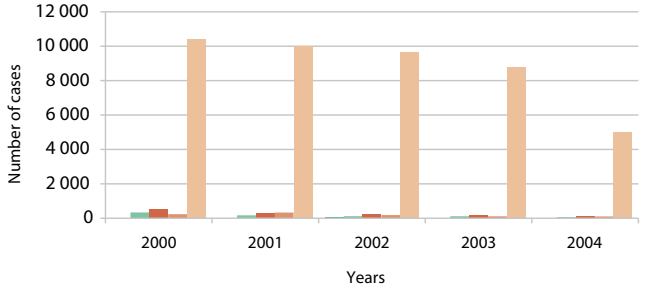
Table 4. Malaria cases reported in Turkey, 1991–1994

Area	1991		1992		1993		1994	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
SAP area	6 309	51.6	11 295	60.5	37 829	80.1	66 521	78.9
Adana	2 108	17.3	3 126	16.7	3 592	7.6	7 092	8.4
Rest of country	3 801	31.1	4 255	22.8	5 789	12.3	10 732	12.7
Total	12 218	100	18 676	100	47 210	100	84 345	100

Source: national malaria control programme

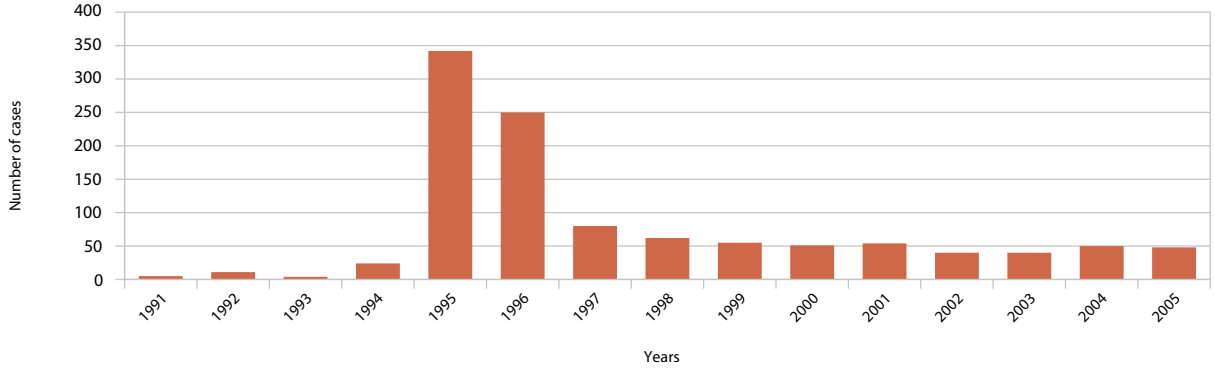
The 1993–1996 epidemic was the second to strike Turkey after the malaria eradication programme ended in the 1970s. As with the first epidemic, it occurred in provinces where large-scale agricultural development projects and irrigation had begun. In these areas the risks of an increase in the vector mosquito density – and thus in malaria transmission – as a consequence of irrigation were well known but no preventive measures were taken. The increase in malaria incidence was the result of a large migration of people from remote rural endemic areas to urban and agricultural areas where neither the antimalarial services nor the health services could cope with the problem. In addition, continuous migration and importation of cases across the border from the neighbouring countries of Iraq, the Islamic Republic of Iran and the Syrian Arab Republic was occasioned by political instability in the area and by the Gulf War (1990–1991).

Figure 14. Distribution of malaria cases by strata and by years in Turkey, 2000–2004



Source: national malaria control programme

Figure 15. Internationally imported malaria cases in Turkey, 1990–2005



Source: national malaria control programme

Containment of the 1993–1996 malaria epidemic in south-eastern Turkey took several years. The disease spread to other parts of the country, mainly to the Çukurova/Amikova plains, as well as to the provinces bordering the epicentre of the epidemic where new active foci were established and residual foci remained. The magnitude of the epidemic affected not only the health but also the productivity of the local population, and tied up the human and material resources of the MOH. Many areas of Turkey remained highly receptive to malaria and there was the threat that the achievements of 50 years of malaria control could be lost if the disease were to spread any further.

The epidemic was ultimately contained by a package of interventions coordinated by the national malaria network and supported by mobile teams of specialists assigned to the affected areas. Once containment of the epidemic had been achieved through intensive attack-phase and mopping-up operations, the malaria control programme continued with control interventions. Despite a number of challenges, the programme achieved an impressive reduction in the disease burden by 2005, the year that other endemic countries of the WHO European Region adopted the Tashkent Declaration, *The Move from Malaria Control to Elimination (10)*.

Programme transition to malaria elimination, 2006–2011

Key dates 2006–2011

2006	Turkey signs Tashkent Declaration
2008	Programme transition to malaria elimination 2010-2011 Only *P. vivax* relapsing cases reported
2010-2011	Only *P. vivax* relapsing cases reported

The stable reduction of malaria cases in the previous two decades and the restriction of transmission to a few provinces in the south-east of the country encouraged the Government to endorse the Tashkent Declaration, *The Move from Malaria Control to Elimination (10)*. In 2008, having had significant success in malaria control, and in line with the WHO malaria elimination strategy, the Turkish Government also decided to reorient the malaria programme to elimination.

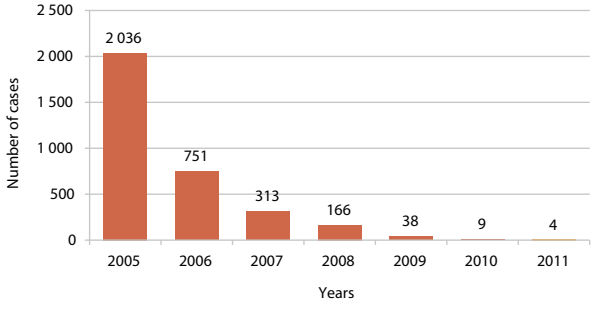
With the assistance of the WHO Regional Office for Europe, a national strategy and plan of action for malaria elimination were developed and implemented. Based on contemporary malaria elimination strategies and policies, they have contributed significantly to the effective planning and performance of interventions.

By 2006, considerable progress had been achieved in malaria control and elimination in Turkey, with locally acquired cases falling below 1000 cases annually for the first time ever. The number of such cases fell from 9182 in 2003 to just 38 in 2009 (Figure 16). After epidemiological investigation conducted by the NMCP, nine cases reported in 2010 and four reported in 2011 were classified as relapsing cases of infection contracted the previous year.

The NMCP continued intensive efforts to clear up remaining foci, and in many provinces malaria transmission was interrupted. Local transmission was again limited to a few provinces in the south-eastern region of the country (Figure 17) – the same areas that had proved difficult in earlier eradication efforts. Most of the cases and foci were clustered in Diyarbakır and the neighbouring provinces of Şanlıurfa and Batm*An. A* few endemic foci have also existed for years in the southern part of Mardin province. Imported cases of malaria outnumbered autochthonous cases in Turkey for the first time in 2009 (Figure 18).

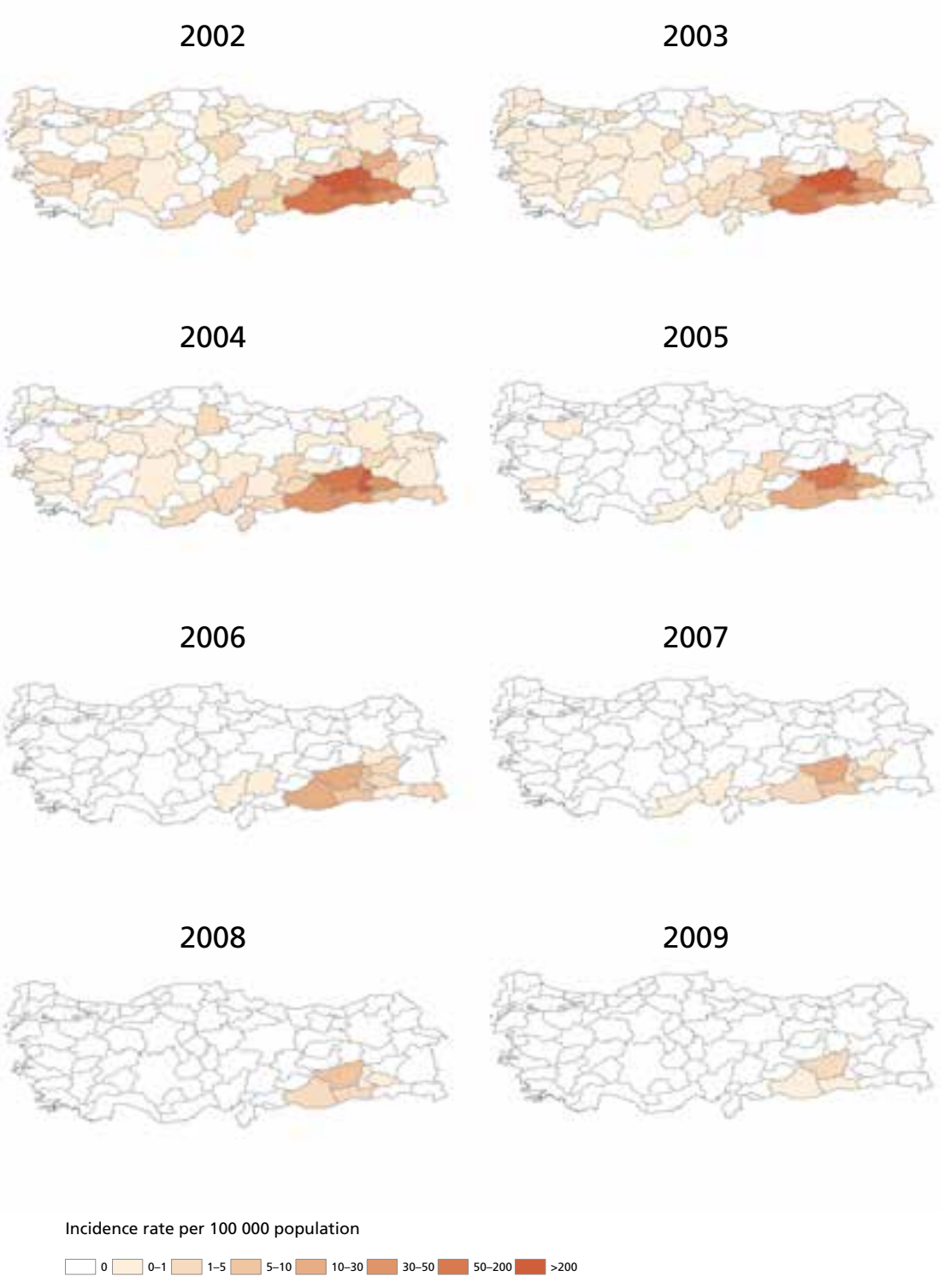
Figure 16. Officially registered autochthonous malaria cases in Turkey, 2005–2011

Note: The cases in 2010 and 2011 were officially reported by NMCP as relapsing cases.



Source: national malaria control programme

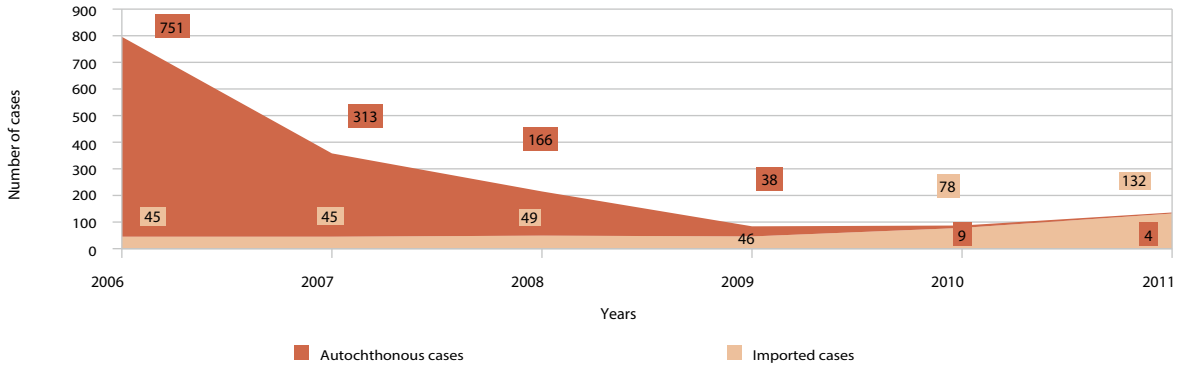
Figure 17. Malaria incidence in provinces with malaria transmission in Turkey, 2002–2009



Source: national malaria control programme

Figure 18. Autochthonous versus imported malaria cases, 2006–2011

Note: The autochthonous cases in 2010 *(9)* and 2011*(4)* were officially reported by NMCP as relapsing cases.



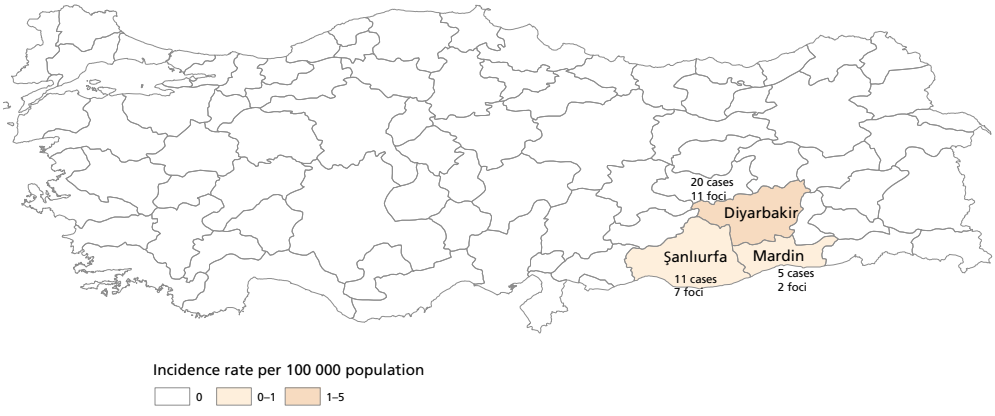
Source: national malaria control programme

AUTOCHTHONOUS MALARIA IN 2009–2011

In 2009, autochthonous malaria cases were registered in 20 foci of 3 provinces (7 in Şanlıurfa, 11 in Diyarbakır and 2 in Mardin) in the south-eastern region of Turkey (Figure 19). In two cases the origin of infection was unclear. Distribution of malaria by age of patients is presented in Box 3. Nine autochthonous cases, classified by the NMCP as relapsing cases (i.e. acquired in previous transmission seasons but not previously detected), were reported in Turkey in 2010. Epidemiological investigation revealed that the disease, detected in the three provinces of Mardin, Sanlıurfa and Diyarbakır), was probably contracted in settlements where autochthonous cases had been detected the previous year, apart from one case originating from ViranŞehir district (Şanlıurfa province), which had been free of malaria in 2009 but which retained some residual foci. There were no epidemiological links between the cases detected in 2010, and none of the patients had been registered with a malaria infection in the year before.

In 2011, another four autochthonous *P. vivax* cases were officially registered that were classified by the NMCP as relapsing, i.e. it was supposed that the patients had been infected before or during the 2010 transmission season but presented with symptoms (renewed or first) only in 2011. The house of one of the malaria patients from 2010 and the surroundings of the small village in Diyarbakır where it is situated are shown in Figures 20 and 21.

Figure 19. Indigenous malaria cases and foci in 2009



Source: national malaria control programme

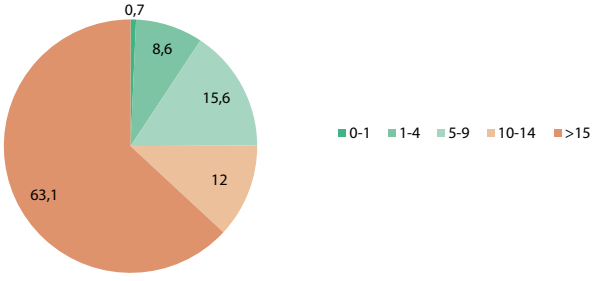
Figure 20. Malaria focus in Diyarbakır: the house of a malaria patient, 2010

Figure 21. Malaria focus in Diyarbakır: surroundings of the village, 2010

Box 3. Distribution of malaria by age of patients 2006–2011

Over the 6-year period 2006–2011, persons over 15 years of age were the worst-affected age group – 63.1% of all cases. This group includes the most productive segment of the population, working in agriculture, on large developmental and irrigation projects, etc. (Figure B3.1). However, malaria was also detected in children in 2006–2009, with almost 25% of cases occurring in 0–9-year-olds. The last two indigenous cases in this age group were diagnosed in 2009 (a 1-year-old child, detected on 30 March 2009 in Catal village, Bismil district, Diyarbakır province, and a 10-month-old child diagnosed in Istanbul on 25 August, precise locality of contraction of malaria unknown).

Figure B3.1 Proportion (%) of autochthonous cases by age groups, 2006–2011



Source: national malaria control programme

IMPORTED MALARIA

Both *P. vivax* and *P. falciparum* malaria infections are imported into Turkey every year. The rise in importation in 1993–1996 related to the migration of refugees to Turkey from neighbouring countries following the Gulf War (1990–1991). Importation dropped during the period 1998–2009; a total of 588 cases were registered, giving an average of 49 cases annually. Since 2010, the number of imported cases has been rising again, with 79 cases in 2010 and 132 in 2011 (Figure 22).

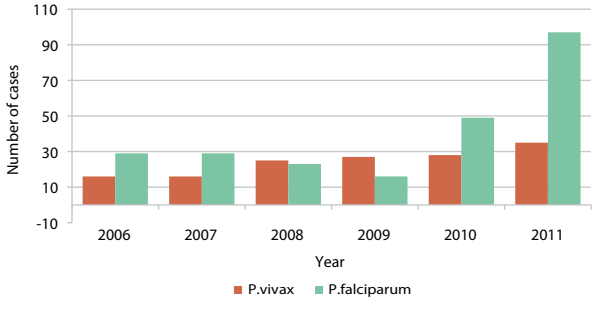
The imported cases of *P. falciparum* and *P. vivax* in 2011 (97 and 35 cases, respectively) are reported to have originated from various countries including Afghanistan, Burkina Faso, Cameroon , Equatorial Guinea, Ethiopia, Gabon, Ghana, India, the Islamic Republic of Iran, Mali, Nigeria, Pakistan, South Africa, Sudan, Uganda and Yemen.

Most *P. vivax* cases over the period 2006–2010 originated from the Islamic Republic of Iran (17.9%), Pakistan (17.9%) and Afghanistan (14.3%).

Turkish citizens returning from travel to endemic countries accounted for the majority of imported malaria cases.

Most imported cases were detected in big cities and resorts (56.83% of imported cases were detected in Istanbul, Ankara, Izmir and Bursa in 2007–2010) where there is no risk of onward transmission, but a few cases of *P. vivax* were imported to the very receptive and vulnerable territory of south-eastern Turkey (Şanlıurfa), which may well have created an epidemiological risk. The importation of *P. vivax* malaria shows an increasing trend, which is probably related to Turkey's geographical location at the junction of Asia and Europe. Importation of Palaearctic malaria strains from Central Asia and Afghanistan is of particular concern with regard to the re-establishment of local transmission in Turkey.

Figure 22. Imported cases of *P. vivax* and *P. falciparum* in Turkey, 2006–2010



Source: national malaria control programme

FACTORS THAT CONTRIBUTED TO CHANGES IN THE MALARIA SITUATION OVER TIME

Why was the initial malaria campaign (1925-1945) unsuccessful

Nationwide antimalaria interventions started early in Turkey, in 1925, shortly after the founding of the Republic: a national organization was established to carry out the activities of the malaria campaign; relevant legislation was enacted; and financial resources for the campaign were provided by the Government.

Over the years, a strong and well-staffed malaria network was built, organized on a vertical basis with three levels *(29)*:

- national level (National Malaria Commission);
- intermediate (province/district) level – with a laboratory and headed by a physician; the district was divided into sections, each staffed by a physician and other malaria control personnel (sanitarians);
- peripheral level (subsections – the so-called "circles" or groups of villages), with personnel for vector control.

Early control activities included the following main interventions:

- **Case management.** Sanitarians visited the households in the villages of their sections at least three times a month distributing antimalarial drugs (in 1945 2 542 272 people - 33% of the target population were treated) and collecting blood samples for parasite index determination. Population surveys for defining the spleen and parasite indexes were conducted in all control areas.
- **Protection of the population.** From 1925, seasonal chemoprophylaxis with quinine, 1.00 g/week (and later with quinacrine, 0.30 g twice a week) was given during the transmission season to military personnel stationed in highly endemic areas and to the general population of some districts.
- **Vector control.** Marshes were drained, conventional antilarval operations with oil and Paris green were carried out, and larvivorous fish were used (Table 5).

Malaria interventions started in selected regions (Figure 23) and the control areas were gradually expanded each year (Figure 24). In 1934, the 11 antimalaria campaign areas covered around a quarter of Turkey's population and territory.

Clearly, the Government of Turkey had recognized the malaria problem early on; however, the national antimalaria campaign, begun in 1925, initially covered few provinces. The programme was administratively feasible and its coverage expanded over the years, yet the first campaign was unsuccessful. The malaria control tools available at that time had limited efficiency, being limited to conventional antilarval operations and distribution of antimalarial drugs, and could not adequately reduce either mosquito density or malaria transmission. The impact of the Second World War was another factor that prevented a successful outcome: coverage by antimalarial activities was reduced during the War, as a result of many of the malaria staff being transferred to the armed forces.

Figure 23. Malaria campaign and control activities, 1926

Source: reference 30

How was malaria control intensified in 1946–1956?

Reducing vector density and malaria transmission were the priority aims of the intensified malaria control campaign that started in 1946. The most significant development was the introduction of DDT.

Figure 24. Malaria campaign and control activities, 1944

Source: reference 31

VECTOR CONTROL AND ENTOMOLOGICAL SURVEILLANCE

The insecticide DDT first became available to Turkey in 1946. Residual spraying of houses with DDT was introduced in 1949 and IRS campaigns began in 1950 *(30)*. Experimental spraying activities were also undertaken in 1950; results were encouraging and blanket spraying was therefore introduced for the main malarious regions of Turkey (Wernsdorfer, 1958, unpublished report, 1958). Residual DDT spraying campaigns were conducted in all known malarious areas during the period 1952–1954, covering a population of 5.6 million in 1952 and 6.5 million by 1954.

During this period there was also widespread larviciding of mosquito breeding areas with oil, with Paris green and later with DDT, together with appropriate drainage. The numerous mosquito breeding sites in the control areas – pools, marshes, irrigation systems, etc. – were mapped to facilitate programme operations.

Entomological studies carried out at the time established the presence of several mosquito species: *An. sacharovi* (endophilic, zoophilic, biting in the late night, favouring marshes) and *An. superpictus* (endophilic, breeding in clear sunlit pools at the edge of streams) were recognized as principal malaria vectors, and *An. maculipennis* was considered to be a potential vector *(37)*.

CASE MANAGEMENT

Even in the early years of the intensified control programme, considerable effort was devoted to effective case detection through ACD and Passive Case Detection (PCD) in endemic areas. In the malaria season, and mainly in rural areas, household visits were carried out twice or three times a month by sanitarians, each responsible for 10–15 villages *(28, 32)*.

Malaria surveys were carried out during the autumn in each village in the 34 control areas, with splenomegaly the principal feature recorded, and an increasing emphasis put on blood examinations. Blood examinations were performed by the local physicians and laboratory technicians assigned to the malaria control programme. Records for every occupant of each house in the villages (age, sex, spleen enlargement, results of blood examinations) were maintained by the sanitarian.

In towns, people seeking medical treatment were examined in the clinics (PCD). More than 2 million patients were treated each year in 1946 and 1947; 1 672 021 were treated in 1948 *(28, 29)*.

Table 5. Key antimalaria interventions directed to the source of infection, mode of transmission and receptive population, 1925–2011

	Periods	Source of infection	Mode of transmission	Receptive population
Initial malaria controlæ	First malaria control campaign, 1925–1945	• Household visits by sanitarians in malaria season every 10 days in selected areas for: – distribution of antimalarial drugs – defining the spleen and parasite indexes • Obligatory notification of malaria cases (since 1930)	• Conventional antilarval operations with oil and Paris green, as well as larvivorous fish • Drainage of marshes	• Seasonal chemoprophylaxis with quinine (1.0 g) and later quinacrine (0.3 g twice a week) for selected population groups • Health promotion
	Scaled up and expanded malaria control operations, 1946–1956	• Active case detection – household visits 2–3 times a month by sanitarians in malaria season, mainly in rural areas for case finding among febrile patients and treatment – malaria surveys for splenomegaly and blood examinations • Passive case detection • Treatment with quinine, quinacrine and eventually chloroquine	• DDT – indoor and outdoor residual spraying campaign • Larviciding with oil, Paris green and, later, DDT • Drainage of marshes • Entomological studies – *An. sacharovi* and *An. superpictus* recognized as principal malaria vectors	• Intensive health promotion
Eradication efforts	National malaria eradication programme, 1957–1974	• MEP surveillance established in 1957 • ACD – through house-to-house visits by the "circle sanitarian", responsible for 10–15 villages, twice a month during transmission season and once a month during the off season for case finding – a general survey by annual blood sampling of infants (0–1 year) and children (1–5 years) • PCD • Radical treatment (chloroquine/quinine and pyrimethamine) • Case investigation • Obligatory notification of malaria cases and reporting of case investigation results	• DDT or dieldrin indoor and outdoor residual spraying – high coverage • Larviciding with oil and with DDT • Environmental management	• Intensive health promotion

	Periods	Source of infection	Mode of transmission	Receptive population
Control of epidemics	Epidemics, 1977 and 1993–1996	• Intensive ACD (2-weekly household rounds) in high-risk areas and among resettlers and immigrants for fever persons screening • PCD and case management in other areas and cities • Radical treatment of malaria patients and interseasonal retreatment with primaquine of all positive *P. vivax* confirmed cases in the previous year • Quality-assured laboratory diagnosis • Case reporting	• Indoor residual spraying with malathion and/or DDT • Thermal fogging (indoors and around houses) and ultra-low volume (ULV) with malathion • Larviciding operations in and around urban centres, using oil and temephos (Abate) • Large-scale distribution of larvivorous fish (*Gambusia affinis*) • Cleaning of drainage canals	• Mass drug administration in the most receptive areas with chloroquine (600mg base) and pyrimethamine (50mg base adult dose), distributed at 2-weekly intervals. • Intensive health promotion
Elimination	Programme transition to malaria elimination, 2006–2011	• ACD – household visits (every two weeks) in malaria foci – screening of risk groups (military personnel, seasonal agricultural workers, migrants) • PCD nationwide; malaria examination of febrile patients seeking medical attention • Case and foci recording and mapping • Reporting, notification and registration in a national register • Epidemiological investigation and classification of malaria cases and foci • Data collection and analysis • Quality-assured malaria laboratory diagnosis • Radical treatment of malaria patients and parasite carriers, free of charge; interseasonal retreatment of *P. vivax* patients with primaquine, 14 days	• Entomological surveillance of vectors and breeding sites • Hydro-engineering works and preventive supervision of the construction and operation of irrigation systems • Use of Gambusia larvivorous fish • Integrated vector control, including IRS in malaria foci (two rounds)	• Preventive measures for travellers, including chemoprophylaxis • Intensive health promotion

INTERNAL ORGANIZATION AND SUPPORT; NATIONAL MALARIA NETWORK AND LEGISLATION

The Directorate of Malaria Control was set up as a separate division under the Ministry of Health and Social Assistance to administer the malaria programme in 1946. The Directorate carried out the programme through the provincial and district medical directorates in the local areas. Much of the effort concentrated on capacity-building with training at the Malaria Institute in Adana. At the primary level, the sanitarians were the key individuals, responsible for diagnostic screening for malaria cases, dispensing of antimalarial drugs, entomological inspections, supervision of IRS and larviciding, collection of statistical data, and household visits. Each sanitarian reported to his or her medical officer who then confirmed the diagnosis of malaria cases (32; Farid, Choumara & Bosci, 1968, unpublished report) at the Malaria Institute in Adana.

OPERATIONAL ASSESSMENT

The malaria control campaign was efficient and had considerable success in reducing malaria transmission and disease burden. This success can be largely attributed to the level of political commitment and to the existence of an experienced, specialized network that carried out malaria operations effectively and with good coverage. Starting in 1926 with 1454 villages and cities, the campaign expanded to 3020 villages and cities in 1951 (see Figure 25), protecting 9.9 million out of the total population of 21 351 000 *(38)*. The resulting steady and substantial decline in disease burden was accompanied by a significant reduction in the spleen index and slide positivity rate by 1954–1956.

Analysis of the operations showed that the two principal strategies – indoor residual spraying and active case detection – had helped to reduce malaria transmission and sources of infection respectively. Considerable knowledge was amassed on malaria parasite species and main vectors, as well as on malaria distribution in the country. An effective network was established; allied to capacity-building efforts, this led to the accumulation of significant expertise in the organization and conduct of malaria control activities.

Figure 25. Malaria campaign and control activities, 1951

Source: reference 31

FACTORS FAVOURING MALARIA TRANSMISSION IN THE 1950s

The factors favouring malaria transmission in Turkey during the 1950s were characterized by Kratz & Bridges *(32)* as follows:

RECEPTIVITY

- *Mosquito-breeding habitats.* In the coastal plains of Asiatic Turkey, there were numerous mosquito-breeding habitats in the form of pools, marshes and seepage areas as a result of the watershed from the coastal side of the mountains, the flood plains of great rivers entering the sea and the outcropping of the water table. Because of the sparse summer rainfall in most of Turkey, irrigation was extensive, and additional breeding sites were formed, especially in rice fields in some areas.
- *Human–mosquito contact* was favoured by the tradition of sleeping on rooftops on summer nights to escape the indoor heat. During the fruit harvesting season, moreover, crops were guarded day and night, often by entire families sleeping outdoors, which also increased the likelihood of mosquito bites.

VULNERABILITY

- *Migration* of labourers from one area to another during the harvest season and living in *temporary dwellings* increased the vulnerability of the territory.

There were also a number of *programmatic factors:* malaria activities did not cover the whole country. Notable exclusions were the most highly malarious provinces in south-eastern Turkey (Farid, Choumara & Bosci, 1968, unpublished report).

What changed with the launching of the national malaria eradication programme of 1957–1974?

The malaria eradication programme launched in 1957 built on the preceding decade of intensified malaria control activities in Turkey. To ensure consistency in policies and strategies and the successful implementation of antimalarial interventions in line with the newly established Global Malaria Eradication Programme (GMEP), the national programme and plan of operations for malaria eradication were developed with international assistance and endorsed by the national authorities. They are described in detail by Wernsdorfer (1958, unpublished report) and by Farid, Choumara & Bosci (1968, unpublished report). Since malaria control services were already long-established in Turkey, the existing control organization, together with its extensive operational network, was refocused on eradication, allowing the preparatory stage to be skipped. The eradication programme thus started with the attack phase *(39)*. A different approach to the activities was adopted in different groups of provinces.

The programme relied on an integrated approach, combining vector control and surveillance operations in line with WHO recommendations *(1)*. The attack phase relied heavily on IRS with DDT. In areas in consolidation, active surveillance was the priority, and mechanisms were established to cope with any possible foci, new or residual *(1)*.

VECTOR CONTROL

The main control intervention in the attack phase was IRS with DDT, complemented by intensive larviciding and environmental management. The country was divided into groups of provinces (see Box 1). Initially, because all target provinces were under attack phase, IRS operations were conducted in all regions. Coverage of the population in these provinces was increased over the years, reaching a peak of 8 590 868 people in 1961. From 1962, the population protected by IRS gradually decreased as the provinces in region A were shifted to the consolidation phase and only residual foci were sprayed (Farid, Choumara & Bosci, 1968, unpublished report).

In 1961, spraying coverage ranged from 86% in region B to about 88% in areas A and C. In 1962 it was 96%, in 1963 93–96%, in 1965 almost 100%, and in 1966–1969 85–96%. The data showed intensive spraying operations

covering almost all the affected population in endemic areas, which led to a substantial reduction in mosquito population density and longevity, and in malaria transmission (Figures 29 and 30).

The staff of the national malaria eradication service (NMES) and an additional 5000 spray-men were involved in the organization and performance of the spraying operations supervised by the sanitarians.

During the attack phase, DDT spraying (dosage 2 g/m^2) of walls and roofs of all permanent and temporary dwellings inside the villages and within a 500-metre radius around them was carried out once a year in April/May (Figure 26). In 1959, dieldrin was introduced as an alternative insecticide in areas with DDT resistance. Larviciding and environmental improvements, especially cleaning of the irrigation canals, were carried out as supportive measures against the main vector, *An. sacharovi* (Figures 27 and 28).

Figure 26. DDT spraying in Turkey, 1972

Credit: WHO/Didier Henrioud

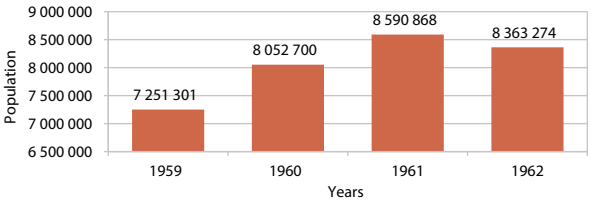
Figure 27. Larviciding in Turkey, 1972

Credit: WHO/Didier Henrioud

Figure 28. Monitoring and cleaning of the irrigation canals in Turkey, 1972

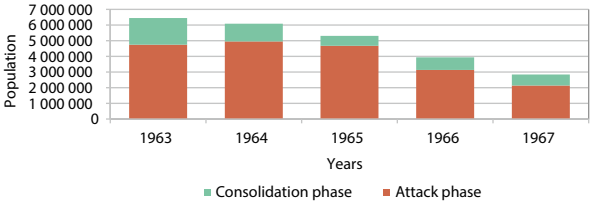
Credit: WHO/Didier Henrioud

Figure 29. Population protected by IRS, 1959–1962



Source: Farid, Choumara & Bosci, 1968 (unpublished report)

Figure 30. Population protected by IRS during attack and consolidation phases, 1963–1967



Source: Farid, Choumara & Bosci, 1968 (unpublished report)

Vector resistance to insecticides applied

Resistance of *An. sacharovi*, *An. maculipennis* subspecies, *An. m. subalpinus* and *An. hyrcanus* to DDT and dieldrin had been increasing and becoming more widespread since 1958–1959 (Acheson, 1993; de Zulueta, 1972; unpublished reports). DDT was replaced by dieldrin (0.5 g/m^2) in the Adana area as from 1959. The following facts were reported later:

- 1967–1968: *An. maculipennis* highly resistant to DDT and dieldrin in Marmara and Central Anatolia;
- 1970: *An. sacharovi* resistant to dieldrin (de Zulueta, 1972, unpublished report);
- 1971: *An. hyrcanus* resistant to DDT and dieldrin in the Çukurova Plain;
- 1974: *An. sacharovi* – incipient resistance to fenithion, fenitrothion and propoxur, none of which had ever been applied by the NMES, but which were used in agriculture, providing evidence that agricultural use of pesticides has contributed to selection of resistance to organophosphorus and carbamate compounds.

EPIDEMIOLOGICAL SURVEILLANCE

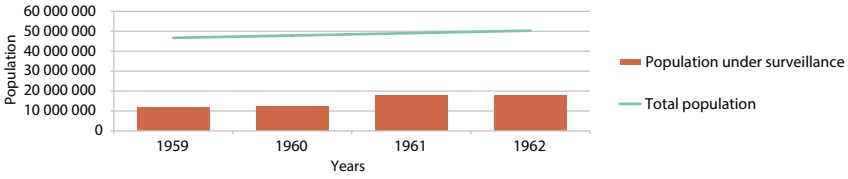
Active surveillance for eradication was established in Turkey in 1957. At the height of the programme in 1958, 1630 sanitary technicians (also called sanitarians or surveillance agents) were engaged in the following:

- *Active case detection* - through house-to-house visits by sanitarians (every two weeks during the transmission season and once a month at other times). During the visits, sanitarians took blood from all individuals who had fever at the time or at any time in the previous two weeks and administered a single dose of pyrimethamine (50mg) as presumptive treatment. Blood slides were sent to the regional laboratory.
- *General surveys* - carried out by blood sampling of infants (0–1 year) and children (1–5 years) to determine whether transmission was still continuing at the end of each year's transmission season in all regions.
- *Passive case detection* - (strengthened from 1961 onwards) through scaled-up malaria vigilance, resulting in an increased number of febrile patients who were tested for malaria.
- *Case investigations* - the surveillance team undertook case investigations, involving a complete survey of the village in order to identify the source of infection and decide on future actions.
- *Radical treatment* - with chloroquine/quinine and pyrimethamine for all slide-positive cases.
- *Notification of malaria cases* - notification of malaria cases became obligatory in January 1930.

The total number of people under surveillance amounted to 11.8 million in 1959, rising gradually to 17.7 million in 1962 (Figure 31) (Farid, Choumara & Bosci, 1968, unpublished report).

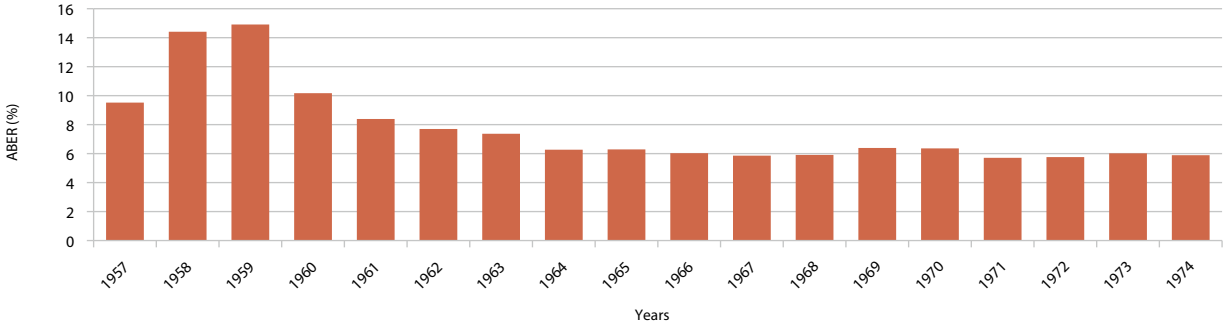
Annual blood examination rate (ABER) was high in 1958–1960 and then remained stable at around 6.0% nationwide over the period 1964–1974 (Figure 32).

Figure 31. Population under surveillance, 1959–1962



Source: Farid, Choumara & Bosci, 1968 (unpublished report)

Figure 32. Annual blood examination rate, 1957–1974



Source: national malaria control programme

LABORATORY SUPPORT

A good laboratory network for malaria diagnosis existed in Turkey. Laboratory diagnosis of malaria was performed at different levels – in zone laboratories (in 58 zones), in four control centres (in Ankara, Diyarbakır, Adana and Aydın) and in two central laboratories in Ankara and Adana. Staffing levels were calculated on the basis of one microscopist for every 150 000 people under ACD, but not all positions were actually filled. There was considerable training/retraining of NMES staff, especially in laboratory diagnosis (Figure 33); laboratories were gradually provided with new microscopes and consumables, and unified reporting forms were developed.

More than 50 years ago, Turkey already had a system of cross-checking (quality control) for malaria laboratory diagnosis. Once a month, zone laboratories sent all negative and positive slides to the designated control centre; the control centre examined all positive slides and 20% of the negative slides and then forwarded all the slides to the central laboratory. There, the senior microscopist selected as large a proportion as practical to be checked.

Figure 33 Training in malaria microscopy, 1972

Credit: WHO/Didier Henrioud

HEALTH EDUCATION

According to the report of a 1961 WHO mission, Turkey had a number of channels for disseminating information on the NMEP (through teachers, agricultural planning committees, village clubs, the army, police officers, etc.) although not all were used efficiently (Nyswander, 1961, unpublished report). The report recommended the development of public health education services

and administrative planning for reaching the public with health education messages.

INTERSECTORAL COLLABORATION

From the start of the eradication programme, efforts were made to involve other ministries and organizations in the programme activities. The Malaria Coordination Committee, established in 1959, included members from the Ministries of Education, Interior, Defence, Public Works, Agriculture and Social Affairs (Farid, Choumari & Bosci, 1968, unpublished report).

INTERNAL AND EXTERNAL SUPPORT AND COLLABORATION

The malaria eradication programme was coordinated and conducted by the NMES, the structure and functions of which are presented in Annex 7.

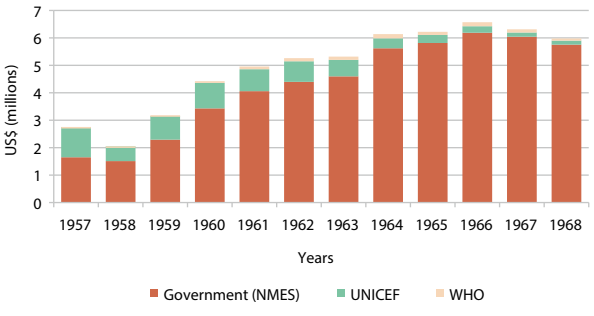
The programme received support from international organizations, both through regular technical assistance (WHO) and financially (WHO, UNICEF). Numerous WHO experts provided technical assistance.

BUDGET/COSTS

Financial support for the malaria eradication programme in Turkey increased progressively. Budgetary allocations for the programme were provided by the Government, WHO and UNICEF (Farid, Choumara & Bosci, 1968, unpublished report). Details of programme funding for the period 1957–1968 are shown in Figure 34.

Figure 34. Budgetary allocations for malaria eradication programme, 1957–1968

Note: US$ not adjusted for 2013.



Source: Farid, Choumara & Bosci, 1968 (unpublished report)

Why was the goal of malaria elimination not achieved in the 1970s?

By the end of 1974, much of Turkey was no longer experiencing local malaria transmission and 93% of the country was under consolidation.

According to the GMEP, malaria morbidity and mortality would become extremely rare in most countries one to two years after beginning of the insecticide campaign *(41)*. However, as previously mentioned, this aim was not achieved in south-eastern Turkey, where the malaria burden remained high. Transmission had not been interrupted and by 1974 this small area was still in the attack phase of the programme (Ramsdale, 1977, unpublished report). Many parts of the country in consolidation phase also remained highly receptive and vulnerable; the reasons for this, which are complex, are discussed below.

EPIDEMIOLOGICAL CHALLENGES: RECEPTIVITY AND VULNERABILITY

Receptivity

A number of factors contributed to the failure to reduce receptivity in many areas of Turkey:

- Well-developed agriculture in Turkey used various irrigation schemes, creating good breeding places for mosquitoes. Even on the plateau, where receptivity was less, the waterlogged edges of the many inland lakes permitted breeding of *An. sacharovi*.
- Although *An. sacharovi*, *An. superpictus* and *An. maculipennis* are largely zoophilic species, the seasonal transfer of flocks of goats and sheep flocks from lowland villages to the cooler plateau before the malaria season may have increased the risk of humans being bitten in the summer months because of the relative absence of livestock.
- The malaria season in Turkey is quite long (up to 5 months) especially in the lowlands, which tends to promote the onward transmission of infections.
- Some human habits, such as sleeping outdoors in the summer, on verandas, on specially constructed

structures called "cherdak", or even in the fields, often without any shelter, favoured mosquito–human contact.

- The early development of resistance of the local *An. sacharovi* to DDT (1958–1959) and later to organophosphate and carbamate insecticides also interfered with the reduction of vector density. In addition, widespread agricultural use of insecticides accelerated the development of resistance.
- Receptivity of the southern provinces has always been higher because of the:
  - Extensive breeding places. Suitable water collections for the breeding of *An. sacharovi* and *An. superpictus* were readily found in the Çukurova plain *(42)*.
  - Relatively long malaria transmission season (May–October), with the two main malaria vectors, *An. sacharovi* and *An. superpictus*, being widely distributed in the area from April to November (Farid, Choumara & Bosci, 1968, unpublished report).
  - The Çukurova plain was the location of the large, multi-purpose Lower Seyhan Project for flood control, hydroelectric power production and irrigation, which included irrigated land of 170 000ha. The network of open earth canals that formed the drainage and irrigation system offered suitable conditions for mosquitoes to breed.
  - There were many rice fields in the region and the Governmental Resolution stating that they should be located at least 3 km from the settlements was not strictly observed *(42)*.

Vulnerability

As a large country at the crossroads of Asia and Europe, Turkey has always been influenced by domestic and international population migration.

- Internal (within-country) malaria importation
  - There was malaria importation from the highly malarious provinces of south-eastern (oriental) Turkey to the southern provinces that were already in the consolidation phase. The huge demand for labour to work in rice and cotton plantations and in the irrigation schemes gave rise to the annual movement of a labour force of 50 000–200 000 people, which represented a high risk to territories that were already in consolidation phase. Some authors estimated that the number of the cases internally imported within areas in the consolidation phase amounted to 91% of the total number of imported cases (42, 43; Farid, Choumara & Bosci, 1968, unpublished report).
  - Military personnel stationed in the oriental region but spending vacations in their malaria-free home provinces were a further source of malaria importation (42; Farid, Choumara & Bosci, 1968, unpublished report).
- International malaria importation
  - Some 33 000 pilgrims annually were at risk of malaria infection during bus journeys to and from Mecca; although malaria did not occur in Mecca, overnight stops were made in malaria–endemic localities. For this contingent, however, NMES organized a number of surveillance and prevention measures (42; Farid, Choumara & Bosci, 1968, unpublished report).
  - Importation was also possible via students from Iraq, Saudi Arabia, the Syrian Arab Republic and some African countries who attended universities in Turkey. However, these cases were confined to Ankara and Istanbul – the cities with a greater number of universities, where the risk of onward transmission was less.
  - The exchange of military missions between Turkey and Pakistan also resulted in some malaria importation.
- The epidemiological risk for the provinces in consolidation phase was as follows:
  - The 11 provinces in the south and west of Turkey (Gaziantep, Hatay, Adana, Icel, Edirne, Antalya, Isparta, Burdur, Denizli, Muğla and

Aydın), population 3 857 592, were the most vulnerable because of the migration of a huge labour force from the eastern provinces; at the same time, receptivity in these provinces was high because of the high density of *An. sacharovi* and *An. superpictus* and the comparatively long malaria transmission season.

- The rest of the provinces *(47)* were advanced in the consolidation phase, and only isolated cases were detected. The receptivity in some of the valley provinces is relatively high but the vulnerability was regarded as rather low (Farid, Choumara & Bosci, 1968, unpublished report).

OPERATIONAL ASSESSMENT

According to WHO guidelines the attack phase of malaria eradication should last 4–5 years *(41)*. In Turkey, however, planned deadlines were missed and the goal of eliminating malaria countrywide by 1966 was not met. The programme was extended, but even by 1975 transmission had not been completely interrupted. Most provinces were in a consolidation phase by 1973, with total spraying coverage being replaced by spraying only in residual foci. In the south-east of the country, however, transmission was not interrupted and these areas remained in the attack phase.

A number of constraints and challenges, discussed below, prevented the goal of malaria eradication being met.

Vector control

The eradication approach called for total coverage of all malaria areas, which usually meant residual spraying with insecticides of all houses of in those areas *(41)*. Extensive vector control activities, mainly involving insecticide spraying, were carried out in the country. However, WHO experts conducting an evaluation of the programme in 1968 reported failure to adhere strictly to the spraying timetable, insufficient spraying coverage in the eastern provinces, and the need for improvements in these activities. (Farid, Choumara & Bosci, 1968, unpublished report).

The early appearance of resistance to DDT and other insecticides interfered significantly with efforts to reduce the vector density.

Surveillance activities

In the south-eastern provinces in the attack phase, staff numbers were insufficient for effective ACD. In addition, a shortage of laboratory consumables and antimalarial drugs hampered effective case management. At the beginning of the programme activities, ACD was the only routine malaria screening device in rural areas, and PCD was neglected.

As the malaria burden reduced in the course of the programme, the disease was given a lower priority, and efforts and financial support declined accordingly. This led to a weakening of the organizational structure of the programme. As a result, the number of malaria cases began to rise, slowly but steadily, from 1970 onwards, especially in the plains of Çukurova, Hatay and Icel (Figure 7).

Administrative and managerial

Progress of the programme from 1957 to 1958 was hampered by a shortage of medical and other personnel, and the same problem was reported in subsequent years, up to 1975 (40; Farid, Choumara & Bosci, 1968, unpublished report). Understaffing was especially apparent in the eastern part of the country where socioeconomic and living conditions were worse than in other areas.

As the malaria programme progressed, programme personnel were transferred from provinces where transmission had been already interrupted to areas that remained endemic; the time taken to carry out this transfer affected timely actions in the endemic provinces. There was also a need for improved cooperation between NMES and the basic health services if PCD was to be more effectively carried out.

CONCLUSION

Turkey's malaria eradication programme led to a dramatic reduction in the malaria burden; most provinces advanced to the consolidation phase, with only single cases detected, and local transmission was interrupted over a great part of the country. However, south-eastern provinces remained in the attack phase. Prolongation of the programme was made necessary: by the high receptivity of some areas where irrigation schemes created good breeding places for mosquitoes; by the early appearance in local vectors of resistance to the insecticides applied; and by the understaffing in some areas that prevented adequate coverage and performance of spraying and surveillance operations.

Why did malaria epidemics occur in the 1970s–1990s?

CAUSES OF THE ÇUKUROVA EPIDEMIC IN 1977

Many factors influenced both receptivity and vulnerability and thus contributed to the deterioration of the malaria situation that culminated in the epidemic of 1977 (Table 6). The factors included the following:

- In the mid-1970s, an extensive irrigation project was started on the Çukurova plain, including the area of Adana. The consequent rapid increase in agricultural development and industrial expansion resulted in a substantial migration of workers from eastern areas of Turkey where malaria was more prevalent at that time (Sharif et al., 1978; Trigg, 1994; Kouznetsov, Gratz, Espinoza, 1995; unpublished reports).
- A World Bank supported project to build dams and extensive networks of draining canals constructed throughout the fertile Çukurova/Amikova plain in the south-east of the country. The irrigation system contributed much to the resurgence of malaria in this part of Turkey and influenced its incidence elsewhere in the country where extensive collecting of river water was taking place, as pooling of water into scattered ponds created many mosquito breeding sites (Samsun plain in the north).
- Many of the drains of the Seyhan River irrigation scheme, which extended to 1446 km, were choked with vegetation, making water flow very slow and providing suitable areas for *An. sacharovi* to breed (Sharif et al., 1978, unpublished report). Cleaning operations slowed down in the 1970s and there was a sharp increase in the density of *An. sacharovi*, especially in the area of the irrigation project.
- The widespread development of resistance of the local *An. sacharovi* to organochlorine compounds and, soon after, to the organophosphate insecticides that replaced them, contributed to the deterioration of the situation that resulted from the widespread use of pesticides (Kouznetsov, Gratz, Espinoza, 1996, unpublished report).
- Many inhabitants reportedly refused domiciliary spraying because they objected to the odour of the insecticide (malathion).
- The migrant seasonal labour force was a powerful source of infection. The extensive agricultural development of the Çukurova/Amikova region attracted a large labour force, (around 800 000 people), mainly from south-east Anatolia, during the sowing and harvesting periods from spring to autumn. They lived in tents along water canals where they were exposed to mosquito bites. Their movements were largely uncontrolled and they were not covered by medical care (Sharif et al., 1978, unpublished report). The return of these workers to their places of origin resulted in the re-export of parasites from the plains, taking malaria to other areas of the country that were already in consolidation phase (Figure 35).
- The growing international trade traffic exposed visitors to the Çukurova /Amikova plain to the risk of contracting malaria and spreading it to other parts of Turkey (Sharif et al., 1978, unpublished report).
- Some programmatic challenges – notably, inadequate surveillance coverage in 1970–1975 – also played an important role in preventing the timely recognition of changes in receptivity

and vulnerability. With the decline of malaria as a major problem, other aspects of public health made increasing demands on limited resources, and the malaria service came under sustained pressure to curtail expenditures. The epidemiological situation had improved so substantially that Turkey considered it could no longer sustain the investment of such a large proportion of its health budget in malaria eradication; these services were therefore radically reduced. The surveillance and control activities were no longer effective in detecting and responding quickly to changes in vulnerability and receptivity and to the increase in cases in the migrating and resident populations (*45;* Ramsdale, 1977, unpublished report; Trigg, 1994, unpublished report).

Figure 35. Schematic presentation of seasonal population movements in Turkey

Source: reference 44

CAUSES OF THE MALARIA RESURGENCE IN SOUTH-EASTERN TURKEY IN 1993–1996

The socioeconomic structure of the south-east region was less advanced than in other parts of the country. This was the site of the extensive Southeastern Anatolia Development Project for irrigation, which brought with it significant changes in the environment, agricultural practices and human migration.

The increase in the incidence of malaria was particularly marked in areas where the SAP was being implemented. However, according to the results of a survey on social changes in the region, outbreaks could not be attributed solely to the impact of the expansion of the irrigation network since they also occurred in areas where construction had yet to begin (Trigg, 1994, unpublished report). Lessons had clearly been learned from the 1977 epidemic and the irrigation canals were made of concrete construction and covered, which prevented the formation of additional mosquito breeding sites.

Table 6. Comparison of the factors contributing to malaria epidemics in 1977 and 1993–1996

Factors	Epidemic in 1977	Epidemic in 1993–1996
Area of epidemics	South-east part of the country; Çukurova/Amikova plain	South-east Anatolia
Economic development	Extensive irrigation project on the Çukurova/Amikova plains	Extensive Southeastern Anatolia Development Project (SAP) for irrigation
	Rapid increase in agricultural development	Rapid increase in agricultural development
	Increased industrial expansion	Increased industrial expansion
		Socioeconomic structure of the south-eastern region less advanced than in other parts of the country
Receptivity	Increase in mosquito breeding sites along the irrigation scheme: ponds resulting from over-irrigation; leakage of irrigation canals not constructed with concrete; abundant growth of hydrophilic vegetation	Formation of new mosquito breeding sites along the irrigation scheme prevented by building covered, irrigation canals of concrete, although some water distribution canals still open
	Sharp increase in the density of *An. sacharovi*, especially in the area of the irrigation project	
	Widespread development of resistance of the local *An. sacharovi* vector to organochlorine and organophosphorus insecticides	
Vulnerability	Seasonal (spring – autumn) migration of labour (approximately 800 000 people), mainly from malaria-endemic south-east Anatolia	Mass migration of the population from remote, often malaria-endemic, rural areas towards provincial and district towns
	Poor living conditions of migrants (sleeping in tents along water canals) and high exposure to mosquito bites	Increased human–mosquito contact for migrants living in improvised houses in periurban areas and in nearby villages located close to existing water bodies
	Growing international trade traffic and tourism exposing visitors to the Çukurova/Amikova area to malaria risk	Flow of migrants from neighbouring countries (Iraq, Islamic Republic of Iran, Syrian Arab Republic) due to political instability and the Gulf War (1990–1991)
		Drastic increase of malaria importation due to seasonal migration of workers from neighbouring countries – Iraq, Islamic Republic of Iran, Syrian Arab Republic – with a peak in 1995 and 1996

Factors	Epidemic in 1977	Epidemic in 1993–1996
Programmatic	Insufficient coverage by the surveillance system 1970–1975	Insufficient access to medical care because of the inadequately staffed and insufficient health facilities in Anatolia, especially in large rural areas
	Considerable reduction in financing and in surveillance services	Insufficient malaria programme staff and a shortage of qualified professionals with malaria expertise in Anatolia
	Insufficient IRS coverage resulting from the high rate of refusal of domiciliary spraying because of the odour of the insecticides	Insufficient malaria control and surveillance activities
External		Gulf War (1990–1991)
		Deteriorating malaria situation in neighbouring countries: in 1993 an epidemic of *P. vivax* malaria occurred in the neighbouring four provinces of Iraq

Vulnerability

Analysis of the available data indicates that changes in the vulnerability of Southeastern Anatolia played a major role in development of the epidemic:

- There was massive internal migration of the population from remote, often malaria-endemic, rural areas towards provincial and district towns, where the population had more than doubled by 1996. The migrants settled in improvised houses in periurban areas and in nearby villages located close to existing water bodies where some agricultural activities were possible. Such an environment created particularly favourable conditions for vector breeding and human–mosquito contact (Kouznetsov, Gratz, Espinoza, 1995, unpublished report).
- The situation deteriorated further with seasonal external migration and the flow of migrants from neighbouring countries (Iraq, the Islamic Republic of Iran, the Syrian Arab Republic) as a result of political instability and the Gulf War (1990–1991). Migrant workers were at particular risk of malaria, as they tended to live close to the irrigation canals and other vector breeding areas, sleeping in tents or outdoors in the summer, without personal protection against mosquitoes.
- Malaria importation rose sharply with the seasonal migration of workers from neighbouring countries – Iraq, the Islamic Republic of Iran, and the Syrian Arab Republic – with peaks in 1995 and 1996 (342 and 250 cases respectively) (Figure 35).

Programmatic challenges

- Health facilities in Anatolia were too few and were inadequately staffed, especially in large rural areas, resulting in insufficient access to medical care (Trigg, 1994, unpublished report).
- Distribution of malaria programme staff did not mirror the needs of the country at the time. In addition, there was a shortage at provincial level of qualified professionals with malaria expertise, particularly epidemiologists, to analyse the local situation and guide implementation of the national plan for malaria control. Malaria preventive activities, as well as health education programmes, were therefore inadequate (Trigg, 1994, unpublished report).
- Difficulties in delivering adequate health care were exacerbated by the distribution of the population in small settlements, security problems, and the existence of cultural and linguistic differences among the local population in these areas.

- The malaria situation in neighbouring countries had deteriorated: in 1993, there was an epidemic of *P. vivax* malaria in the neighbouring four provinces of Iraq.

How were the epidemics controlled?

CONTROL OF THE 1977 EPIDEMIC

The dramatic epidemic explosion in Çukurova/Amikova (Stratum 1b) in 1997, necessitated the reintroduction of attack phase operations in this large and economically important region (46; Ramsdale, 1977, unpublished report; Sharif et al., 1978, unpublished report).

Following the declaration of a state of emergency by the Turkish Government and an international appeal under the auspices of the WHO Regional Office for Europe, supplies and equipment became available, enabling urgent implementation of a programme specifically aimed at containing the epidemic and preventing its spread to other areas of Turkey and neighbouring countries *(35)*.

Interventions for containment of the epidemic

An integrated approach was adopted, designed to rapidly reduce the sources of infection and the vector density, as well as to protect the healthy population. Containment of the epidemic was achieved quickly and the number of malaria cases had been dramatically reduced by 1979.

The interventions implemented can be summarized as follows (Onori, 1978; Sharif et al., 1978; Rafatjan, 1978; unpublished reports):

Vector control operations for fast reduction of the mosquito population density

- Indoor residual spraying greatly contributed to the reduction of transmission in the malaria foci.

The following supportive vector control activities were also carried out:[1]

- Larviciding operations in and around urban centres (oil and temephos were used).
- Large-scale distribution of larvivorous fish (*Gambusia affinis*); use of *Bacillus thuringiensis* (WHO, 1985, unpublished report).
- Cleaning the drainage canals.
- Thermal fogging with insecticides, and ULV application of malathion although there are no data available on their efficiency.

Surveillance operations that brought about prompt reduction of the source of infection

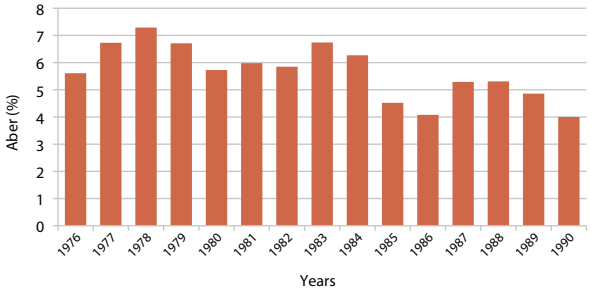
- Intensive case detection in affected areas allowed sources of infection to be identified and radically treated.
  - In 1978, ACD involved household visits every two weeks in high-risk localities (mainly in Stratum 1), monthly visits in localities with moderate-to-high risk and twice-yearly rounds in low-risk settlements, usually from May to October. To intensify ACD and improve case management as a whole, mobile teams were assigned to the affected areas.
  - The blood collection network for PCD comprised 9900 centres within hospitals, health institutions, dispensaries, etc., where blood sampling of patients with suspected malaria was conducted. In urban areas, additionally, surveillance agents visited medical institutions and collected blood from all patients with fever (Sharif et al., 1978, unpublished report). Over the period 1975–1978, PCD improved markedly

1 There are no data on whether these activities had additional effect.

with the proportion of slides examined rising from 1.67% to 24.7% and the ABER increasing simultaneously (Figure 36).

- There was radical treatment of malaria patients (with chloroquine and primaquine) and "winter" retreatment with primaquine (15mg/day for 14 days) of all positive cases discovered in the previous malaria season (WHO, 1985, unpublished report).

Figure 36. Annual blood examination rate, 1976–1990



Source: national malaria control programme

Protection of the receptive population

From the beginning of May until the end of September, the resident population in the most receptive areas was given seasonal massive chemoprophylaxis – chloroquine (600mg base)[1] and pyrimethamine (50mg base), distributed at 2-weekly intervals – but overall coverage and supervision were unsatisfactory (*35*; Sharif et al., 1978, unpublished report; WHO, 1985, unpublished report).

Strengthening the national malaria programme network

Strenuous efforts by the Turkish Government to reorganize the antimalarial services involved the recruitment of large numbers of personnel, particularly surveillance agents, and the solving of logistic problems. Between 1976 and 1978, the number of laboratories rose from 65 to 80 and of microscopists from 197 to 329.

All operations were carried out approximately according to schedule *(35)* and resulted in a dramatic improvement in the situation by 1979.

Funding

Containment of the 1977 epidemic required funding from the Government and allocations increased considerably from TL 270 044 000 (US$ 54 507 431)[2] in 1977 to TL 838 272 000 (US$ 119 709 870) in 1978 (Sharif et al., 1978, unpublished report). Assistance with consumables, drugs, etc. was provided by other European countries.

Outcome

Through concentrated efforts and at considerable cost, the incidence of malaria began to decline in this area in 1978, following the reintroduction of large-scale control operations. By 1979, the reported number of malaria cases had dropped to 29 324, and the epidemic was considered contained. (*35*; WHO, 1985, unpublished report).

The vector control measures conducted during the transmission season and the scaled up surveillance in Stratum 1 in 1978 are believed to have had an impact in containing the epidemic. Governmental support and funding, together with the assistance of WHO and other European countries, were crucial for the improvement of the situation.

Unfortunately, in the years after the epidemic, the weakness of intervention measures in Southeastern Anatolia meant that local transmission began to spread. The situation in the other highly receptive and vulnerable areas of Stratum 2 showed some deterioration, which could be related to the increased number of cases (parasite carriers) originating from Çukurova resulting from the epidemic wave of 1977 and the appearance of new foci (942 in 1977, 1390 in 1978). In Strata 3 and 4, where the malariogenic potential was much lower, the same trend was observed, with a relatively small increase in the number of cases resulting

1 The WHO recommended dose of chloroquine is 300mg base weekly.

2 US$ inflation has been calculated for 2013 using US inflation calculator (http://www.usinflationcalculator.com/).

from malaria importation from Çukurova/Amikova (*35;* Sharif et al., 1978, unpublished report).

CONTROL OF THE 1993–1996 EPIDEMIC

Recognizing the seriousness of Turkey's new malaria epidemic, the national malaria programme had to remobilize the entire network to undertake malaria control and surveillance interventions once again. Emergency activities focused on the prompt reduction of transmission and were generally similar to those carried out during the 1977 epidemic.

Vector control

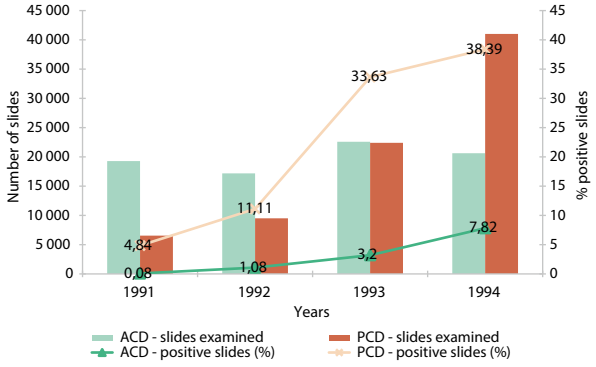
Vector control relied on IRS (the principal intervention), with larviciding, thermal spraying and ULV applications as supporting interventions. The measures were undertaken by malaria programme staff from the Provincial Health Directorate and from health centres. Some municipalities also undertook vector control interventions. Deltamethrin was used in Şanlıurfa in 1997 and 1998 although there were no data on the susceptibility of local vectors; deltamethrin resistance was reported in the Çukurova region in 1997. Temephos was the larvicide of choice and was used to treat breeding sites in rice fields in the high-risk areas (Trigg & Muir, 1998, unpublished report).

Surveillance

Activities for prompt case-finding included ACD, conducted predominantly in the high-risk areas and among resettlers and migrant workers. PCD was carried out by the medical institutions of the national health service among the populations of their respective areas. Private physicians who detected malaria cases referred them to the nearest health facility for laboratory confirmation and treatment.

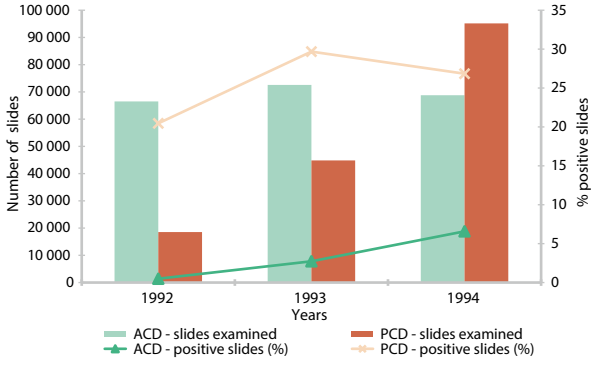
As shown in Figures 37 and 38, the number of slides collected during ACD in Batman (1991–1994) and Diyarbakır (1991–1993) provinces varied little during the period leading up to the epidemic, which might be expected for routine surveillance but not for intensified active surveillance. By contrast, the number of slides examined during PCD in both provinces increased more than 5-fold, indicating that health facility workers had achieved and maintained a good level of vigilance. Both provinces showed a clearly rising trend in the proportion of slides that were positive; in 1994, SPR levels reached 38.39% in Batman and 26.84% in Diyarbakır, indicating the beginning of the epidemic (Kouznetsov, Gratz, Espinoza, 1995, unpublished report).

Figure 37. ACD and PCD in Batman province, 1991–1994



Source: Kouznetsov, Gratz & Espinoza, 1995, unpublished report

Figure 38. ACD and PCD in Diyarbakır province, 1991–1994



Source: Kouznetsov, Gratz, Espinoza, 1995, unpublished report

Radical treatment of malaria with chloroquine and primaquine was carried out at the health care centres. In addition, during the transmission season, chemoprophylaxis with chloroquine (600 mg base adult dose) was administered every 2 weeks to seasonal workers and resettlers.

There was strong political commitment to, and financial support for, containment of the outbreak. Additional

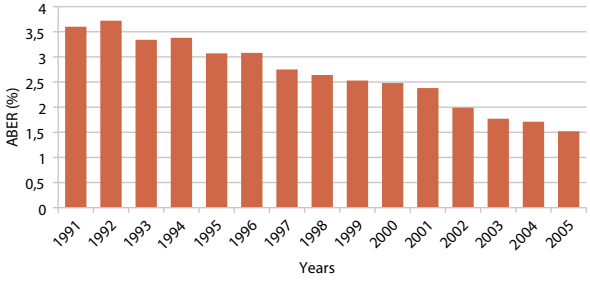
financial support (US$ 200 000) came in 1997–1978 from a UNDP/SAP project on strengthening the national capacities of the malaria services in Turkey; priority areas for the project, which lasted 14 months, were Southeastern Anatolia and the Çukurova/Amikova plains).

Programmatic challenges in the timely containment of the epidemic

It was some years before the epidemic was contained. The programmatic challenges of timely containment included (Kouznetsov, Gratz, Espinoza, 1995, unpublished report):

- Drastic reduction in the scale of vector control operations, particularly in the years 1992–1994, as a consequence of a lack of resources to purchase adequate supplies of insecticides for IRS, equipment and drugs.
- Insufficient coverage of the populations of malaria foci by IRS from 1992 due to the shortage of insecticides.
- Lack of entomological evaluations before and after interventions to assess the results achieved.
- Lack of regular and systematic monitoring of mosquito resistance to the insecticides used. Introduction of new insecticides without prior studies on the susceptibility of local vectors.
- IRS operations carried out when insecticides arrived in the provinces, rather than in response to seasonal features of malaria.
- Insufficiently effective larval control in support of other vector control interventions, because of a lack of resources (manpower, equipment, insecticides, transport).
- A serious shortage of trained staff in the provinces.
- A national decline in ABER over the whole period (Figure 39).

Figure 39. ABER nationwide, 1991–2005



Source: national malaria control programme

- An increase in time-lag between laboratory diagnosis and treatment as the number of malaria cases increased, as well as delays in delivery of antimalarial drugs from the centre to the provinces.

Outcome

Overcoming the difficult period of the epidemic, the malaria programme continued with complex surveillance interventions that led to the disease becoming focalized in only a few provinces in the south-east. A stable reduction in malaria transmission and disease burden had been achieved by 2005.

HOW IS THE PROGRAMME CHANGING TO ACHIEVE MALARIA ELIMINATION BY 2015?

Changes in the malaria programme followed the launch by the Turkish Ministry of Health of an ambitious new health policy – the "Health Transformation Programme" (HTP) – in 2003. The main objective of the HTP is to maintain well-being and prevent illness, and priority has been given to prevention. Primary health care services have been strengthened and the efficient control of epidemic diseases has been emphasized (46).

Particular attention has focused on malaria – historically one of Turkey's leading infectious diseases. Turkey was considered to have achieved the conditions that make the goal of elimination feasible and which would allow the malaria programme to make the transition to elimination. The country therefore joined the initiative embodied in the Tashkent Declaration, *The Move from Malaria Control to Elimination,* signed by the Minister of Health in 2005.

Justification for moving to an elimination programme

The favourable epidemiological factors identified included the following:

- feasibility of reducing malaria morbidity demonstrated in the past;
- visible impact of malaria control programme interventions, with a substantial reduction in the incidence and prevalence of *P. vivax* (the only malaria parasite species transmitted locally in the country since 1970);
- malaria distribution confined to a small geographical area in south-eastern Turkey (mainly in just three provinces);
- the seasonal character of malaria transmission;
- the efficacy of various methods of vector control;
- the susceptibility of principal and secondary malaria vectors to the insecticides currently in use in the country;
- large-scale application of biological methods for vector control;
- the availability of effective technologies and tools to control and eliminate malaria.

Socioeconomic factors that could contribute positively to malaria elimination included the following:

- strong political commitment to achieving a greater impact on the national malaria situation, including endorsement of the Tashkent Declaration;
- governmental resolve to pursue the malaria elimination programme, providing it with political and financial support;
- political and financial support from the Government for socioeconomic development in malaria-affected areas of the country;
- substantial recent improvements in the quality of life;
- improved nutritional status of the population.

Goal, strategies, interventions

In accordance with the Tashkent Declaration, a national strategy and plan of action for malaria elimination, focusing on intensive malaria surveillance, were developed and implemented.

The ultimate goal of the new national strategy was to interrupt malaria transmission within the country by 2015. In areas where malaria had been eliminated, attention was to be given to maintaining a malaria-free status. Particular emphasis was also placed on tackling problems associated with imported malaria.

STRATEGIES APPLIED

Turkey took an integrated and complex approach to malaria control and elimination, with activities focused on scaling up epidemiological surveillance. The main directions of the new elimination programme were founded on: case-based surveillance, including laboratory confirmation of each case by quality-assured/controlled laboratories; compulsory notification; case and focus investigation; monitoring and classification of foci; and integrated vector control in foci and in case of emergencies. Features of the programme can be summarized as follows:

- case detection and management;
- epidemiological investigation of cases and foci;
- a prompt health information system;
- monitoring the determinants of the malaria situation;
- anti-vector and antimalarial interventions;
- training of national malaria programme staff;
- public health education and community mobilization;
- monitoring and evaluation of the effectiveness of interventions;
- intersectoral collaboration;
- cross-border cooperation.

One of the core activities was the strengthening and upgrading of the existing malaria surveillance system and mechanisms so as to provide reliable information to programme management, key public health personnel, professionals and health care workers, enabling them to make informed, evidence-based decisions on actions to be taken. Active and passive case detection were given special emphasis.

Vector control was designed to reduce the lifespan of female mosquitoes to prevent the development of sporozoites (by IRS), reduce larval density (by use of larvivorous fish – specific chemical larvicides were not used), and reduce human–vector contact (by use of mosquito nets). The activities of programme staff concentrated on reducing and preventing transmission in residual or new active foci.

Turkey's malaria elimination strategy and plan of action are proving successful. Local malaria transmission has been focalized in the past few years – limited to just a few foci in three provinces (Diyarbakır, Şanlıurfa and Batman) in the south-east. The numbers of malaria cases and active foci have declined dramatically, with the last official registration of indigenous cases in 2009. The few isolated autochthonous cases in 2010 and 2011 were classified by the national malaria programme as relapsing, although some additional epidemiological information on these cases is needed to definitively prove the interruption of the local transmission.

The policies, strategies and successful implementation of the programme were ensured by the Ministry of Health through a number of specific decrees, regulations and guidelines.

The national malaria programme is coordinated and implemented by the Ministry of Health (Malaria Control Department) and conducted by a well-trained and experienced network that includes specialized structures at central, intermediate and peripheral level. The overall improvement in the general health services involved in malaria elimination has also contributed to positive results. Strategies, interventions and supportive mechanisms are described in the following sections.

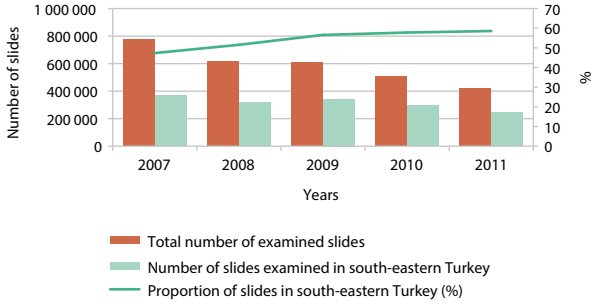
EPIDEMIOLOGICAL SURVEILLANCE AND CONTROL ACTIVITIES

Case detection

Case detection is addressed with particular emphasis. Although local malaria transmission has recently been limited to a few south-eastern provinces, laboratory examinations for malaria are performed all over the country (Figure 40). In recent years, the number of people examined has fallen (Figure 40), which correlates with country's declining malaria burden and population at risk. More than half of the slides examined came from the affected south-eastern provinces (Diyarbakır, Batman, Şanlıurfa, Mardin, Siirt, Gaziantep, Kilis, Adıyaman and Şırnak). The slides examined in these areas make up an increasing proportion of the total annual number of slides examined nationwide, increasing from 47.37% in 2007 to 58.59% in 2011.

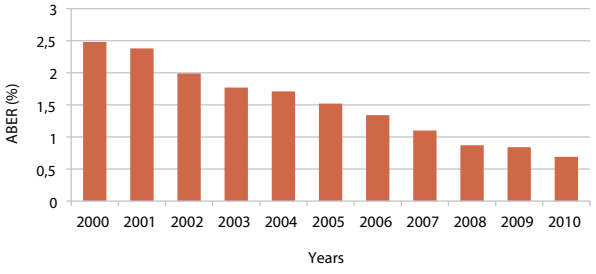
Although the ABER dropped from 2.48% in 2000 to 0.57% in 2011 (Figure 41), it was much higher in the south-eastern provinces compared with the national average (Figure 42). The slides examined in these provinces as a proportion of the total number of slides for the country shows an increasing trend. Coverage of the population in 2007–2010 with malaria examination was highest in Diyarbakır (ABER 10.96–12.52%), followed by Batman (4.78–8.88%); it is lower in Şanlıurfa (2.11–5.39%) and especially in Mardin (0.36–0.97%). In Kilis, no malaria examinations have been carried out in the past 4 years. The data indicate generally some decline in ABER and in vigilance and malaria surveillance activities in certain provinces of the south-east, which may create a risk of some cases being missed and of a renewal of transmission.

Figure 40. Slide examination for malaria, 2007–2011



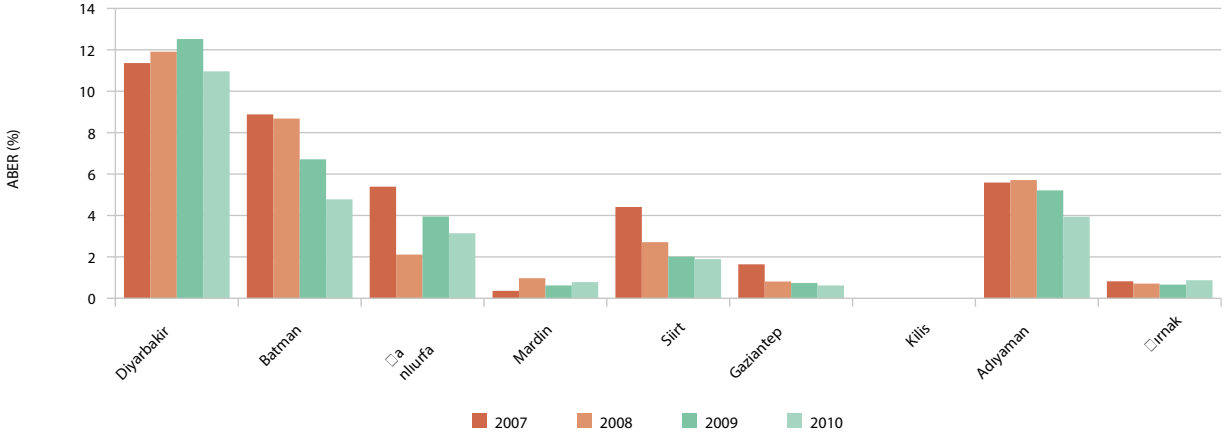
Source: national malaria control programme

Figure 41. Annual blood examination rate in Turkey, 2000–2010



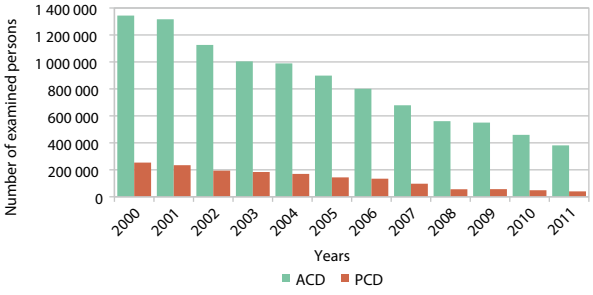
Source: national malaria control programme

Figure 42. Annual blood examination rate in south-east Turkey, 2007–2010



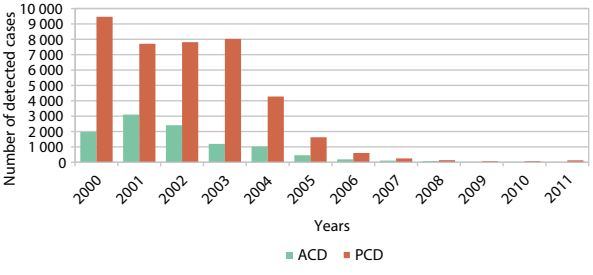
Source: national malaria control programme

Figure 43. Number of persons examined by ACD and PCD, 2000–2011



Source: national malaria control programme

Figure 44. Positive cases detected by ACD and PCD, 2000–2011



Source: national malaria control programme

Both ACD and PCD are carried out in Turkey: in areas with higher risk (according to NMCP estimation) all febrile patients seeking medical assistance in governmental or private health facilities are examined for malaria.

Regular ACD is carried out in risk areas, particularly in the south-east of the country, by:

- regular household visits (every two weeks); visits are conducted for 5 years after registration of last local case in a malaria focus;
- examination both of the families of malaria patients and of residents of the focus of a new case and – on epidemiological indications – co-workers;
- screening of risk groups: temporary agricultural workers, migrants and military personnel (examined for malaria once during the period of service).

During 2000–2011, the majority (86.23%) of laboratory examinations for malaria were conducted as part of ACD, which is an indication that the ACD system is functioning well. Most positive cases (79.2%) were detected by PCD (Figures 43 and 44). The gradual downward trend in the annual number of examinations (both ACD and PCD) is reflected in the declining ABER data.

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

Malaria has been a notifiable disease in Turkey since 1930. Currently, there are standard case diagnosis, surveillance and laboratory guidelines for 50 diseases, including malaria, that are subject to Ministry of Health notification. The standardized definitions for malaria case classification developed by WHO are used (see glossary). Data are processed manually at the peripheral level and by computer at the central level (the Turkish Public Health Institute of the Ministry of Health), where a national case register and central malaria database have been established. All public and private health centres, hospitals and laboratories are considered to be the main sources of primary malaria-related data (Annex 8).

Confirmed malaria cases and foci are subject to epidemiological investigation and classification by peripheral malaria workers employed by NMCP, who complete a standard form. The various forms for reporting malaria information (notification, epidemiological investigation, laboratory activities, vector control interventions, etc.) are collected at the peripheral and intermediate levels and sent to the appropriate upper levels (see Annex 8).

The primary data from health facilities are collected by the provincial public health directorates, from where they are forwarded to the Ministry of Health Zoonotic and Vector Borne Diseases Department of the Turkish Public Health Institute, which maintains the national database. The Department processes and analyses the data and provides annual feedback to the peripheral levels.

Focus registers

Focus registers are maintained at provincial level. Information on active malaria foci is being collected at the national level and a national focus register has been developed. National epidemiological data on malaria – including incidence, number and location of foci, age, sex, profession, citizenship of malaria patients – and on the results of special surveys conducted, together with operational information, are used to monitor the progress and effectiveness of the antimalarial activities. All data are entered into the health information system to support the services provided by the Ministry of Health and to be used in policy and programme development processes at the central level.

MANAGEMENT OF THE DISEASE

In principle, diagnosis and treatment of malaria are considered to be part of the primary health care system. Turkey has implemented a malaria drug policy. Drugs used to treat *vivax* malaria have been registered under national regulations, and treatment guidelines have been produced and delivered to health services. However, not all of the contemporary drugs for the treatment of imported falciparum malaria are registered in the country, which can create problems for the Ministry of Health in providing the quantities needed.

Drugs for both *vivax* and imported falciparum malaria are purchased by the Turkish Public Health Institute and sent to the Public Health Directorates and to 17 provinces, where a stock is maintained for delivery to health facilities when needed.

All malaria patients in Turkey are diagnosed and treated free of charge in the country. Patients with *P. vivax* malaria are treated radically with chloroquine and primaquine. Since 2008, daily primaquine treatment is given under observation by malaria workers to ensure completion of treatment. Imported *P. falciparum* cases are treated with artemisinin-based combination therapy, or with a quinine/tetracycline combination complemented by 1-day treatment with primaquine.

At present, no seasonal or mass drug treatment with primaquine is being undertaken. Since 2007, however, all patients treated for *vivax* malaria receive a second (inter-seasonal) treatment with 14 days of primaquine in February/March, before the beginning of the new season.

Expenses of hospitalized severe malaria cases are principally covered by social security institutions.

LABORATORY SUPPORT AND EXTERNAL QUALITY ASSURANCE

Malaria diagnosis is based on microscopic examination of Giemsa-stained blood slides. Primary laboratory diagnosis is conducted at all clinical laboratories – at governmental and private hospitals and outpatient clinics as well as at the public health laboratories. When the examination takes place at clinical laboratories, the diagnosis of malaria is confirmed by the public health laboratories before treatment is started. In the past few years, confirmation of some positive cases by polymerase chain reaction has been performed at the National Malaria Reference Laboratory, Microbiology Reference Laboratories, Department of the Turkish Public Health Institute.

External laboratory quality assurance and control is carried out by six malaria control laboratories (in Adana, Diyarbakır, Antalya, Edirne, Izmir and Ankara) where all positive slides are confirmed and a minimum of 20% of negative slides from the primary laboratories are examined monthly. Up to 2012, the malaria laboratory at the Ankara health directorate has been used as a national reference laboratory, re-confirming positive slides and examining 20% of the negative slides already cross-checked in the control laboratories. Since 2012, re-confirmation of the slides is performed by the National Malaria Reference Laboratory, Microbiology Reference Laboratories Department of the Turkish Public Health Institute. This laboratory is to be officially designated as a national reference laboratory and included in an international external quality assurance programme.

PREVENTION OF MALARIA IMPORTATION AND ITS CONSEQUENCES

At present, with only four relapsing cases officially reported in 2011 throughout Turkey, attention is turning increasingly to the identification of imported cases. The country's geographical location results in many travellers from other countries, which means there is a risk of malaria being imported. Moreover, the number of Turkish nationals travelling to malaria-endemic countries for business, trade and tourism is ever-increasing.

Prevention for travellers

The Ministry of Health has developed a legislative and regulatory framework concerned with prevention of malaria among travellers to/from endemic countries and has established a Turkish Directorate General of Health for Border and Coastal Areas.[1] One of the branches of the Directorate General, the Health Services Department, coordinates the work of 26 travel health centres in the country, which provide consultations for people travelling to endemic countries. These centres are clustered principally in the large towns and resorts.

The centres provide pre-travel information; necessary vaccinations and malaria chemoprophylaxis free of charge to the traveller. The drugs and vaccines are provided by the Ministry of Health. On its Internet site, the Directorate General provides regularly updated information, by country, on the preventive measures recommended by WHO and by the U.S. Centers for Disease Control and Prevention. It also operates a call centre.

Activities regarding migrants and refugees

Internal migration of temporary workers from remote areas of south-eastern Turkey – where the remaining residual active malaria foci were located – to other parts of the country, takes place seasonally. Regulations dictate that these temporary workers, usually living in camps, be visited and examined by local malaria workers. There is also international migration, most often from Iraq, the Islamic Republic of Iran, Pakistan and the Syrian Arab Republic. At provincial level, there is collaboration between the malaria control health facilities and the Ministry of Internal Affairs, which allows appropriate and timely coverage of migrants by malaria examination and follow up. Thus far, no secondary cases or epidemic consequences of malaria importation by migrants have been registered.

INSTITUTIONAL FRAMEWORK FOR MALARIA SURVEILLANCE AND ELIMINATION

The Malaria Control Department of the Ministry of Health, responsible for control and surveillance operations during all periods of malaria control and eradication, acts as the national coordinator of the malaria elimination campaign. The Department is responsible for coordination, technical guidance, planning, implementation, monitoring and evaluation of malaria surveillance and elimination activities in the country. Its staff comprises medical officers, biologists, medical technicians and administrative personnel.

At a provincial level, the head of the communicable disease section of the Provincial Health Directorate, a branch of the Ministry of Health, has overall responsibility for all malaria-related activities in the respective province. At district level, the malaria control team of the communicable diseases section is responsible for malaria control and elimination activities. The team includes health technicians, laboratory technicians and malaria workers.

A significant number of malaria programme staff have been engaged in malaria elimination interventions. Although the total number of personnel has been gradually reduced, the number of remaining staff has remained sufficient for conducting operations. Programme personnel are concentrated mainly in south-east Turkey, in the areas where the last residual foci had been located.

Under recent legislation, the Ministry of Health – together with its affiliated institutions – has been reorganized, both structurally and in terms of its duties

1 http://www.hssgm.gov.tr/EN/Default.aspx

and responsibilities *(46)*. The Public Health Institute that is a part of the Ministry maintains Public Health Directorates in all the provinces of the country, with communicable diseases units (formerly sections) that are responsible for malaria surveillance and control at provincial level.

CAPACITY BUILDING

The Malaria Control Department has done much to strengthen capacity for malaria laboratory diagnosis, disease management, case notification and investigation, and information and reporting systems. Physicians, laboratory staff and other field health personnel have been trained in the rationale and methods for malaria surveillance.

INTERNAL COLLABORATION

Collaboration over the years between the Ministry of Health and the SAP administration in the field of malaria interventions has yielded very positive results. Joint malaria interventions undertaken at the grassroots level in SAP project areas have demonstrated how partners can cooperate for the benefit of the local communities (Ejov, 2002, unpublished report).

Programme funding

With the exception of a small contribution from WHO, funds required for the complex of elimination activities were provided by the Government, as shown in Table 7.

Table 7. Budget of malaria programme by year, 2000–2010

Year	Budget (US$)	
	Government	WHO
2000	1 624 000	10 000
2001	1 933 083	10 000
2002	2 313 260	10 000
2003	3 072 871	10 000
2004	31 990 282	10 000
2005	32 938 553	10 000
2006	38 544 677	15 000
2007	38 770 483	15 000
2008	40 865 967	15 000
2009	44 200 000	0
2010	33 486 133	0

Source: national malaria control programme

Government funding increased 10-fold in 2004, and increased steadily and progressively thereafter, reaching US$ 44.2 million in 2009, the last year that indigenous cases were reported. This increase mirrored the expanding surveillance activities aimed at malaria elimination. Over the same period, the WHO Regional Office for Europe provided technical assistance and support. In 2010, however, the Government budget for malaria dropped to around US$ 33.5 million. This reduction in funding may be premature, given the continued reporting of relapsing malaria cases in 2010 and 2011.

A comparison of the Government budget breakdowns for the years 2008, 2009 and 2010 (Table 8) shows that the largest allocation went to human resources and technical assistance. The allocation for IRS activities declined from around US$ 2 million in 2008 to US$ 93 000 in 2010, which is related to the marked reduction in active malaria active foci in the country. Funding for infrastructure and equipment, as well as for antimalarial medicines, rose in 2010, (Table 8), which is probably explained by the strengthening of malaria preventive measures (e.g. prevention for travellers).

Table 8. Expenditure breakdown of state funding, 2008–2010

Expenditure category	Expenditure (US$) by year		
	2008	2009	2010
Human resources and technical assistance	37 891 451	37 158 000	30 795 933
Training	15 000	0	0
Insecticide-treated nets (excluding distribution costs)	0	0	0
Insecticide and spraying materials (excluding distribution costs)	2 033 422	1 891 304	93 220
Diagnostics (excluding distribution costs)	0	0	10 908
Antimalarial medicines (excluding distribution costs)	148 064	63 333	392 520
Procurement and supply management costs (transport, fees, etc.)	0	24 467	0
Infrastructure and other equipment	64 803	55 667	2 193 552
Communication and advocacy	7741	0	0
Planning, administration, overheads	642 259	0	0
Other	48 227	5 007 229	0
Total	40 850 967	44 200 000	33 486 133

Source: national malaria control programme

Economic and social development

Following reforms that began in 1986, Turkey now has one the fastest growing economies in the world, and socioeconomic gaps between the various regions in the country are narrowing as a result. Special attention is being given to south-eastern regions, where extensive social developments and improving living conditions have helped to reduce the malaria burden and ensure the success of malaria operations.

LESSONS LEARNED AND OUTLOOK FOR THE FUTURE

The history of malaria in Turkey shows that the road to elimination is long and difficult and requires substantial financial resources. Nevertheless, it also shows that disease burden can be dramatically reduced and malaria incidence maintained at a very low level for years by the application of integrated approaches, sustained interventions and the use of new tools available for malaria control and elimination, as well as by building and sustaining human resource capacity.

Turkey has been committed to malaria control since early in the last century, launching its first malaria campaign in 1926 but hampered by the lack of efficient tools for combating the disease. Expanded malaria interventions after the Second World War, making use of DDT – a valuable new tool – led to a radical decline in the burden of malaria by the 1950s.

The malaria eradication programme achieved a material impact between 1957 and 1975 by applying recommended policies, by good organization and coordination of activities, and by engaging all health structures. The programme's integrated approach, combining vector control and surveillance operations, benefited substantially from consistent and continuous financial support from the Government. Stratification of the country, according to malaria risk, facilitated appropriate decisions on the interventions to be applied. The disease burden was again radically reduced and malaria incidence was maintained at a low level during the 17 years that followed the programme's launch. By 1974, much of Turkey had no local malaria transmission and 93% of the country had progressed to the consolidation phase.

Learning from challenges

The final goal of the malaria eradication programme – elimination of malaria by 1966 – was not achieved, and the programme was prolonged. Antimalarial measures had not been universally applied during the early years of the programme, which compromised efforts to meet the planned deadlines. Malaria transmission was reduced to a few focal areas in the south-east of Turkey. Failure to interrupt transmission in these areas was a result of high receptivity: the various irrigation schemes created good breeding places for mosquitoes, local vectors rapidly developed resistance to the insecticides applied, and a lack of personnel in some areas prevented good coverage and performance of spraying and surveillance operations. Against this background of low malaria incidence, large epidemics occurred in southern Turkey in 1977 and in 1993–1996.

Turkey learned the important lesson that failure to maintain adequate vigilance of malaria receptivity and vulnerability can compromise even comprehensive and efficient strategies and interventions by an experienced network.

As well as an intensive agricultural development scheme, including major irrigation projects that created good breeding places for mosquitoes, a number of conditions favourable to the spread of malaria occurred simultaneously and were not addressed with sufficient urgency: widespread agricultural use of pesticides led to vector resistance; a massive influx of labour (parasite carriers) increased the parasite reservoir; growing agricultural and industrial expansion resulted in mass population movements from remote, often rural, endemic areas of the south-east to the Adana region (1977 epidemic), and to provincial and district towns (1993–1996 epidemic). In addition, regular cross-border migration from neighbouring Iraq and – in response

to political instability and the Gulf War of 1990–1991 – also from the Islamic Republic of Iran and the Syrian Arab Republic, led to the importation of cases.

Another lesson learnt was the importance of good epidemiological preparedness and maintaining attack measures at an adequate level, rather than implementing them on a reduced scale as happened in south-east of Turkey in the 1970s (Postiglione, 1981, unpublished report).

Efforts to eliminate malaria were also challenged by rapid population growth and by the size of the health network required to undertake antimalarial activities in a country as large as Turkey.

Comprehensive control and elimination strategies applied

Turkey adopted a complex, integrated, approach to malaria control and elimination. The interventions focused on the three main components of the epidemiological process – source of infection, mode of transmission, and receptive population – formulated by Gromashevski in 1942 *(48)*.

The aim was to eliminate the source of infection by timely and complete case detection and radical treatment, and by prompt and comprehensive investigation of every case and focus, and to reduce the transmission by control of the vector; reducing its density and longevity, the number of breeding places and the extent of human–vector contact. The measures taken were effective in dramatically reducing the malaria burden, promptly containing outbreaks and clearing up the foci.

Several aspects of this approach merit special mention.

CONTAINMENT OF THE OUTBREAKS

Containment of the outbreaks in 1977–1978 and in 1993–1996 was achieved by applying a complex of operations designed to rapidly reduce transmission in affected areas and clear up foci.

- Fast reduction in mosquito density and longevity by integrated, evidence-based (guided by foci investigations) vector control with good IRS coverage of all foci.
- Reduction/elimination of sources of infection by:
  - intensive case detection through ACD in all malaria foci, and PCD, followed by radical treatment of malaria-positive patients;
  - combining ACD with mass blood surveys among residents of the affected villages and co-workers of identified malaria cases;
  - prompt and comprehensive investigation of every case and focus, notification and reporting;
  - mass drug administration with chloroquine and pyrimethamine in the most receptive areas in the malaria season, plus intensive health education.

ELIMINATION STRATEGIES

In 2005 a political decision was taken to engage in renewed elimination efforts in Turkey, with the ultimate goal of interrupting malaria transmission by 2012 and eliminating the disease within the country by 2015. A National Strategy and Plan of action of Malaria Elimination, in line with the new WHO regional strategy and centred on intense malaria surveillance, were developed in 2008 and subsequently implemented.

While the first eradication campaign (1956–1974) started with an ambitious attack phase, with interventions covering the whole country and priority given to IRS, elimination operations after 2008 were more appropriately directed to a limited areas of south-eastern Turkey where the last active foci were located. In the rest of the country, case-based surveillance and a high level of vigilance were maintained.

The malaria elimination programme benefitted much from the following malaria elimination directions that were specially addressed:

- Enforced, case-based surveillance enabling evidence-based decisions to be taken and actions planned in a timely manner.
    - In risk areas, the prompt detection of malaria cases was emphasized. ACD was conducted by means of regular (2-weekly) household visits and fever screening, examination of the families and co-workers of malaria patients and of residents of the focus of a new case. Populations at higher risk (military personnel, seasonal agricultural workers, migrants) were screened on epidemiological indications, which led to the detection of parasite carriers, particularly during the outbreaks. At primary care level, PCD was performed by general health facilities – public and private. The high level of malaria vigilance merits special mention, as does the examination of all febrile patients seeking medical assistance in affected regions. Once the transmission was reduced and focalized, greater attention was paid to imported cases. All of these interventions contributed strongly to the early detection and radical treatment of cases and thus to the timely elimination of sources of infection and limitation of local transmission.
    - Prompt, radical treatment was provided for all malaria patients in accordance with the up-dated national malaria treatment policies. (Malaria treatment is free of charge in Turkey, and regular supplies of drugs are provided by the Government.)
    - Comprehensive case investigations contributed to the early identification and investigation of all new active and potential foci, permitting appropriate planning and implementation of control measures. Well-organized and efficient processing of information by the malaria network made for timely case registration and notification of laboratory-confirmed malaria cases and a regular flow of information to the upper levels of the health system, as well as feedback to the lower levels. Rapid analysis of the situation and prompt, evidence-based decision-making by the responsible authorities were made possible. All public and private health centres, hospitals and laboratories were considered as the country's main sources of primary malaria-related data. A malaria focus was regarded as the minimum unit for antimalarial action; for this reason, monitoring and evaluation of foci were stepped up and a focus register established, which was regularly updated and well maintained. All information of this kind is critical for the timely initiation of interventions when necessary, and for determining the appropriate nature, scope and period of application of those interventions.
- Well-designed, integrated vector control activities guided by the results of foci investigations. Vector control activities were designed to shorten the life span of female mosquitoes (by IRS) so that there was insufficient time for sporozoites to develop, and to reduce larval density (using larvivorous fish or the application of oil – no specific chemical larvicides were used). Programme staff focused on reducing and preventing transmission in residual or new active foci by full IRS coverage of active foci, larviciding and environmental management. Environmental management was particularly important in areas of large irrigation schemes and concentrated on cleaning of existing open canals and the use of underground canals in the new projects. Entomological surveillance – with special attention to the risk areas of south-east Turkey – was conducted by identification and mapping of breeding sites, use of representative sentinel sites for monitoring larval control, determination of mosquito density, and identification of *Anopheles* species.

Experienced malaria network

The national malaria network, created in the early years of malaria control and upgraded and expanded over the years, plays a leading part in all malaria interventions. Primary health care services all have an integral role in programme interventions. The existence of the specialized malaria network, with its substantial

expertise in control and elimination, appears to have been a critical factor in achievement of the goals. Over the years, it has proved to be a strong and reliable system for the surveillance and control of malaria.

Turkey also has the strong laboratory support that is crucial for achieving elimination. A system of external quality control was in place as early as the 1950s. Testing in quality assured/controlled laboratories, overseen by reference laboratories, is important for confirmation of every clinical malaria case.

Strengthening collaboration and community mobilization

Turkey has done much to strengthen intersectoral and international collaboration in the field of malaria, as well as to improve the health education of the population. Community mobilization, through the building up of community-level intervention channels, has strengthened the participation of the entire population in malaria elimination and prevention.

Strong political commitment

The high level of political commitment to, and governmental support for, the national malaria programme, are worthy of special attention. The Government of Turkey provided continuous and substantial support for malaria control operations, for containment of the outbreaks and for elimination efforts. Malaria control and elimination interventions were supported by policies and strategic plans, decrees and guidelines endorsed by the Ministry of Health. The activities of the national malaria control programme have been backed by adequate and consistent funding, provided principally by the Government.

International support

Support from WHO was important for Turkey's malaria elimination programme, and this prompt technical and financial assistance may well have facilitated the containment of outbreaks. Turkey also benefited from a WHO consultancy in periodic evaluations of the programme's progress and in the development of national strategies, plans and guidelines. Continuing financial and technical assistance was provided by WHO to help the country move towards its stated elimination goals. Turkey participated in many WHO meetings, including a meeting in 2007 on progress achieved with malaria elimination in the WHO European Region. Achievements and experiences in malaria elimination were reported and shared between countries and regions.

Outlook for the future

Turkey has made enormous progress towards malaria elimination. There is both strong political commitment and the operational and technical capacity to maintain the results obtained to date and to achieve elimination of the disease. Lessons learned from the past show that any neglect of malaria interventions at this stage may result in a rapid resurgence of malaria and require enormous effort and financial support to combat the disease again.

Malaria elimination efforts should continue, following the national strategic plan and applying the strategies and integrated approaches that have proved effective. Attention should be paid to preventing the consequences of malaria importation in order to prevent a resurgence of infection; this requires a comprehensive plan of action with secured financial support.

Some important drivers of change that should be taken into consideration are summarized below.

Although Turkey's disease burden has been dramatically reduced and malaria transmission limited to just a few foci in the south-east of the country – where 38 indigenous cases were last reported in 2009, and 9 and 4 local (reported as relapsing) cases in 2010 and 2011 respectively – monitoring of receptivity and vulnerability, especially in the SAP territory, is important for the future to prevent the epidemiological risk of malaria transmission. Receptivity in certain other parts of the country, as well as vulnerability in many of them, is still high, stressing the need to maintain a high level of malaria vigilance in the future.

Durable solutions are needed to reduce receptivity, such as the permanent infilling or draining of mosquito breeding sites, as well as higher living standards and the improvement of human habitations. If maintenance work and cleaning of the open channels of the various irrigation schemes is insufficient or irregular, favourable conditions for vector breeding and propagation will be created. Entomological surveillance to provide information on mosquitoes and their breeding sites should continue in the areas with high malaria potential.

Changes in the vulnerability of Turkey, especially in the south-east, should be regularly and closely monitored.

Turkey is located at the crossroads of Asia and Europe, which favours significant east-to-west travel through the country and creates a potential risk of malaria importation. History shows that an increase in migration from neighbouring countries may cause a rise in malaria importation and contribute to the outbreak of epidemics, as happened in 1977 and 1993. Recent years have seen much international migration, largely from Iraq, the Islamic Republic of Iran, Pakistan and the Syrian Arab Republic. Fortunately, the malaria risk in the countries bordering Turkey is also declining markedly; Iraq has not reported indigenous cases since 2009; in 2010–2011 only imported cases were reported in the Syrian Arab Republic; and geographically more limited transmission and a smaller number of indigenous cases (3131 in [2011]) were registered in the Islamic Republic of Iran *(49, 50)*. Nonetheless, it is important to consider the effect that the continuing political instability in the Syrian Arab Republic may have on the malaria situation in Turkey. The greatest risk with regard to malaria importation is posed by Pakistan, which reported more than 8 million suspected cases in 2010 *(50)*.

At the provincial level, good collaboration between the malaria control health facilities and the Ministry of Internal Affairs units should be maintained as a means of ensuring effective and timely malaria examination and monitoring of migrants.

As the number of Turkish nationals travelling to malaria-endemic countries rises in response to intensified international business, trade and cultural relations, it becomes increasingly important to ensure preventive measures for travellers to malaria-endemic countries. This should be continued through the Travel Health Centres that provide advice and immunizations to people travelling to endemic countries.

Internal migration, especially of seasonal workers, should be carefully monitored. It is also crucial that epidemiological surveillance of malaria be maintained at a satisfactory level to ensure prompt detection and treatment of cases, as well as timely response to any epidemiological emergency.

There will be a clear need to maintain a robust level of malaria vigilance. Maintaining epidemiological surveillance of malaria to ensure the prompt detection and treatment of cases, as well as a timely response to any emergency, will also be important. The importance of these antimalarial activities was demonstrated in 2012 when as a result of *P.vivax* importation by lorry drivers coming to Turkey from endemic countries, and a delay of the recognition of the index cases, a malaria outbreak was registered in the province of Mardin with 208 introduced and indigenous cases. By mobilizing the malaria network and general health services, and by conducting a massive scale-up of control and surveillance interventions, the national malaria programme achieved a prompt containment of the outbreak.

The sustainability of the results achieved thus far will be highly dependent on continued financial support for malaria activities.

Maintaining stable results in the fight against malaria and achieving elimination of the disease will contribute to the economic and social development of Turkey, especially of the south-eastern part of the country.

CONCLUSION

This case-study demonstrates that a shrinking of the national malaria map and drastic reduction of the malaria burden, to the point where only single local cases remain, can be achieved through strong political commitment, adequate funding (mainly domestic), correct policies, strategies and guidelines, a well-developed health system with the capacity for surveillance, rapid response, technical assistance and the human resources necessary to run a comprehensive malaria control and elimination programme.

The experiences of Turkey underline the risks of malaria resurgence when malaria receptivity and vulnerability increase and the need for continuous monitoring by the national malaria control programme. At the same time, this case-study also proves that a strong malaria programme, well supported by the government, can quickly contain resurgences and make good progress towards malaria elimination. It highlights, too, the fact that continued funding for malaria activities, even during periods of very low endemicity, is critical if adequate vigilance is to be maintained and a prompt response provided to all epidemiological emergencies.

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ANNEX 1: DATA SOURCES AND ANALYTICAL METHODS APPLIED

Information was collected from the following sources for this case-study:

- **WHO**
  - Malaria-related materials in the WHO Registry and Archives collections of reports of technical missions, records, reports of WHO EURO meetings and other information on Turkey up to 2011 were reviewed. The following unpublished reports of WHO missions to Turkey were found to be especially useful sources of information:
    - Acheson MA. *Report on an assignment to Turkey.* Geneva, World Health Organization, 1963
    - *Annual evaluation of malaria control activities in Turkey (1984). Report on a joint Ministry of Health and Social Assistance – WHO meeting, Ankara, 18-22 February, 1985*
    - *Beales PF. Report on a second evaluation of malaria eradication laboratories in Turkey. Geneva, World Health Organization, 1964'*
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  - Other WHO publications relating to malaria in Turkey were also consulted.
  - Country data reported to WHO and to the WHO Regional Office for Europe as part of the

annual reporting cycle, including information submitted for the annual *World Malaria Report,* were reviewed (1–3).

- **Country data,** including:
  - Country publications and manuals.
  - Ministry of Health material – laws, regulations, orders, guidelines, reports.
  - National malaria control programme documentation – reports, registers of cases and foci, maps, guidelines.

The following two sources have been found to contain especially useful information: *Malaria in Turkey: situation analysis, 2005 (4)* and *The Strategic Plan for the Malaria Elimination Programme in Turkey (2008) (5)*.

- **Scientific publications** concerning malaria in Turkey were identified using PubMed and Google and by screening scientific journals and other sources.
- **Materials and data** collected by the authors during their various technical support missions to Turkey over the period 2005–2011. The midyear population for the period 1927–2012 from the Turkish Statistical Institute web site *(6)* was used for analysis. As the First General Population Census was conducted in 1927, after the establishment of the Turkish Republic, data from reference 7 were used for population numbers in 1925–1926.

All data collected were epidemiologically analysed, with the aim of characterizing the malaria situation in different periods; the principal epidemiological parameters and indicators included the annual number of cases (autochthonous and imported); malaria morbidity and mortality; distribution of cases by age, sex and other parameters; geographical distribution of malaria; the number, category and transition of malaria foci; parasites and vectors. Data on the interventions applied were analysed to provide estimates of coverage and performance of surveillance and control activities.

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ANNEX 2: SOME KEY CHARACTERISTICS OF THE POPULATION

Demographic data

Table A2.1 Demographic data, 2010

Variable	Value
Population (in thousands) total	72 752
Population median age (years)	28
Population proportion under 15 years (%)	26
Population proportion over 60 years (%)	9
Population living in urban areas (%)	70
Annual population growth rate (%)	1.3

Source: reference 1

Social and cultural features

Turkey has a highly heterogeneous social and cultural structure. There are sharp contrasts between population groups: the "modern" and the "traditional" coexist within society. Attitudes to life are generally those of the industrialized world, especially among inhabitants of metropolitan areas; however, people living in rural areas are often more conservative and religious *(2)*. Strong family ties have a significant influence on social life as well as on values, attitudes, aspirations and goals. Although the law is considered to be quite liberal on gender equality, patriarchal ideology is still generally dominant in society.

The Turkish population is predominantly Muslim. About 98% belong to the Sunni and Alawi sects, with the Sunnis forming the overwhelming majority. Approximately 80% of the population is Turkish, and an estimated 17%, concentrated in the south-east, is Kurdish. Arabic, Armenian, Caucasian, Georgian, Greek and Jewish communities contribute to the rich and complex culture of Turkish society.

Education

One of the most striking achievements since the establishment of the Turkish Republic has been the increase in both literacy and education. In 1935, only 29% of males and 10% of females were literate. With the enactment of Law No. 4306 in 1997, 8-year primary school education was made compulsory in Turkey, since which time educational attainment has increased dramatically. In the scholastic year 2002–2003, the average rate of schooling at primary level was 96.3% (100% for males and 91.8% for females) *(3)*. The literacy rate among adults aged 15 years and over was 90.8% in 2009 *(1)*.

Despite these encouraging figures, considerable regional, urban–rural and gender differences still persist in literacy and education. The median duration of schooling is 4.3 years for females but 4.7 years for males; for females over the age of 50, the median duration of schooling is less than 1 year, while for males aged 20 years the figure is more than 7 years *(4)*. The median duration of schooling for males varies little between regions, but is as low as 0.6 years for females in the eastern region, compared with 4.5 years for females in the west of the country. One male in 10 has at least secondary school education, while the figure for females is 1 in 20 *(5)*.

For the educational year 2003–2004, the total number of students at all levels, primary to tertiary, reached 18.6 million – 25% of the total population.

Employment

Changes in the age structure of the Turkish population mean that the size of the working age group (15–64 years) is expected to increase in both absolute and relative terms in the coming years. As of 2000, the working age group made up 64.5% of the total population. For the Marmara and Aegean regions this figure was 68.7%, but for the south-east it was only 54.1%, reflecting the migration of people of working age to industrialized parts of the country.

The employment profile of the Turkish population has been changing rapidly. In 1990–2000, the proportion of working people employed in the agricultural sector fell from 47.9% to 34.9%; over the same period the proportion employed in the industrial and service sectors rose from 14.9% to 18.1% and from 37.1% to 47%, respectively. In the light of the limited and declining contribution of the agricultural sector to the national GDP (less than 14%), there is clearly a significant imbalance in the distribution of the labour force, with important implications for income levels among the rural population.

Some details of the domestic labour market are given in Table A2.2.

Internal migration

Since the 1950s, migration has shaped the population distribution in Turkey, with a marked shift between villages and cities. In the early stages, rural-to-urban migration appeared to be the dominant migration pattern, as a result of socioeconomic changes and high population growth rates in rural areas, coupled with the increased accessibility of, and job opportunities in, the cities. According to the 2000 census, almost 28% of people had been born in a different province from that in which they now resided *(7)*. The rate of urbanization was approximately 50 per thousand during the period 1970–1990. Marked socioeconomic differences between regions – for example, in income, unemployment rates, the existence of social networks – have a significant impact on migration. The process of urbanization has inevitably caused problems in the provision of services and the emergence of large areas of squatter housing in unplanned cities.

In contrast to earlier movements from rural to urban areas and from less developed provinces to cities such as Istanbul, Ankara and Izmir, recent trends in internal migration appear to be changing. More specifically, there is a diversification of areas of destination, which now include less developed provinces in the south-east, as well as metropolitan areas and newly growing cities such as Antalya, Adana, Izmir, and Bursa.

The past decade has also witnessed migration movements resulting from security problems and political unrest affecting the eastern region. Some provinces, such as Diyarbakır, Gaziantep and Van, have experienced an influx of unprecedented numbers of migrants from neighbouring provinces and rural areas of the region.

Migration has had profound effects not only on demographic structure, but also on economic and social life in Turkey. The creation of periurban areas in the large cities, the emergence of subcultures in cities and unplanned agriculture in rural areas, pollution, and as witnessed in the recent earthquake disasters, unplanned and unsafe housing in the cities, are the result of rapid and uncontrolled migration.

Table A2.2 Developments in the domestic labour market

Labour force	1995	2000	2003	2005
Civilian labour force (millions)	21.907	22.029	23.602	25.689
Civilian employment (millions)	20.394	20.578	20.970	24.242
Agriculture (millions)	9.538	7.187	7.185	8.727
Industry (millions)	3.111	3.733	3.783	4.322
Services (millions)	7.745	9.658	10.002	11.183
Unemployed (millions)	1.513	1.451	2.632	1.447
Unemployment rate (%)	6.9	6.6	11.2	5.6
Underemployment (millions)	1.474	1.541	1.137	1.672
Underemployment rate (%)	6.7	7.0	4.8	6.5
Total unemployment and underemployment (%)	13.6	13.6	16.0	12.1

Source: reference 6

Among the major characteristics of the Turkish population that can be considered to have influenced the spread of malaria over the years are the following *(8)*:

- large population movements within the country (spreading malaria from endemic rural and remote areas, especıally in the south-east, to non-endemic areas);
- the difficulties of providing malaria services to this group of people;
- rapid urbanization and urban concentration.

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ANNEX 3: ADMINISTRATIVE DIVISIONS AND POLITICAL ORGANIZATION

Since the founding of the Republic, three Constitutions (1924, 1961 and 1982) have shaped the Turkish administrative structure. They proclaimed Turkey to be a Republic with a parliamentary system and specified that the will of the people was vested in the Turkish Grand National Assembly (TGNA). The Constitutions adopted basic individual, social and political rights and accepted the principle of separation of powers *(1)*.

The TGNA is the legislative body of the Republic and is composed of 550 deputies, who are elected for five-year terms. The President of the Republic is elected by the TGNA for a seven-year term. The Prime Minister and other Cabinet Ministers compose the Council of Ministers, the executive body of the Republic.

Turkey is administratively divided into 81 provinces, further subdivided into 923 districts (ilçe), subdivisions (bucak) and villages. The head of the province is the governor, appointed by and responsible to the central government. The chief official of the district is the district governor (kaymakam), who is also appointed by the central government but is responsible to the provincial governor. The provincial governor carries out central government policies, supervises the overall administration of the province, coordinates the work of the various ministry representatives appointed by the central authority in Ankara, and maintains law and order within his/her jurisdiction *(1)*.

A mayor and a municipal council administer local government at the municipality level. Municipalities are expected to provide basic services such as electricity, water, gas, road building and maintenance, and sewage and garbage disposal facilities. Educational and health services are provided mainly by the central government, but municipalities also provide some public training programmes and health services.

In all, 19 provinces have populations that exceed 1 million, and 20 provinces have populations between 500 000 and 1 million *(1)*.

Reference

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ANNEX 4: ECONOMY

During the first six decades of the republic, between 1923 and 1983, Turkey adhered largely to a quasi-statist approach, with strict government planning of the budget and government-imposed limitations on private sector participation, foreign trade, flow of foreign currency, and direct foreign investment. In 1983, however, a series of reforms were initiated, designed to shift the economy from a statist, insulated system to a more private-sector, open market-based model *(1)*.

Turkey has gradually opened up its markets through economic reforms, reducing government controls on foreign trade and investment and privatizing publicly owned industries; the liberalization of many sectors to permit private and foreign participation has continued amid political debate. The public debt: GDP ratio, while well below its levels during the recession of 2001, reached 46% in 2010 From 2002 to 2007, the GDP growth rate averaged 7% *(2)*, making Turkey one of the fastest growing economies in the world at that time. However, growth slowed to 1% in 2008, and in 2009 the Turkish economy was affected by the global financial crisis, experiencing a recession of 5%. In 2010, the economy was estimated to have returned to 8% growth *(3)*, and in 2011 GDP was 1 288 638 million international dollars *(4)*.

Tourism in Turkey has experienced rapid growth over the past 20 years and constitutes an important part of the economy. In 2008, there were 31 million visitors to the country, who contributed US$ 22 billion to Turkey's revenues *(5)*.

Other key sectors of the Turkish economy are banking, construction, home appliances, electronics, textiles, oil refining, petrochemical products, food, mining, iron and steel, and the machine industry. Turkey also has a large and growing automotive industry, which produced 1 189 131 motor vehicles in 2010 *(6)* and it is one of the world's leading shipbuilding nations.

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ANNEX 5: HEALTH SYSTEM AND POPULATION HEALTH PROFILE

In the second half of the 20th century, Turkey achieved substantial progress in health care. In 1965 there was one physician for every 2860 individuals; that ratio improved to 1:1755 in 1976, 1:1391 in 1985, and an estimated 1:1200 in 1995. Between 1977 and 1995, the number of all health care facilities – hospitals, health centres, clinics and dispensaries – rose from 7944 to 12 500. Over the same period, the increase in available hospital beds outstripped population growth; by 1994 there was one bed per 400 citizens. Turkey has made significant progress in controlling a variety of debilitating and crippling diseases and in treating major infectious diseases.

Baris, Mollahaliloglu & Aydin *(1)* made the following observations in 2011: *"Transformation in health,* a white paper issued by the Ministry of Health in December 2003, pro vided a candid assessment of the shortcomings of the existing system. It also laid out the guiding principles of the Health Transformation Programme: a people focused approach, pluralism, separation of power, decentralisation, and competitiveness. These goals entailed radical restructuring, such as the redefining of the roles and responsibilities of the Ministry of Health towards 'more steering and less rowing'; separation of the provision and financing of healthcare to achieve more efficient resource allocation and use; the introduction of universal health insurance; increasing the financial and administrative autonomy of public hospitals to improve technical efficiency and strengthen management; and the introduction of family medicine to integrate and streamline the delivery of primary and inpatient care".

All this brought about essential improvement in health and health system indicators (Table A5.1), with reductions in infant and maternal mortality and substantial increases in access to and use of services and in patient satisfaction, especially in primary care *(1)*. Health Indicators according to WHO (2009–2010) are presented in Table A5.2.

Table A5.1 Health system indicators before (2000) and after (2008) the Health Transformation Programme in Turkey

Health system goals and functions	2000[a]	2008[b]
Health improvement		
Life expectancy at birth (both sexes, in years)	70	73
Infant mortality (1000 live births)	38	19.4
Under 5 mortality (1000 live births)	44	23
Maternal mortality ratio (100 000 live births)	70	19.8
Measles incidence (100 000 population)	11.1	0.004
Financial access[c]		
Total expenditure on health (% GDP)	3.6	5.6
General government expenditure on health as percentage of total government expenditure	11.5	16.5
Per capita government expenditure on health (purchasing power parity, US$	213	461
Out-of-pocket expenditures on health as percentage of total health expenditures	27.6	19.3
Health insurance coverage (%)	66	87
Health care resources		
Acute care hospital beds per 100 000	193	232
Doctors per 100 000	103.6	158.2
General practitioners per 100 000	41.1	52.6
Ministry of Health doctors working private part time (%)	89	25
Geographical distribution (ratio of best to worst endowed provinces):		
specialists	13.7:1	3.5:1
general practitioners	8.3:1	2.8:1
nurses	7.9:1	3.6:1
Medical technology (no. of units):		
Computed tomography	121	329
Magnetic resonance imaging	18	200
Intensive care beds	869	6633
Ambulances	618	2029
Neonatal intensive care beds	665	2918
No. of separate examination rooms for doctors:		
Ministry of Health hospitals	6643	18 807
primary care	6308	16 055
Service delivery		
Full vaccination coverage (%)	78	96
Pregnant women delivering in hospital (%)	78	92
Average no. of visits to physicians per capita/year	2.4	6.3
Acute inpatient care admissions/100 per year	7.5	13.1
Emergency medical service calls/year	350 000	1.5 million

[a] *Mid-year population 66.4 million; gross national income per capita (PPP international dollars)*: 8730.

[b] *Mid-year population 73.9 million; GNI per capita (PPP international dollars)*: 13 770.

[c] *Expenditure data for 1998.*

Source: reference 1, reproduced by kind permission of the publisher.

Table A5.2 Health Indicators according to WHO, 2009–2010

Indicator	Value
Distribution of causes of death among children aged <5 years (%), 2010:	
pneumonia	11
injuries	4
diarrhoea	1
measles	0
HIV/AIDS	0
other diseases	23
prematurity	24
neonatal sepsis	7
congenital anomalies	23
birth asphyxia	7
Number of under-five deaths (thousands), 2010	18
Number of infant deaths (thousands), 2010	16
Number of neonatal deaths (thousands), 2010	10
Age-standardized mortality rate by cause (ages 30–70, per 100 000 population), 2008:	
cancer	163
cardiovasular disease and diabetes	268
chronic respiratory condition	30

Source: reference 2

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ANNEX 6: PARASITES, GEOGRAPHICAL DISTRIBUTION, MALARIA SEASONALITY AND VECTORS

Parasites and geographical distribution

In the past, three malaria parasites – *Plasmodium vivax*, *P. falciparum* and *P. malariae* – occurred in Turkey. In the early studies of Serif *(1924)* in 45 hospitals in the country, *P. vivax* accounted for 54.6% of the 9576 microscopically diagnosed cases of *vivax* and tropical malaria *(1)*. It was also found that *P. vivax* cases predominated over the period of June–August and *P. falciparum* cases in the autumn and winter. In 1951, laboratory screening of about 1 million individuals detected 20 132 positive cases – 80% *P. vivax*, 18% *P. falciparum*, 2% *P. malariae*.[1]

Except for the Aras Valley near the borders with the Islamic Republic of Iran and the former USSR, the temperatures suitable for the transmission of *P. falciparum* were restricted to the Marmara, Aegean and Mediterranean coastal areas and to the relatively low-lying regions of Southeastern Anatolia (Wernsdorfer, 1958, unpublished report). Since 1970, no indigenous cases of *P. falciparum* malaria have been registered in Turkey – the only cases have been imported from abroad *(2, 3)*.

According to Ramsdale et al., *(3)*, *P. vivax* transmission is possible over a much greater part of the country than *P. falciparum*. However, areas where transmission may last for more than three months are limited to: regions where *P. falciparum* transmission is possible; some low-lying areas around the Black Sea coast; and the valleys of some of the larger rivers, penetrating into the central plateau. The rest of the central plateau, the eastern highlands and the Black Sea coastal areas could be regarded as marginal for *P. vivax*.

The studies of Corradetti, 1956, showed that malaria transmission is possible only up to an attitude of 1000 m in the central plateau, at the Black Sea and in the eastern mountains; for the Marmara and Aegean coasts the altitude limit is 1200 m and for the south-east 1500 m.[2]

Vivax malaria was endemic in the south-eastern part of the country, mainly in the three provinces of Diyarbakır, Şanlıurfa and Mardin – until 2011 when, for the first time in Turkey's malaria history, no indigenous cases were reported.

Seasonality of malaria transmission

Malaria transmission in Turkey is seasonal. The potential duration of the transmission season duration varies with the climatic conditions of different areas:

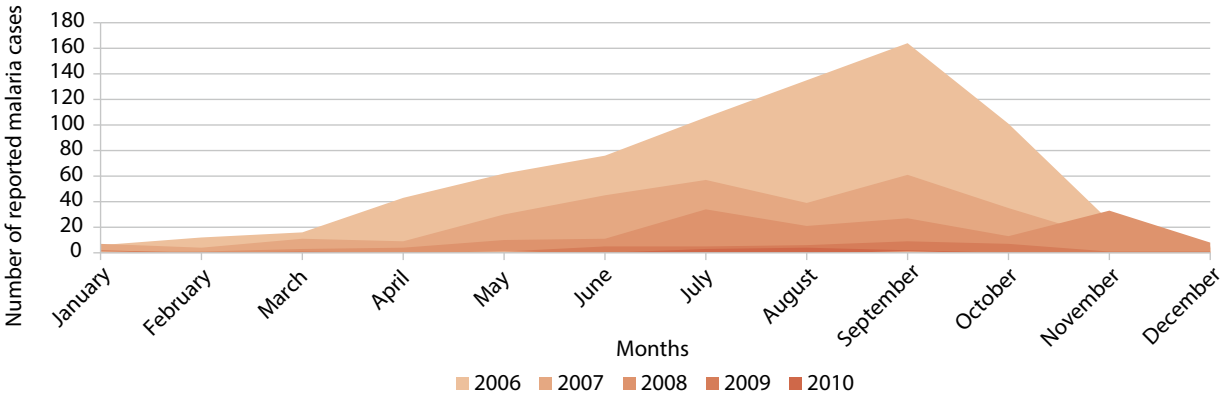
- northern and north-western coastal area: June–September;
- southern and south-western coastal areas and south-eastern districts: May–October;
- central plateau and mountains: July–August.[2]

Over the five years 2006–2010, there was an apparent increase in cases from March; numbers reached peak levels between July and September and declined after October (Figure A6.1) The early cases in March are probably due to long-incubation infections contracted in the previous transmission year.

1 Farid MA, Choumara R, Bosci L, 1968 (unpublished report, see Annex 1).

2 Wernsdorfer WH, 1958 (unpublished report, see Annex 1).

Figure A6.1 Monthly distribution of autochthonous malaria cases, 2006–2011



Source: national malaria control programme

Vectors

Ten *Anopheles* species can be identified in Turkey: *An. algeriensis*, *An. claviger*, *An. hyrcanus*, *An. maculipennis*, *An. marteri*, *An. plumbeus*, *An. pulcherrimus*, *An. sacharovi*, *An. subalpinu*, and *An. superpictus*. Of these, *An. sacharovi* is the most significant vector of malaria, followed by *An. superpictus*. *An. maculipennis* and *An. subalpinus* (3–5).

Under laboratory conditions, *An. sacharovi* was found to be a more competent vector of *P. vivax* than *An. superpictus*. In a study conducted in eastern Turkey, *An. sacharovi* was found to be the primary vector in malaria transmission, followed by *An. maculipennis* and *An. superpictus (5)*.

ANOPHELES SACHAROVI

Anopheles sacharovi completes its sporogonic stage within 9.8 days *(6)*. The larvae are abundant in June, especially in slow-flowing water and water channels containing plants. The mosquitoes are most active in August and October and are found predominantly in animal shelters. It is characteristic of this species that adults survive the winter in a state of semi-hibernation in natural shelters such as stables, taking blood meals without ovarian development. Breeding starts early in the spring in grassy drains and small canals near villages, then spreads outwards to swampy areas, weed-choked drainage channels and young rice fields. The vector favours marshy situations and is implicated in malaria transmission in the irrigated areas of the plain.[1] It is 95% zoophilic, biting mostly late at night, and is widely distributed in the country (Figure A6.2). Resistance to DDT and dieldrin has been detected, but the vector was susceptible to malathion, fenithrothion, propoxur, bendiocarb, lambdacyhalothrin, permethrin, cyfluthrin, etofenprox and deltamethrin *(7)*.

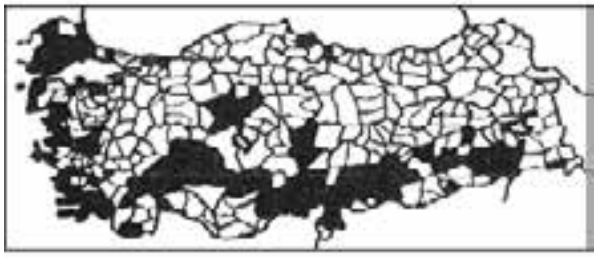
ANOPHELES SUPERPICTUS

Anopheles superpictus is found in more hilly areas than *An. sacharovi*; it is also a semi-hibernating species and breeds in clear sun-lit pools at the edge of streams or in residual pools in stream beds. Vector density varies with rainfall in the mountain catchment areas, tending to increase in the hot summer as streams diminish to form pools. The sporogonic stage is completed within 11.7 days *(6)*.

The geographical distribution of this species is shown in Figure A6.3.

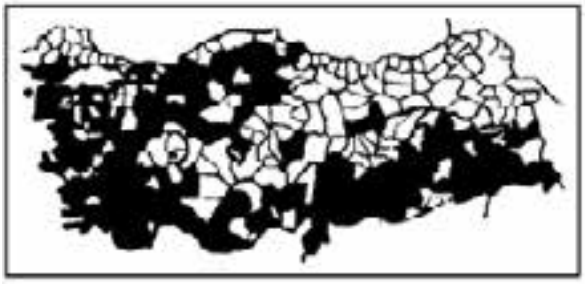
1 Trigg PI, 1993 (unpublished report, see Annex 1).

Figure A6.2 Distribution of *An. sacharovi* in Turkey



Source: reference 8

Figure A6.3 Distribution of *An. superpictus* in Turkey



Source: reference 8

RESISTANCE OF LOCAL VECTORS TO INSECTICIDES

The development of resistance of the local mosquitoes to insecticides played an important role in the prolongation of the malaria eradication programme.

From 1953, DDT was used for residual indoor applications for malaria vector control in Turkey, and by 1960 it was being used almost everywhere where malaria was endemic. Resistance to DDT began to spread, and dieldrin was introduced in 1959, replacing DDT in some areas. By 1975, tests on members of the *An. maculipennis* group and on *An. sacharovi* demonstrated resistance to DDT or dieldrin, or both, in all of the six natural regions of Turkey. Resistance was most common, and affected larger proportions of the mosquitoes, in the Marmara–Aegean, Mediterranean and Central Anatolian regions, which had the longest history of crop spraying. Breeding sites subject to contamination by crop spraying were favoured by *An. sacharovi*, *An. maculipennis maculipennis*, *An. m.* subalpinus and *An. hyrcanus*, and each of these species was resistant to DDT and dieldrin.

Normal susceptibility to both insecticides was observed in *An. superpictus*, which bred elsewhere. All members of the *An. maculipennis* complex, though normally endophilic, were quickly irritated by DDT and rarely found in DDT-treated buildings.

Ramsdale et al. *(3)* reported that susceptibility tests carried out in Turkey after 1974, both in the field and in the laboratory, revealed resistance to organophosphate and carbamate insecticides in *An. sacharovi*, *An. hyrcanus* and *An. maculipennis* – in the first two in the southern Çukurova plain and in the third in the northern area around Osmanjik. The broad spectra of resistance shown by all three species (though with inter-species differences) were attributed to the extensive and intensive use of a wide range of agricultural pesticides. Of the insecticides readily available for house-spraying for malaria control, malathion appeared to have the greatest potential usefulness and was then used for indoor applications. However, malathion has an unpleasant odour and householders objected to its use; it was subsequently replaced for indoor residual use by pirimiphos methyl, which persists for many weeks and to which *An. sacharovi* remained susceptible *(3)*.

In summary, *An. sacharovi* in Turkey has been under field selection pressure sequentially with DDT, dieldrin, malathion and pirimiphos-methyl used over a period of 30 years for the purpose of malaria control. In 1984, the field population of *An. sacharovi* in the malarious Çukurova plain of Adana Province contained an altered acetylcholinesterase-based resistance gene, giving broad-spectrum resistance against organophosphorus and carbamate insecticides. The cross-resistance spectrum from this mechanism conferred resistance to malathion but not to pirimiphos-methyl.

By 1999/2000, resistance to 12 insecticides (DDT, dieldrin, malathion, fenitrothion, pirimiphos-methyl, bendiocarb, deltamethrin, permethrin, lambdacyhalothrin, eofenprox, cyfluthrin and propoxur) was reported for specimens of *An. sacharovi*, in both laboratory cultures and wild-caught mosquitoes collected in the malarious areas of Adana, Adiyaman,

Antalya, Aydın, and Mugla in southern Turkey. In Adana, Adiyaman and Antalya, *An. sacharovi* was susceptible only to malathion and pirimiphos-methyl.[1]

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ANNEX 7: INTERNAL ORGANIZATION AND SUPPORT: THE NATIONAL MALARIA ERADICATION SERVICE, 1957 – 1975

The national malaria eradication service (NMES) was established in 1957 and its structure, organization and functions were formulated by Malaria Law No. 7402, enacted in January 1960. The structure of NMES is shown in Figure A7.1.

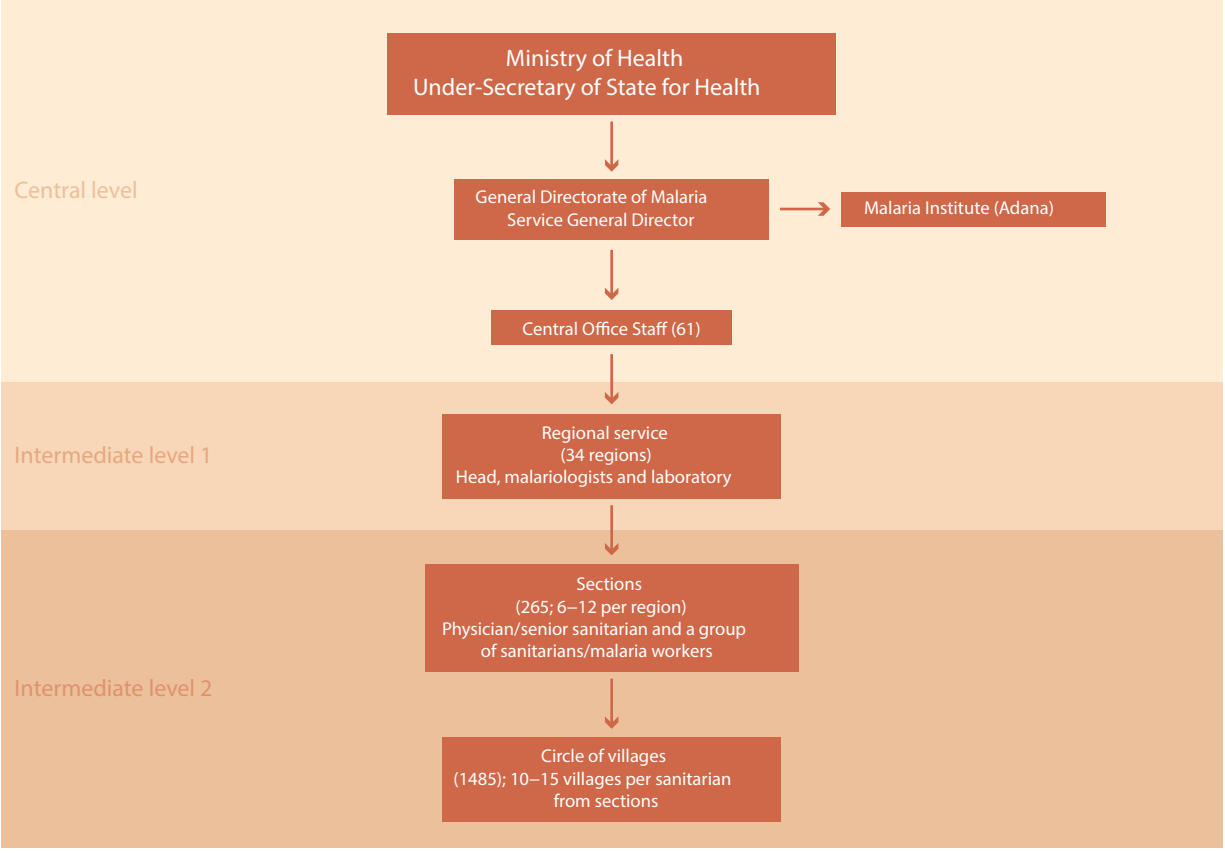
NMES was a directorate of the Ministry of Health and Social Welfare, directly attached to the Undersecretary of State for Health. It was organized as a vertical programme, with staff in the provinces being independent of the provincial directorates of health. The entral office comprised four bureaux – for planning and evaluation, for epidemiology, for operations, and for administration – and employed 61 people.

Each of the provincial/regional offices in 34 regions of the country included a regional malariologist and administrative staff, plus an assistant regional malariologist in the areas under attack phase, who were responsible for supervision and coordination of the activities in the sections/zones. In sections, the staff was comprised of malaria zone officer, assistant zone chiefs, a clerk, microscopists (1 per 150 000 population), and drivers. In 1957, 200 physicians and 1470 sanitarians were employed.

The so called "revision" laboratories were located in Diyarbakır, Aydın, Adana and Ankara.

Training of newly recruited NMES staff – including malaria zone chiefs, microscopists, entomology technicians, sector chiefs, surveillance agents, and spraying squad chiefs – was carried out by the Adana Institute of Malariology.

Figure A7.1 Structure of malaria eradication service/network



ANNEX 8: MALARIA SURVEILLANCE

Turkey's malaria surveillance systems rely on case-based surveillance and, to a great extent, on physician and laboratory reporting and analysis of data.

The following Ministry of Health reporting forms are used:

- Forms 014 and 017, which include core data such as diagnosis, reporting site, date of diagnosis and notification, sex and age group, outcome, and case classification. Additional data regarding malaria cases and control activities are covered in malaria-specific forms.
- The Malaria Epidemiological Investigation Form covers epidemiological investigations and vector control activities, with information on parasite species, classification of cases, disease history, and interventions undertaken.
- The Monthly Malaria Laboratory Activity Report is completed by health centres and provincial health directorates; it includes basic data on malaria laboratory activities including total number of positive and negative slides, and number of confirmed slides.
- The Monthly Malaria Control Activities Form includes all provincial malaria control activities carried out in a given month; it includes total number of malaria cases, parasite species, laboratory work, classification of cases, and diagnostic activities.
- The Malaria Equipment Stock Form provides data on treatment drugs and insecticides quantities available.
- The Financial Report provides information on personnel movements and on funds expended for malaria services.

A standard reporting form (Form 014) is used for notifiable diseases. All health units are required to complete this form and send it to the relevant institution on the day of diagnosis. Each health unit is also responsible for completing a statistics form (Form 017) for diseases subject to compulsory reporting; these forms are sent to the provincial health directorate on a monthly basis.

In addition, all health units are required to complete a Malaria Epidemiological Investigation Form for each malaria case, and a Monthly Malaria Laboratory Activity Report, which are then sent to the appropriate provincial health directorate. Provincial health directorates, in turn, are required to complete the Monthly Malaria Control Activities Form, Monthly Malaria Laboratory Activity Report, Malaria Equipment Stock Form and the Financial Report, sending them to the Malaria Control Department of the Ministry of Health; copies of Malaria Epidemiological Investigation Forms, the Monthly Malaria Control Activities Form and the Monthly Malaria Laboratory Activity Report are sent monthly, and the Malaria Equipment Stock Form and Financial Report are sent 3-monthly.

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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