Towards a malaria-free world

Elimination of malaria in Kyrgyzstan

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World Health Organization

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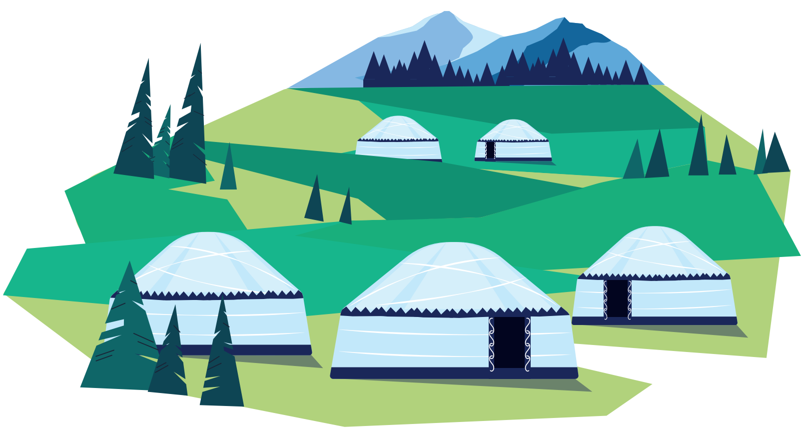
ISBN 978-92-4-008083-6 (electronic version)
ISBN 978-92-4-008084-3 (print version)

Suggested citation. Towards a malaria-free world: elimination of malaria in Kyrgyzstan. Geneva: World Health Organization; 2023. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

Design and layout by Inís Communication

Contents



Acknowledgements

WHO is grateful to the numerous specialists from the Ministry of Health of the Kyrgyz Republic, Department of Disease Prevention and State Sanitary and Epidemiological Surveillance at the national level and its branches at the provincial and district levels and experts for development of this publication.

WHO acknowledges with thanks Dr Gulnara Abdyldaeva, Dr Kubanychbek Almerekov, Dr Akjol Anarbaev, Dr Gulmira Jumashova, Dr Zaynidin Mamyrov and Dr Gulnara Minbayeva from the Department of Disease Prevention and State Sanitary and Epidemiological Surveillance of the Ministry of Health of the Kyrgyz Republic for their contribution to the collection and analysis of country information.

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Abbreviations

ACTED	Agency for Technical Cooperation and Development
CDC	Centers for Disease Control and Prevention
CDPSSES	Centre for Disease Prevention and State Sanitary Epidemiological Surveillance
DDPSSES	Department of Disease Prevention and State Sanitary Epidemiological Surveillance
DDT	dichlorodiphenyltrichloroethane
GDP	gross domestic product
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
Merlin	Medical Emergency Relief International
MPPT	mass primaquine preventive treatment
NMCP	National Malaria Control Programme
PCR	polymerase chain reaction
SSES	State Sanitary Epidemiological Service
TB	tuberculosis
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics
WHO	World Health Organization

Glossary

case, confirmed	Malaria case (or infection) in which the parasite has been detected in a diagnostic test, i.e. microscopy, a rapid diagnostic test or a molecular diagnostic test Note: On rare occasions, the presence of occult malaria infection in a blood or organ donor is confirmed retrospectively by the demonstration of malaria parasites in the recipient of the blood or organ.
case, imported	Malaria case or infection in which the infection was acquired outside the area in which it is diagnosed
case, indigenous	A case contracted locally with no evidence of importation and no direct link to transmission from an imported case
case, introduced	A case contracted locally, with strong epidemiological evidence linking it directly to a known imported case (first-generation local transmission)
case, locally acquired	A case acquired locally by mosquito-borne transmission Note: Locally acquired cases can be indigenous, introduced, relapsing or recrudescent; the term "autochthonous" is not commonly used.
malaria elimination	Interruption of local transmission (reduction to zero incidence of indigenous cases) of a specified malaria parasite in a defined geographical area as a result of deliberate activities. Continued measures to prevent re-establishment of transmission are required. Note: The certification of malaria elimination in a country will require that local transmission is interrupted for all human malaria parasites.
malaria eradication	Permanent reduction to zero of the worldwide incidence of infection caused by human malaria parasites as a result of deliberate activities. Interventions are no longer required once eradication has been achieved.
malaria reintroduction	Malaria reintroduction is the occurrence of introduced cases (cases of the first-generation local transmission that are epidemiologically linked to a confirmed imported case) in a country or area where the disease had previously been eliminated Note: Malaria reintroduction is different from re-establishment of malaria transmission (see definition).
malaria-free	Describes an area in which there is no continuing local mosquito-borne malaria transmission and the risk for acquiring malaria is limited to infection from introduced cases

transmission, re-establishment of	Renewed presence of a measurable incidence of locally acquired malaria infection due to repeated cycles of mosquito-borne infections in an area in which transmission had been interrupted Note: A minimum indication of possible re-establishment of transmission would be the occurrence of three or more indigenous malaria cases of the same species per year in the same focus, for 3 consecutive years.
transmission, interruption of	Cessation of mosquito-borne transmission of malaria in a geographical area as a result of the application of antimalarial measures

Executive summary

This publication describes the resurgence of malaria in Kyrgyzstan in the 1990s after its elimination in 1960, and the efforts that followed to interrupt local malaria transmission for a second time. Special attention is given to evaluation of the strategies and policies applied to cope with the epidemic situation and to achieve malaria elimination. Kyrgyzstan's experiences and the lessons learned during this process may be useful for other countries attempting to eliminate malaria.

Initial malaria control and elimination

Malaria was formerly a widespread disease in Kyrgyzstan. Both *Plasmodium vivax* and *P. falciparum* were recorded in the country. In the years following the Second World War, Kyrgyzstan set itself the goal of eliminating the disease by implementing the World Health Organization (WHO) Global Malaria Eradication Programme.

Malaria control and surveillance were scaled up through large-scale dichlorodiphenyltrichloroethane (DDT) and hexachlorane indoor spraying. This was carried out alongside environmental management and other measures, including active and passive case detection; microscopic confirmation of cases; radical treatment of *P. vivax* malaria; recording, reporting and follow-up of cases; and seasonal chemoprophylaxis in active foci.

The last five locally acquired cases of *P. vivax* malaria were recorded in 1959, and local transmission was interrupted. *P. falciparum* malaria had been eliminated in the country earlier, in 1957. Kyrgyzstan was not certified by WHO as malaria-free, however, because at the time it was part of the Union of Soviet Socialist Republics, which still included some endemic areas.

From 1960 to 1986, Kyrgyzstan was malaria-free. To prevent reintroduction of the disease, a vigilance system was set up in accordance with the recommendations of the WHO Global Malaria Eradication Programme.

Malaria resurgence, response and elimination

During the period 1981–1985, against the background of the maintenance of malaria-free status for more than 20 years, imported *P. vivax* malaria was detected at the border with Tajikistan. Increased importation of malaria led to a resumption of local transmission. After 1986, both introduced and indigenous cases of *P. vivax* malaria were reported. During the period 1981–2001, a total of 141 cases of imported and locally acquired malaria were registered.

In 2002, the resumption of transmission of *P. vivax* malaria produced an explosive epidemic situation in the southern provinces of the country, and the number of indigenous cases reached 2725. As a result of internal migration, malaria was also distributed in the north of the country.

One of the main factors contributing to re-establishment of malaria in Kyrgyzstan was intensive importation of malaria by seasonal workers from Tajikistan and probably from Uzbekistan. There were also a number of programmatic factors, including:

- weakening of the National Malaria Control Programme (NMCP) and a low level of vigilance by general health services at the provincial and district levels due to the long absence of malaria in the country;
- delayed case detection and management;
- weak laboratory skills in malaria microscopy;
- understaffing of the State Sanitary Epidemiological Service (SSES), leading to delayed investigations, reporting and responses;
- lack of medicines to treat the first cases of malaria in 2002;
- insufficient supply of insecticides for vector control interventions at the start of the epidemic;
- delayed seeking of medical assistance due to insufficient knowledge of malaria in the general population.

The Ministry of Health, and in particular its NMCP, mobilized the malaria network and public health facilities and scaled up antimalarial interventions. NMCP was guided by policies and strategies regulated by Government documents and comprehensive plans of action on measures to control the epidemic and prevent malaria. Technical and financial support from the WHO Regional Office for Europe were of key importance.

A WHO malaria field office set up in Osh province in 2003 with international and national staff gave valuable assistance towards improving malaria case detection and disease management, strengthening surveillance and vector control activities, and capacity-building. The establishment of village health committees helped to bring about social mobilization.

Kyrgyzstan managed to restrain the first attack of malaria and achieved a significant reduction in morbidity. In 2004, the number of officially registered locally acquired cases dropped to 93.

The main policies and approaches applied in containing the 2002 epidemic were:

- Eliminating sources of infection:
  - intensified passive case detection by malaria screening all people presenting with fever;
  - intensified active case detection in all malaria foci through weekly house-to-house visits, fever screening and blood sampling people with fever, and mass blood surveys among residents of the home villages of identified people with malaria;
  - all people found to have malaria were offered radical treatment of *P. vivax* malaria using chloroquine for 3 days and primaquine for 14 days;
  - prompt and comprehensive investigation of every case and focus by SSES;
  - timely notification of cases and reporting;
  - interseasonal preventive treatment in spring 2003 with primaquine (15 mg daily for 14 days) of all people with malaria from the previous year to ensure full coverage in case of gaps during initial treatment and to prevent relapse.
- Integrated and evidence-based (guided by focus investigations) vector control, and improved entomological surveillance:
  - indoor residual spraying in affected provinces in 2003;
  - larviciding – this involved treatment of ponds and rice fields with diflubenzuron in 2002; and distributing *Gambusia affinis* fish in mosquito breeding sites, especially rice fields, from 2003;

  - reducing the number of breeding places through environmental measures (mainly infilling non-productive water bodies);
  - reducing human–vector contact through housing improvements;
  - using locally manufactured mosquito nets;
  - improved entomological surveillance.
- Prevention and education of the general population:
  - health education and increased community awareness and engagement of the whole population in malaria control and prevention;
  - seasonal chloroquine prophylaxis during the malaria transmission season in a few active foci.

After containment of the 2002 epidemic, the National Strategic Plan to Combat Malaria in the Kyrgyz Republic was developed to expand and scale up interventions across the country to prevent further distribution of malaria.

In 2005, the number of locally acquired cases increased to 225. This was the result of intensive migration from southern provinces to Bishkek, which led to malaria infecting 129 local residents.

In 2005–2007, a few cases of malaria were introduced from Chuy province to Ysyk Kol, Naryn and Talas provinces.

In 2005–2006, in Tashkomur city, Jalal Abad province, an outbreak of *P. vivax* malaria was registered, with 28 indigenous cases in the first year and 75 in the second year.

The malaria burden then gradually decreased. By 2007, the epidemiological situation had stabilized to some extent. Nationally, 96 indigenous cases were registered (compared with 318 in 2006), including cases in Batken province, Bishkek city, Chuy province and Jalal Abad province, and one case each in Ysyk Kol and Osh provinces.

Malaria epidemics and outbreaks in the country were contained by an adequate level of response. Backed by international support, NMCP had been strengthened and anti-epidemic activities intensified. This was achieved through an integrated approach and comprehensive plans of action for epidemic containment legislated for and prepared by the Ministry of Health and transmitted to local governments and related organizations.

In line with the malaria elimination strategy of the WHO Regional Office for Europe, the Kyrgyz Government reoriented the malaria programme towards elimination. The Government signed the Tashkent Declaration: the Move from Malaria Control to Elimination in the WHO European Region in 2005, showing political commitment to interrupt malaria transmission.

In 2008, the Programme for the Elimination of Malaria in the Kyrgyz Republic and guidelines on improving malaria surveillance were developed and approved by the Ministry of Health.

The large-scale control and elimination interventions implemented in 2005–2010 are summarized below:

- Surveillance and response:
  - active and passive case detection and disease management was continued and expanded, including quality-controlled microscopy and radical treatment free of charge;
  - quality assurance of malaria laboratory diagnosis using national programme coordinated by national reference laboratory was strengthened and expanded;
  - special attention was paid to timely and comprehensive epidemiological investigation of cases of malaria and foci, case definition and focus classification according to WHO definitions, and monitoring of foci;

  - maintenance of information system, with timely compulsory notification, recording and reporting of cases; maintenance of database of national, provincial and district registers of cases and foci; and data collection and analysis;
  - chemoprophylaxis for people from at-risk groups.
- Vector control interventions and entomological surveillance:
  - integrated vector control to reduce longevity of female mosquitoes (indoor residual spraying) in new and residual active foci; to reduce larval density (mainly using *G. affinis* fish); and to reduce human–vector contact in vulnerable areas (use of insecticide-treated and long-lasting insecticidal mosquito nets) were addressed with special attention;
  - drainage of breeding sites and periodic cleaning of irrigation canals;
  - mapping and monitoring of vector breeding sites at sentinel points every 10 days during the malaria season, and maintenance and annual updates of registers of breeding sites at district level;
  - analysis of meteorological data;
  - definition of parameters of potential malaria season based on entomological surveillance and temperature records.
- Training of health personnel on malaria elimination and prevention:
  - between 2006 and 2014, 23 infectionists, parasitologists, epidemiologists, entomologists, clinical laboratory workers, primary health-care physicians and health-care managers participated in postgraduate training courses on malaria aetiology, pathogenesis, symptomatology, diagnosis, treatment, epidemiology, entomology, surveillance and control and programme management at the Institute of Medical Parasitology and Tropical Medicine;
- Public health education and community mobilization:
  - implemented in conjunction with Republican Centre for Health Promotion through village health committees in vulnerable areas;
  - programmes for schools developed, often using drama and puppets;
  - training courses for professionals and rural activists;
  - education and information materials for general population.
- Effectiveness of interventions was monitored and evaluated.
- Interagency and intersectoral integration and coordination of antimalarial interventions were in place.
- Active cooperation with neighbouring countries was nurtured:
  - participation in WHO malaria cross-border meetings;
  - joint statement on cross-border cooperation on malaria signed in 2010 by Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan;
  - cooperation among NMCP services at border areas with Kyrgyzstan, Tajikistan and Uzbekistan;
  - development of joint plans for antimalarial activities;
  - joint roundtables and meetings in border areas;
  - exchanges of information.
- Operational research on:
  - parasites and vectors through molecular genetic studies;
  - sensitivity to antimalarial medicines and treatment efficacy;
  - epidemiological aspects of resurgence of *P. vivax* malaria.

Kyrgyzstan benefited from assistance from the WHO Regional Office for Europe in developing strategies, approaches, programmes and plans of action, and training of health staff. The country received technical and financial support from the Polish and Turkish Governments, the Agency for Technical Cooperation and Development (ACTED), the Centers for Disease Control and Prevention (CDC), Medical Emergency Relief International (Merlin), and the United States Agency for International Development (USAID).

In 2006, Kyrgyzstan received a Round 5 grant from the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) to strengthen national health capacity for malaria control. A second Global Fund grant was extended until the end of 2014. Within the framework of these grants, Kyrgyzstan received essential technical and financial assistance for malaria control and elimination. Sustainable funding was also provided by the Kyrgyz Government.

In 2008, as a result of these efforts, there were only a few active foci in the north in Bishkek and Chuy province and in the southern province of Batken. In 2010, the last three indigenous cases of malaria were reported in Jalal Abad province.

In the following years, no locally acquired cases of malaria were reported, although there were some imported cases and receptivity remained high. The absence of locally acquired cases for more than 3 years after 2010 encouraged the Government to apply for WHO recognition of the country's success. In 2016, Kyrgyzstan was certified malaria-free by WHO.

Prevention of re-establishment of malaria

A large part of Kyrgyzstan still has high malaria receptivity because of the many vector breeding areas, including rice fields, irrigation systems and other water bodies. Temperature conditions are favourable for mosquitoes. The southern region, especially the Fergana Valley, has the highest level of receptivity.

After interruption of local transmission in 2010, introduction of malaria was low. In the period 2011–2022, there were 28 officially registered imported cases (21 *P. vivax*, seven *P. falciparum*). The risk of importation of malaria may change in the future, however, as international relations in economics, trade, tourism and culture expand.

To maintain the country's malaria-free status, prevent resumption of local transmission, and establish effective mechanisms for the post-elimination period, a programme to prevent re-establishment of local transmission was approved and funded by the Kyrgyz Government. The objectives of the programme were:

- early diagnosis and notification of all cases of malaria, with timely radical treatment;
- identification of all cases and causes of any reintroduction of transmission;
- immediate response to any reintroduction of transmission;
- continuous training and retraining of health-care professionals;
- ongoing social mobilization and coordinated intersectoral actions;
- partnerships with international and donor organizations;
- cross-border cooperation.

Taking into account receptivity indicators, the malaria situation in the recent past, and the currently low rate of importation of malaria (which may change over time), NMCP stratified the territory of Kyrgyzstan according to the risk of re-establishment of malaria and applied preventive measures accordingly. The country maintains a strong health system and a malaria surveillance mechanism in which special attention is given to imported cases.

In 2017, Kyrgyzstan signed the Ashgabat Statement: Preventing the Re-establishment of Malaria Transmission in the WHO European Region.

Outlook for the future

Using contemporary evidence-based strategies, Kyrgyzstan managed to contain a malaria epidemic after resurgence of local transmission, to dramatically reduce the malaria burden, and to achieve malaria elimination. Strong political commitment, adequate funding and a well-developed surveillance system were required to set up and implement the malaria control and elimination programmes.

To maintain its malaria-free status, Kyrgyzstan must maintain a high degree of vigilance and retain its rapid epidemic response system.

Lessons learned during the period of malaria control and elimination show that the activities and financial allocations made to the malaria programme should not be terminated, even though Kyrgyzstan is now malaria-free. The activities set out in the programme for prevention of malaria re-establishment should be continued efficiently and effectively.

Introduction

The World Health Organization (WHO) *Global technical strategy for malaria 2016–2030* was adopted by the World Health Assembly (WHA) in May 2015 and updated in May 2021. The strategy reiterates the vision of a world free of malaria *(1)*.

One of the three pillars of the strategy calls for all malaria-endemic countries to "accelerate efforts towards elimination and attainment of malaria-free status". The strategy has milestones at each five-year mark for the number of countries to eliminate malaria: 10 countries by 2020, another 10 by 2025 and a final 15 by 2030 *(1)*.

Progress towards malaria elimination is increasing as several countries near the goal of zero indigenous malaria cases. In 2021, there were 84 malaria-endemic countries, compared with 108 in 2000. The number of malaria-endemic countries with fewer than 10 000 indigenous malaria cases increased from 27 in 2000 to 46 in 2021. During the same period, the number of countries that reported fewer than 100 indigenous cases increased from six to 27, and the number of countries that reported fewer than 10 indigenous cases increased from four to 25 *(2)*.

Plasmodium vivax and *P. falciparum* malaria were formerly widespread diseases in Kyrgyzstan. An elimination programme was launched after the Second World War, and local transmission had ceased by 1960. Kyrgyzstan was malaria-free for more than 20 years. In 1981, malaria importation was reported, and over time the number of imported cases increased – predominantly caused by *P. vivax* from neighbouring Tajikistan, a country that was still affected by malaria.

In 2002, importation of malaria led to an epidemic situation in the southern regions of the country bordering Tajikistan. Malaria then spread to the north *(3–5)*. Huge efforts and funding were needed to set up and implement malaria control and elimination programmes, to scale up antimalarial activities, to combat the epidemic and outbreaks, and to achieve the goal of malaria elimination, which was recognized by WHO certification in 2016 *(4–6)*.

This publication presents an analysis of malaria resurgence in Kyrgyzstan and its reasons, and the strategies and approaches used to contain the epidemic and outbreaks and then to achieve malaria elimination. It covers the main interventions, best practices in epidemiological surveillance and control, and lessons learned.

The publication describes an example of contemporary evidence-based elimination strategies and policies that were applied in a situation in which malaria transmission was re-established and were followed by successful efforts to eliminate malaria. The strong political commitment and the mobilization of human resources that were crucial in achieving elimination are emphasized. It is hoped that the experiences of the National Malaria Control Programme (NMCP) of Kyrgyzstan may assist other countries aiming to eliminate malaria.

Country background information

Geography, climate and vegetation

Kyrgyzstan is located in the north-eastern part of central Asia, occupying part of the Pamir-Alai and Tien Shan mountain systems (Fig. 1) *(7)*. The country covers 199 900 km^2. It has borders with China, Kazakhstan, Tajikistan and Uzbekistan. The total length of its borders is 4503 km.

Fig. 1. Geography of Kyrgyzstan

Source: WHO GIS Centre for health, DNA/DDI.

Kyrgyzstan is a mountainous country. About 90% of the country lies more than 1500 m above sea level. The main mountain system is Tien Shan. Part of southern Kyrgyzstan is occupied by the foothills of the Pamir-Alai and the Pamirs and by the Fergana Valley, an intermountain depression in central Asia.

The rivers of Kyrgyzstan are part of the Central Asian Internal Drainage Basin. The main waterway of Kyrgyzstan is the Naryn River, which gradually falls to the Fergana Valley and merges with the Kara Darya, to form the Syrdarya, which flows into the Aral Sea. The country has about 2000 lakes *(8)*.

The climate of Kyrgyzstan is characterized as sharp continental, with cold winters and hot summers. It is strongly influenced by the country's elevation above sea level. The average air temperature is 27 °C (16 °C to 33 °C) in summer and 1 °C (–12 °C to 10 °C) in winter.

There are four climatic zones, which are markedly distinct from each other. The valley–foothill zone (500–1200 m) is characterized by hot summers and moderately cool, snowless winters, with a serious lack of rainfall. This zone, especially in the Fergana Valley, has a subtropical climate. The warmest area is the valley–foothill zone of the Osh region (Nooken, Jalal Abad). The zone includes Chuy, the Ysyk Kol basin, the Talas valley and south-western Fergana. There is intensive agriculture here. In this zone, the conditions are good for malaria vectors.

The mountain zone (900–2200 m) is characterized by a temperate climate, with warm summers and cold, snowy winters. The high mountain zone (2000–3500 m) is cooler in the summer and has relatively cold, snowless winters, with temperatures ranging from well below zero to 16 °C. The nival belt zone (3500 m and higher) has a polar climate and is covered by numerous snowfields and glaciers *(8–10)*.

Precipitation is distributed unevenly over the country. There is high rainfall (up to 1000 mm a year) on the south-western slopes of the Fergana Range and northern slopes of the Kyrgyz Range, which are open to moisture-laden air flows from the west and north-west. Rainfall is also heavy on the northern slopes of the Chatkal Range *(9)*.

The lower belt of the mountains of Kyrgyzstan is a desert composed of grey soils. Moving upwards, there are steppes with cereals, meadows, thickets of shrubs and deciduous forests. Forests occupy a small part (3.5%) of the land area. The terrain is mainly occupied by grazing land and desert, including the high-altitude cold zone *(11)*.

Population and demography

Kyrgyzstan has a resident population of approximately 7 million people *(12)*, with a population density of 34 people per square kilometre *(8)*. In 2021, life expectancy at birth was 71.8 years and annual population growth was 1.66% (Table 1) *(12)*.

Table 1. Kyrgyzstan: demographic data[a]

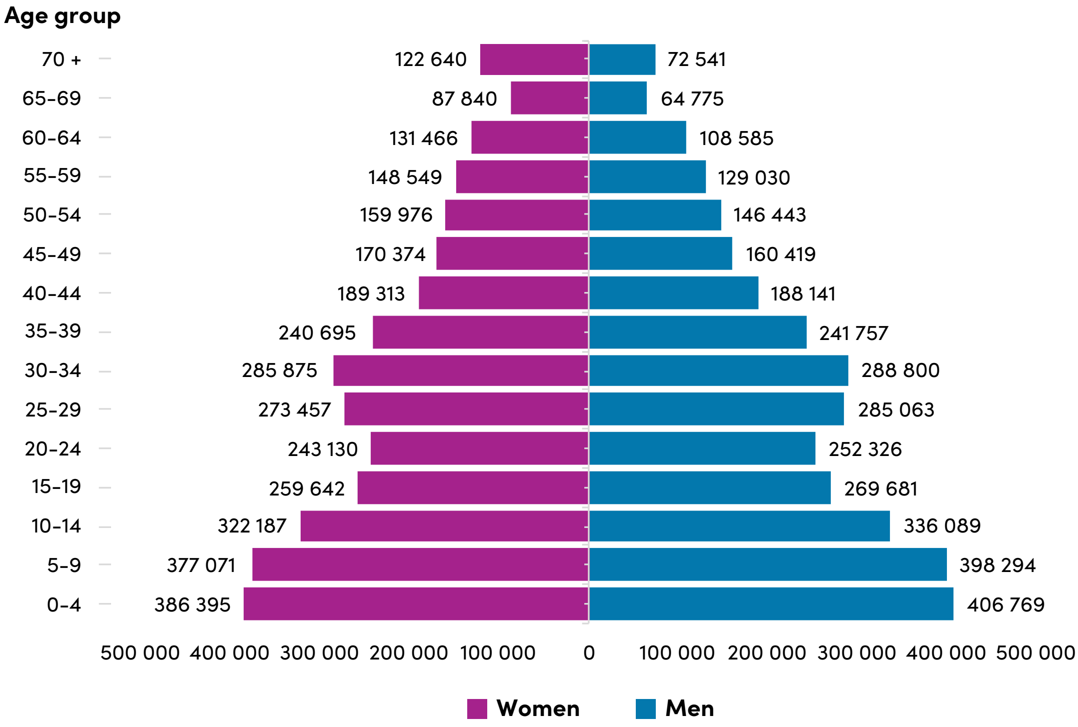
	2018	2019	2020	2021
Population (millions)	6.26	6.30	6.52	6.64
Annual population growth (%)	2.19	2.17	1.79	1.66
Life expectancy at birth (years)	71.3	71.5	71.7	71.8

[a] Considering that much more detailed demographic and health-related data were available at country level, this publication presents country statistics which do not necessarily represent the official WHO statistics.

Source: Statistical yearbook of the Kyrgyz Republic. Bishkek: National Statistical Committee of the Kyrgyz Republic; 2022 (http://www.stat.kg/kg/publications/statisticheskij-ezhegodnik-kyrgyzskoj-respubliki/).

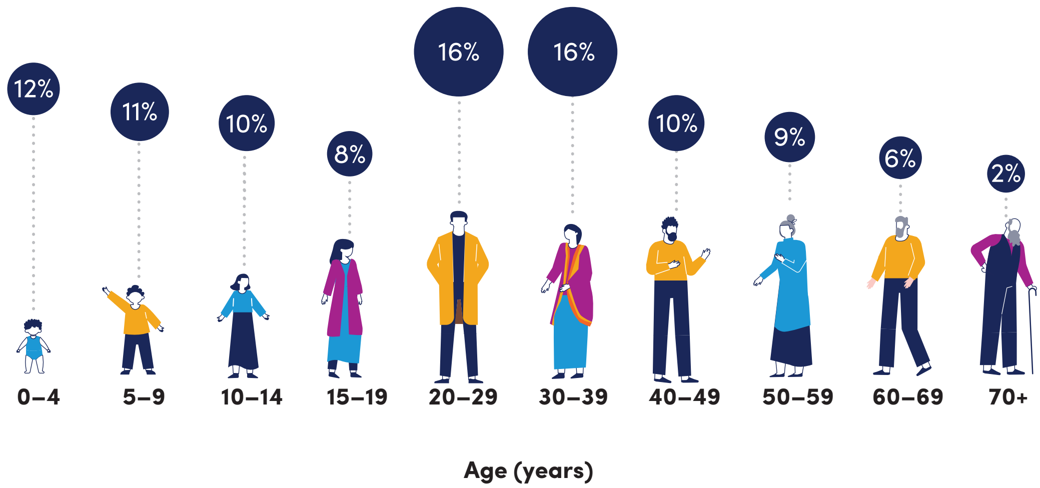
The largest population age groups are 20–29 years (16%) and 30–39 years (16%). There is also a high proportion of children and young people aged 0–19 years (41%) (Figs 2 and 3), consistent with the rising annual population growth (Table 1). The female/male ratio is almost equal *(12)*.

Fig. 2. Sex and age structure of population of Kyrgyzstan, January 2018



Source: Statistical yearbook of the Kyrgyz Republic. Bishkek: National Statistical Committee of the Kyrgyz Republic; 2022 (http://www.stat.kg/kg/publications/statisticheskij-ezhegodnik-kyrgyzskoj-respubliki/).

Fig. 3. Age of population of Kyrgyzstan, 2018

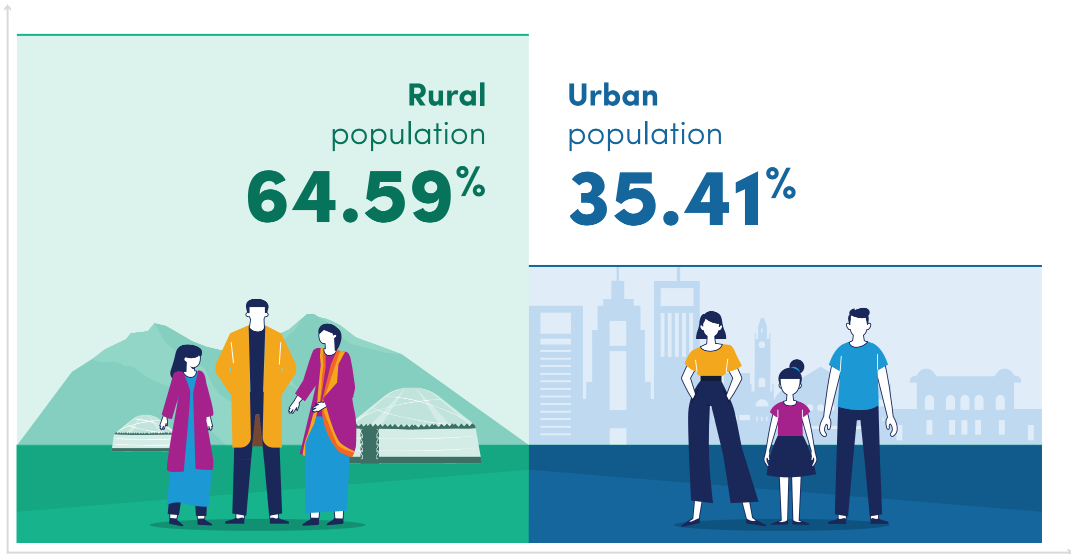


Source: Statistical yearbook of the Kyrgyz Republic. Bishkek: National Statistical Committee of the Kyrgyz Republic; 2022 (http://www.stat.kg/kg/publications/statisticheskij-ezhegodnik-kyrgyzskoj-respubliki/).

In 2021, the dominant ethnic group in Kyrgyzstan was Kyrgyz (74.1%), followed by Uzbek (14.8%), Russian (5.0%), Dungan (1.1%), Uigur (0.9%). Other ethnic groups accounted for 4.1% *(8)*.

A characteristic feature of Kyrgyzstan is its weak urbanization. In 2021, nearly two thirds of the population, especially Kyrgyz and Uzbek people, lived in rural areas (Fig. 4).

Fig. 4. Distribution of population of Kyrgyzstan, 2021



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Most of the population is concentrated in the valley foothills in Chuy (on the border with Kazakhstan), Fergana (on the border with Uzbekistan), the Naryn and Talas valleys, and the Ysyk Kol basin *(8)*.

Educational reforms were adopted after Kyrgyzstan gained independence in 1991. The school education system covers 11 years, of which nine are mandatory. There are over 2000 public schools, and 55 higher educational institutes and universities. In 2021, there were 35 600 students in primary education, 98 100 in secondary education, and 196 600 in higher or professional education *(8)*.

Political organization and economy

Kyrgyzstan is a secular country that declared itself an independent and sovereign state on 31 August 1991 *(13)*. The state structure is determined by the constitution adopted on 27 June 2010, which defines that the state form of government of Kyrgyzstan is a parliamentary republic.

The president is elected by popular vote for a term of 6 years. The prime minister is the head of the Government and is appointed by parliament. The parliament is unicameral and consists of 120 deputies elected for a term of 5 years *(14, 15)*.

The administrative territorial division of Kyrgyzstan has three levels (Fig. 5). There are seven provinces, two cities, 40 districts, 31 towns, nine urban settlements, three villages and 453 village communities. The largest province is Naryn (45 200 km^2). The most densely populated provinces are Chuy and Osh (49 people/km^2). The capital city is Bishkek, with a population of more than one million people *(13, 16)*.

Fig. 5. Political map of Kyrgyzstan, showing administrative divisions

Source: WHO GIS Centre for health, DNA/DDI.

Kyrgyzstan is classified as a lower-middle-income country *(17)*. Its economy consists mainly of agriculture and industry.

There has been a rise in gross domestic product (GDP) in recent years. GDP increased from US$ 1.37 billion in 2000 to US$ 8.54 billion in 2021. GDP per capita was US$ 1123.37 in 2021 *(18)*.

Health-care policies and system

Health system

After gaining independence in 1991, Kyrgyzstan started to implement health-care reforms. In 1992, the country became a WHO Member State *(15)*.

In accordance with a series of national health reform programmes – *Manas* (1996–2006), *Manas Taalimi* (2006–2010) and *Den Sooluk* (2012–2016) – structural changes were made to health authorities and facilities. Primary care was strengthened; family medicine was developed; the hospital sector was restructured; and the legal framework of the new health-care system was created.

In 1997, the Mandatory Health Insurance Fund was created. As a result, there were general improvements to the quality of and access to primary health care, public health services, specialized care, and undergraduate, postgraduate and continuing education for health professionals *(15)*.

In 2021, there were 177 hospitals, with 27 600 beds; 40 institutions providing primary medical assistance; and 1059 primary health-care and obstetric centres. There were 14 000 physicians (21 per 10 000 people) and 34 600 paramedical personnel (51 per 10 000 people) (Table 2) *(8)*.

Table 2. Numbers of physicians, paramedical personnel and health institutions in Kyrgyzstan

	2010	2019	2020	2021
Physicians				
Total	13 300	14 300	14 200	14 000
Per 10 000 population	25	22	21	21
Nursing staff				
Total	29 700	35 000	35 400	34 600
Per 10 000 population	55	54	53	51
Hospital institutions and units	184	190	185	177
Hospital beds				
Total	27 700	26 500	26 900	27 600
Per 10 000 population	51	41	41	41
Institutions providing primary medical assistance	137	96	103	40
Primary health worker and obstetric centres and units	993	1 054	1 057	1 059
Beds for pregnant and postpartum women	2 700	2 700	2 700	2 700
Beds for children	5 000	4 900	5 000	5 300

Source: Kyrgyzstan: brief statistical handbook. Bishkek: National Statistical Committee of the Kyrgyz Republic; 2022 (http://www.stat.kg/media/publicationarchive/672efdec-dda1-400c-96b4-f0508d24d220.pdf).

The Ministry of Health is a central state administrative body *(19)*. Local self-administrations are responsible for public health in their own areas or territories. The Ministry of Health coordinates and controls these local administrations through coordination commissions on health management that are responsible for the implementation of public health policies and programmes, and development and implementation of territorial health programmes.

Health-care services are also provided by the Ministry of Defence, the Ministry of Emergency Situations, the Ministry of the Interior Affairs the National Security Service, and cross-industry associations.

Since gaining independence in 1991, the country has gradually developed the private health sector. In 2008, the private sector had about 350 hospital beds, more than half of which were in Bishkek *(15)*.

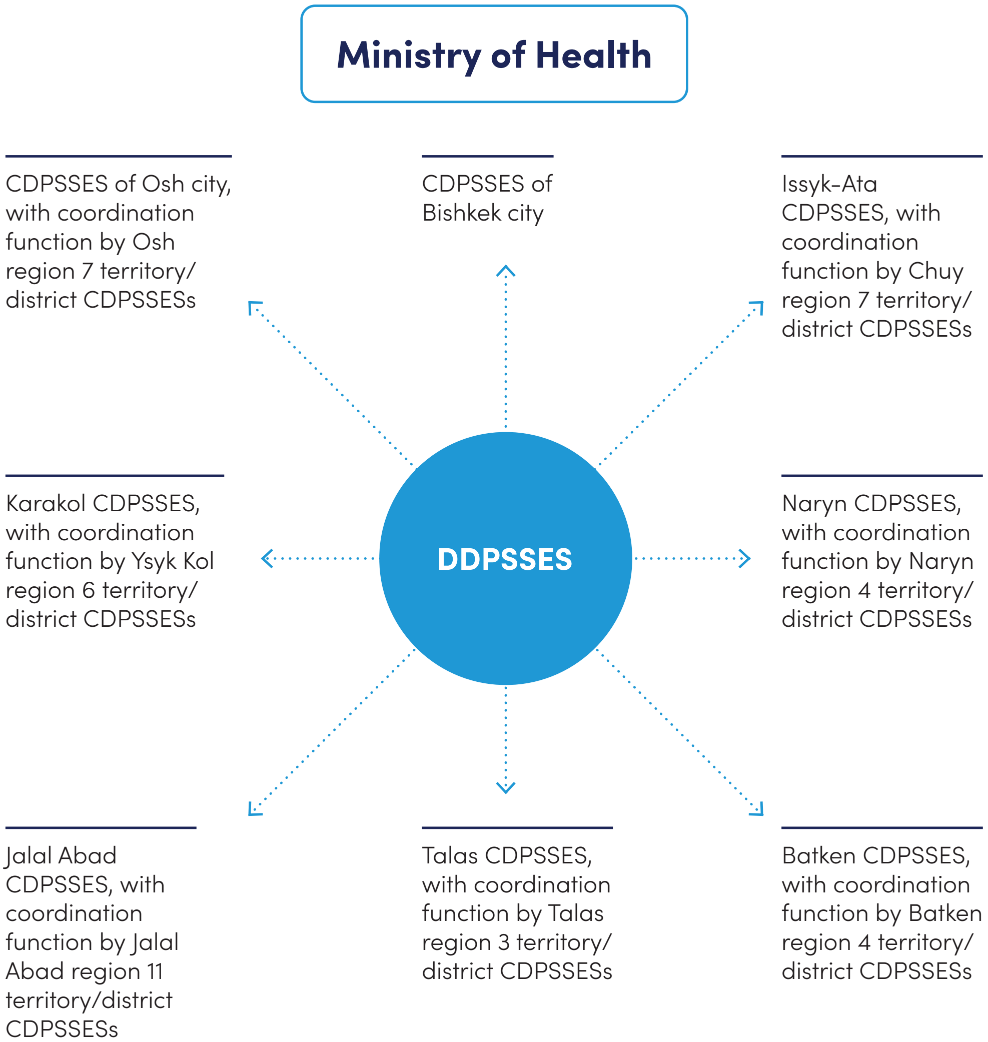
Public health services

Public health services are being reformed, with the aim of integrating the services that deliver healthy lifestyle formation and disease prevention and control.

The Department of Disease Prevention and State Sanitary Epidemiological Surveillance (DDPSSES) is a state body subordinate to the Ministry of Health. It was established in 1997 to carry out control and surveillance of infectious, parasitic and noncommunicable diseases by implementing preventive and anti-epidemic measures; to ensure sanitary and epidemiological welfare; to monitor and assess the effectiveness of programmes and projects in the field of public health; to control the safety of goods and environmental conditions; and to prevent harmful effects of environmental factors on human health.

DDPSSES has provincial and territory (district) Centres for Disease Prevention and State Sanitary Epidemiological Surveillance (CDPSSES) (Fig. 6) *(20)*. DDPSSES played a major role in malaria control and elimination.

Fig. 6. Structure of DDPSSES in Kyrgyzstan



Health financing

Allocations of government funds to health purposes have generally followed an upward trend in recent years, rising from 6.4 billion soms in 2010 to 20.8 billion soms in 2021 (Table 3) *(8)*. Health expenditure as a percentage of GDP has decreased since 2012, however, from 8.51% to 4.49% in 2019, and health expenditure per capita decreased from US$ 104.78 in 2013 to US$ 62.1 in 2019 *(18, 21)*.

Table 3. Health-care expenditure in Kyrgyzstan, 2010–2021

	2010	2019	2020	2021
Total state budget (billion soms)	33.5	91.4	100.3	111.3
Health care (billion soms)	6.4	14.0	17.3	20.8

Source: Kyrgyzstan: brief statistical handbook. Bishkek: National Statistical Committee of the Kyrgyz Republic; 2022 (http://www.stat.kg/media/publicationarchive/672efdec-dda1-400c-96b4-f0508d24d220.pdf).

General health profile

There has been a decrease in the incidence of newly diagnosed diseases in Kyrgyzstan, dropping from 228.9 per 1000 people in 2016 to 167.9 per 1000 people in 2020 (Table 4) *(12)*. Infectious and parasitic diseases followed this trend.

Table 4. Morbidity of population, by main groups of diseases

	Incidence per 1000 people		Incidence per 1000 children aged 0–14 years	
	2017	**2021**	**2017**	**2021**
Total cases of newly diagnosed diseases	256.5	216.7	339.7	263.9
Blood and haematopoietic organ disorders	10.4	5.2	20.5	10.2
Circulatory system disorders	9.5	5.5	0.5	0.2
Digestive system disorders	21.5	26.0	22.8	30.2
Disorders of eye and its appendages	13.5	9.6	12.7	6.8
Ear and mastoid process disorders	9.2	6.0	15.1	7.5
Endocrine, metabolic and immune disorders	4.5	2.7	4.4	1.6
Genitourinary disorders	19.6	12.9	6.3	3.8
Infectious and parasitic diseases	14.3	16.0	28.0	19.0
Injuries and poisoning	14.1	10.0	9.8	5.7
Musculoskeletal system and connective tissue disorders	8.9	7.0	2.5	2.0
Neoplasms	1.6	1.2	0.4	0.2
Nervous system disorders	7.2	6.1	4.0	6.0
Respiratory disorders	92.6	89.1	182.0	152.5
Skin and subcutaneous tissue disorders	12.8	8.5	18.9	10.9

Source: Statistical yearbook of the Kyrgyz Republic. Bishkek: National Statistical Committee of the Kyrgyz Republic; 2022 (http://www.stat.kg/kg/publications/statisticheskij-ezhegodnik-kyrgyzskoj-respubliki/).

The death rate in Kyrgyzstan fell from 6.9 per 1000 people in 1990 to 5.8 in 2021. The leading causes of death are cardiovascular diseases, cancers, digestive system disorders and respiratory system disorders. The number of deaths caused by infectious and parasitic diseases dropped from 12.9 per 100 000 people in 2017 to 7.9 in 2021. Official data show a downward trend in infant and child mortality, from 15.6 per 1000 live births in 2017, to 14.4 in 2020 and 15.2 in 2021 (Table 5) *(12)*.

Table 5. Selected health indicators in Kyrgyzstan

	2017	2018	2019	2020	2021
Mortality (per 1000 people)	5.4	5.2	5.2	6.1	5.8
Infant (under 1 year) mortality (per 1000 live births)	15.6	14.8	15.1	14.4	15.2
Under 5 mortality (per 1000 live births)	18.5	17.6	17.5	16.7	17.9
Mortality per 100 000 population due to infectious and parasitic diseases	12.9	11.7	10.0	9.0	7.9
Life expectancy at birth (years)					
• Men	67.2	67.4	67.6	67.8	67.9
• Women	75.4	75.6	75.8	76	76.1
Number of people with active TB (per 100 000 people)	63.0	59.4	69.9	41.2	44.1
Number of new cases of hepatitis	8 936	10 373	10 580	4 805	2 093
Number of new cases of acute intestinal infection	32 081	31 488	32 866	11 039	21 924
Number of new cases of echinococcosis	941	906	970	653	866

Source: Statistical yearbook of the Kyrgyz Republic. Bishkek: National Statistical Committee of the Kyrgyz Republic; 2022 (http://www.stat.kg/kg/publications/statisticheskij-ezhegodnik-kyrgyzskoj-respubliki/).

History of malaria

Parasites and vectors

In the past, two species of malaria parasites were registered in Kyrgyzstan – *P. vivax* and *P. falciparum*. The last indigenous cases of *P. falciparum* were reported in 1957, after which *P. vivax* was the only species known to be transmitted in the country. Local transmission was interrupted on two occasions: in 1960 (the last indigenous cases of *P. vivax* malaria were reported in 1959), and in 2011 (the last three indigenous cases of *P. vivax* malaria were registered in 2010). Since 1960, single cases of *P. falciparum* have been imported, but no secondary cases have occurred *(15)*.

Fauna of *Anopheles* mosquitoes in Kyrgyzstan include eight species, belonging to two subgenera (*Anopheles* and *Cellia*). The principal vector in the northern part of the country is *An. messeae* (endophilic). Secondary or rare vectors are *An. claviger* and *An. hyrcanus* (exophilic); some new data show the higher efficiency of *An. hyrcanus.*

In the south, the principal vector is *An. superpictus* and the secondary vector is *An. artemievi*. Both species are endophilic.

The density of the exophilic *An. hyrcanus* population is higher at lower altitudes and in areas with rice fields (Aravan, Kara-Suu and Uzgen districts). At higher altitudes, *An. claviger* plays the role of a rare vector of malaria transmission. *An. Pulcherrimus*, detected in the south (Osh province), is also likely to play some role in transmission *(15)*.

Additional information on fauna, ecology and geographical distribution of *Anopheles* mosquitoes in Kyrgyzstan is presented in Fig. 7 and Annex 3.

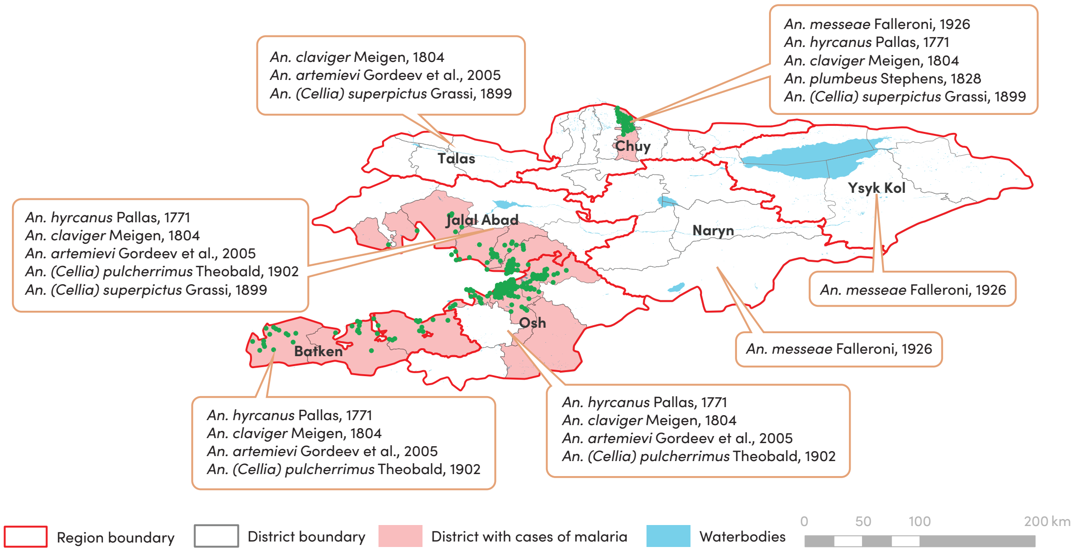
The major rivers of Kyrgyzstan originate high in the mountains, where conditions are unfavourable for mosquito breeding because of low water temperatures, rapid flow and lack of standing water. By contrast, areas favourable for breeding are found where the rivers leave the foothills and drain into the valley floodplains, forming slow-moving stretches with pebbly beds and standing water or pools. For the most part, the lakes in Kyrgyzstan do not serve as breeding sites because the water is cold (alpine lakes Chatyr-Kul Sary-Chelek and Son-Kul) or salty (Ysyk Kol). Some role in the formation of breeding sites can be played by temporary lakes, however, most of which are of the oxbow type formed from old riverbeds.

Especially in the recent past, significant areas of mosquito breeding sites have formed as a consequence of human economic activity, due mainly to improper functioning of hydrotechnical constructions.

Rice fields, which are particularly extensive in the southern part of the country, form vast breeding sites. Other artificial breeding sites include the shallow-water parts of the series of reservoirs on the Naryn river; overgrown drainage canals and irrigation ditches, which become littered and overgrown with water vegetation; and city and village ponds and potholes.

The distribution of malaria vector species and the density of populations are influenced by ecological factors in Kyrgyzstan, which is characterized as a mountainous country. The largest number of species is found in the foothill valleys, especially in the Chuy and Fergana valleys. With increasing altitude, the species composition is depleted. In the valleys located more than 2000–2200 m above sea level (Alai, At-Bashi, Susamyr), malaria vectors have not been found *(15)*.

Fig. 7. Geographical distribution of *Anopheles* mosquitoes in Kyrgyzstan



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

Early malaria control efforts

In the nineteenth century, malaria was one of the most common infectious diseases in Kyrgyzstan. Incomplete data show that during the period 1891–1897, 11 958 cases of malaria were registered in the area of Semirechye, in the northern part of Kyrgyzstan. Archival records from the sanitary service of the Turkestan Military District show that in 1890, malaria incidence in the army was 982 cases per 1000 people. Malaria-related mortality at that time reached 193 per 10 000 people *(15)*.

In 1926, after the formation of the Kyrgyz Autonomous Socialist Soviet Republic, the first malaria station was established in the town of Frunze (now Bishkek). The malaria burden continued to increase until 1933, however, when 120 000 microscopically confirmed cases of *P. vivax* and *P. falciparum* malaria were registered in the country. The incidence rate was 1090 per 10 000 people – 11% of the population was infected.

The serious nature of the situation called for political intervention. In 1935, a decision of the All-Russian Congress of Soviets brought about a significant expansion of the network of malaria facilities, and eight malaria stations and 42 malaria points were established. From then on, the problem was addressed more broadly and systematically.

In 1935, 1.2 tonnes of quinine, 200 kg of pamaquine, 25 kg of acrichine and other medicines were used for malaria treatment and chemoprophylaxis. To identify carriers, 87 412 people were screened for malaria. To gain control of malaria mosquitoes, 17 874 hectares were sprayed by plane with insecticides and 22 680 hectares of land and breeding sites were treated with insecticides. A total of 17 814 bednets were distributed.

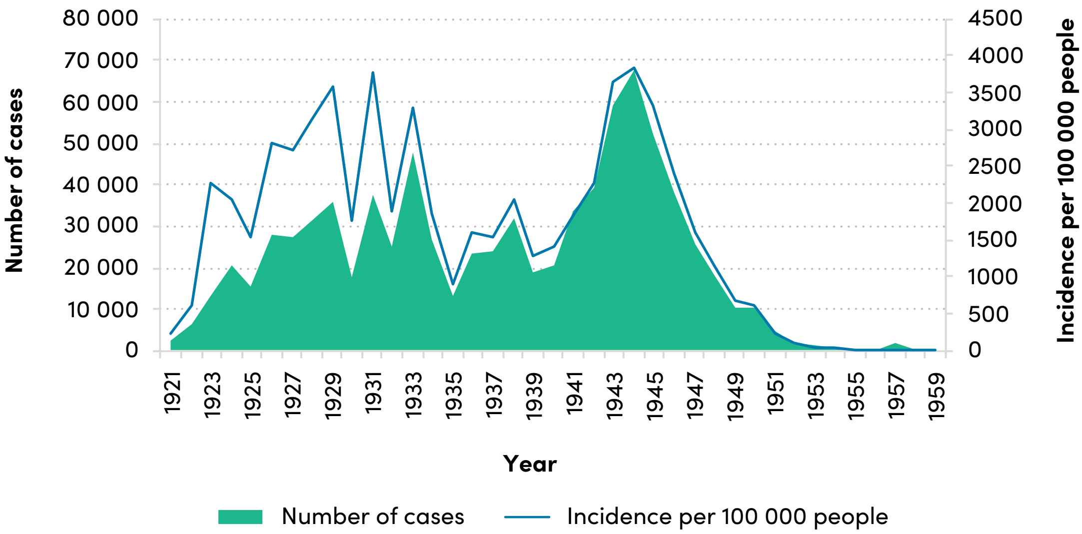
By 1940, the country had 38 malaria stations and 70 malaria points, staffed by 830 malaria personnel, including 62 physicians qualified in malariology and 108 assistants *(15)*.

Initial malaria elimination efforts and interruption of transmission

After the Second World War, the Union of Soviet Socialist Republics (USSR) set the goal of "eliminating malaria as a mass disease", including in Kyrgyzstan. Malaria surveillance and control were scaled up. Active and passive case detection was intensified, and radical treatment of *P. vivax* malaria was conducted. After 1949, bigumal was introduced in addition to the previously used combination of acrichine and primaquine for the treatment and chemoprophylaxis of malaria. Seasonal chemoprophylaxis was carried out in active foci. All cases were microscopically confirmed, recorded, reported and followed up. Vector control activities included large-scale dichlorodiphenyltrichloroethane (DDT) and hexachlorane indoor spraying, in parallel with land and avia chemical methods. Environmental management was also conducted.

These large-scale antimalarial interventions led to a dramatic reduction in the malaria burden (Fig. 8). The annual incidence dropped from 3852 per 100 000 people in 1944, to 619 in 1950, to 7.4 (153 cases) in 1955, to 3.4 (69 cases) in 1956, and to 1.3 (26 cases) in 1957. Malaria was eliminated as a mass disease in the Talas valley in 1951, in the Chuy valley in 1952 and in the Osh region in 1955. The last five indigenous cases of *P. vivax* malaria were recorded in 1959, and local transmission was interrupted. *P. falciparum* malaria was eliminated in the country in 1957. Kyrgyzstan was not certified by WHO as malaria-free, however, because at the time the country was part of the USSR, which still included some endemic areas *(15)*.

Fig. 8. Number of cases and annual incidence of malaria in Kyrgyzstan, 1921–1959



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

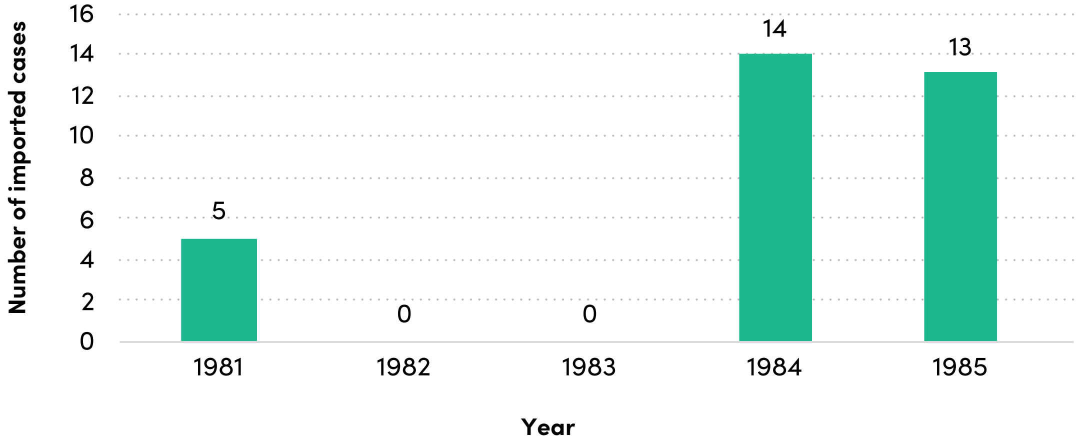
Malaria-free period, 1960–1985

During the period 1960–1980, Kyrgyzstan was malaria-free. There was no local transmission, and only one case in 1963 of imported malaria was detected. To prevent reintroduction of malaria, a vigilance system was set up in accordance with the recommendations of the WHO Global Malaria Eradication Programme. Under supervision of the State Sanitary Epidemiological Service (SSES) of the Ministry of Health, all public health-care institutions were engaged in maintaining the malaria-free status.

The main activities carried out included epidemiological surveillance directed at early detection of any malaria case, preparedness for immediate radical treatment, epidemiological investigation of cases and new foci, reporting, vector control interventions on epidemiological indications, entomological surveillance, and training of medical personnel *(15, 22)*.

In 1981, five imported cases of *P. vivax* malaria were detected, followed by 14 imported cases in 1984, and 13 in 1985 (Fig. 9), mainly near the border with Tajikistan. The real number of imported cases may have been greater than reported, as some of the people entering from Tajikistan – already affected by malaria – may have brought antimalarial medicines with them and not sought treatment *(3, 15, 22, 23)*. It is also likely that some imported or even introduced cases were missed by NMCP, whose vigilance declined over the long period in which malaria was absent.

Fig. 9. Imported cases of malaria in Kyrgyzstan, 1981–1985



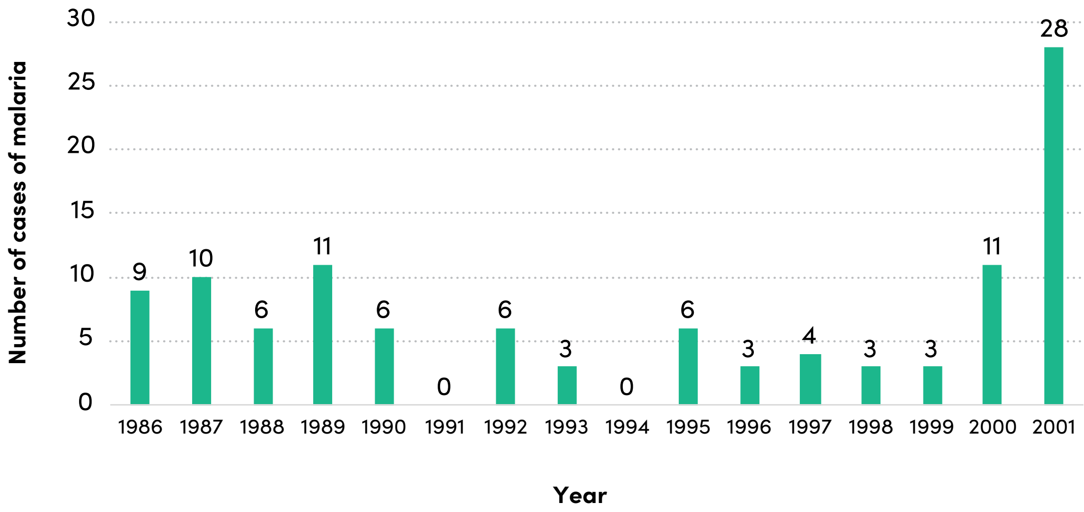
Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

Malaria resurgence, control and elimination, 1986–2010

Resumption of local transmission

Increased importation of malaria led to a resumption of local transmission and infection of the local population. After 1986, introduced and indigenous cases were reported in Kyrgyzstan. Four locally acquired cases of *P. vivax* malaria (out of nine registered), classified as "introduced" (first-generation local transmission), were detected in 1986; these were a consequence of malaria importation by military personnel returning from Afghanistan (Fig. 10) *(22)*. Another 10 cases were registered in 1987, indicating local transmission was ongoing on a limited scale and in limited areas. During these 2 years, 11 of the cases were reported from Batken district, on the borders with Tajikistan and Uzbekistan.

Fig. 10. Cases of malaria in Kyrgyzstan, 1986–2001



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

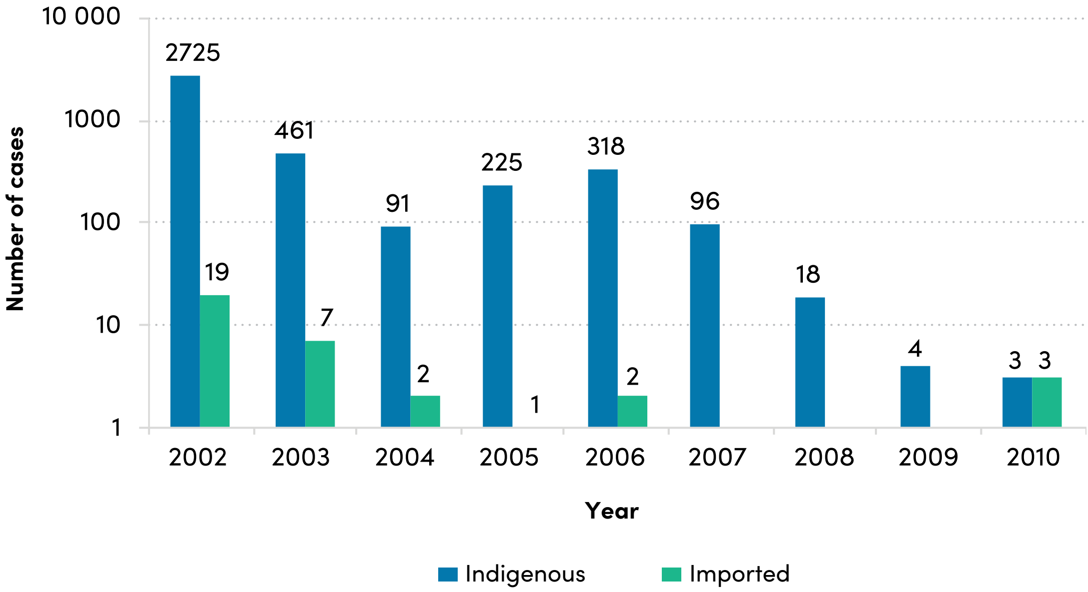
During the period 1981–2001, a total of 141 cases of malaria were registered. Of these, 86 cases of *P. vivax* malaria were detected in the southern regions of the country with high malariogenic potential, of which 50 were due to local malaria transmission in the Fergana Valley. In 2001, 15 of the 28 officially reported cases were a result of local transmission. The majority of cases (63%) were imported from Tajikistan (50%) and Azerbaijan (13%), with single cases from India, Pakistan, Saudi Arabia and Türkiye.

Epidemiological investigation of malaria cases showed that the majority (70%) were recorded between April and September – the period when vectors are effectively infected and there is mass migration of the population. The causative agent of malaria was 98% *P. vivax* (locally acquired and imported) and 2% *P. falciparum* (imported) *(15)*.

Malaria epidemic in the south, 2002–2003

In 2002, the resumption of transmission of *P. vivax* malaria produced an explosive epidemic, with a far higher incidence than had previously been reported in Kyrgyzstan. From June 2002, the number of indigenous cases rose sharply in the southern regions of the country, including Batken, Jalal Abad and Osh provinces. A total of 2744 cases was registered nationally by the end of the year (Fig. 11). Most cases (2725) were locally acquired. The situation deteriorated dramatically, and there was a drastic increase in the number of indigenous cases. In all affected areas, only *P. vivax* was detected, and no mixed infections (*P. vivax* and *P. falciparum*) were registered *(3, 22–25)*.

Fig. 11. Officially registered cases of malaria in Kyrgyzstan, 2002–2010



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

The Ministry of Health, and NMCP in particular, mobilized the malaria network and public health facilities and scaled up antimalarial interventions. They were guided by policies and strategies informed by key government documents on measures for malaria epidemic prevention and control *(26, 27)*. In this way, the first wave of malaria was restrained and a significant reduction in morbidity was achieved (Fig. 11).

In 2003, a sharp reduction in the number of indigenous cases of malaria (461) compared with 2002 (2725) was achieved. The lower number of vectors, caused by the cold spring and cool summer of 2003, led to a lower level of transmission, which contributed to the success of the control and prevention interventions. The epidemic in the south was contained, with a trend towards stabilization. In 2004, the number of officially reported indigenous cases dropped to 91 *(15)*.

Spread of malaria to the north, 2005–2007

In 2005, as the malaria situation in the north of the country deteriorated, the number of registered indigenous cases of malaria increased to 225 (Fig. 11). Due to population migration, 70 people with malaria arrived from the southern regions, reaching Bishkek and staying in the residential suburbs. This led to the spread of malaria, and a total of 129 local people were infected.

During the period 2005–2007, a few cases of malaria were imported from Chuy region to Ysyk Kol, Naryn and Talas provinces *(15)*.

In 2005, in Tashkomur city, Jalal Abad province, an outbreak of *P. vivax* malaria was registered. Between 27 May and 5 November 2005, a total of 28 cases were reported. In the following year, 75 indigenous cases were detected. Epidemiological investigation and analysis indicated the outbreak was related to importation of malaria by workers from China and Türkiye, who were reconstructing roads in the area. Tashkomur is situated on the country's south–north population migration route, so it is likely that local migrants also contributed to the outbreak *(28, 29)*.

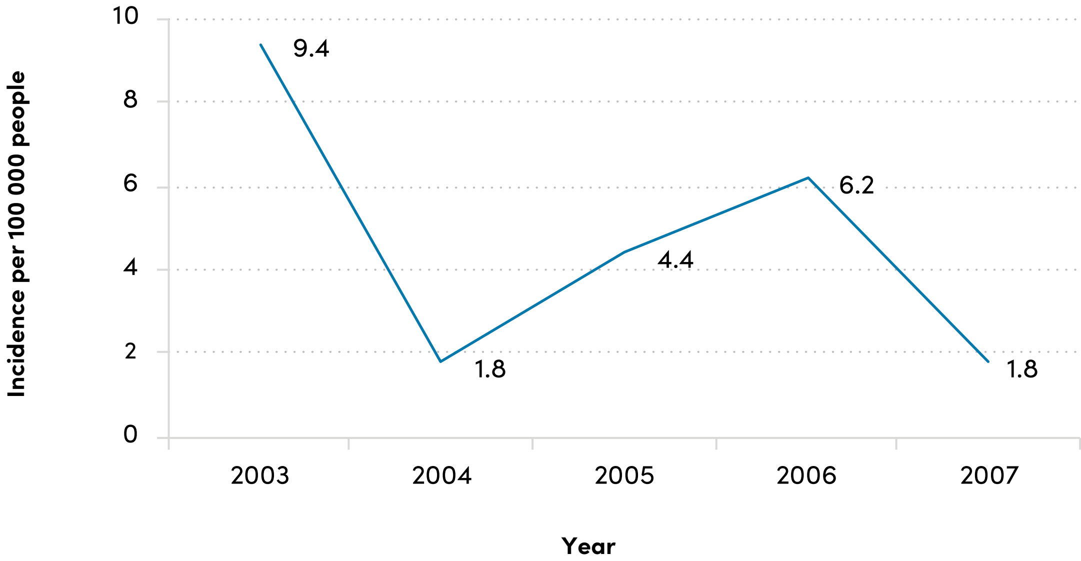
Declining malaria burden and the shift to elimination, 2007–2011

Malaria outbreaks in Kyrgyzstan were contained by an adequate response and by further intensifying anti-epidemic activities. These interventions were backed by international support.

Over a few years, malaria control interventions carried out by NMCP led to a decrease in the malaria burden in Kyrgyzstan. By 2007, the epidemiological situation of malaria among the population had stabilized to some degree. Nationwide, 96 indigenous cases of malaria were registered, compared with 318 in 2006. These included cases in Batken province, Bishkek, Chuy province and Jalal Abad province, and one case each in Ysyk Kol and Osh provinces.

After the outbreak in Toshkomur in 2005–2006, the average annual incidence per 100 000 people decreased to 1.8 in 2007, compared with 9.4 in 2003 and 6.2 in 2006 (Fig. 12). The incidence in Batken, the most affected province in the country, dropped from 86.5 per 100 000 people in 2003 to 5.3 in 2007. Alongside the general reduction in morbidity across the country, however, new active foci were established in Bishkek and the Chuy province, and small outbreaks were registered elsewhere *(15)*.

Fig. 12. Annual incidence of malaria in Kyrgyzstan, 2003–2007



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

The stable reduction in the number of cases of malaria, the dramatic decrease in the annual incidence (Fig. 12), and the restriction of transmission to a few areas encouraged the Government of Kyrgyzstan to endorse the Tashkent Declaration: the Move from Malaria Control to Elimination in the WHO European Region *(30)*.

In 2008, following significant success in malaria control and in line with WHO guidelines *(31)* and the malaria elimination strategy for the European Region *(32)*, the Kyrgyz Government reoriented its malaria programme towards elimination. An elimination programme centred on intense malaria surveillance was developed and implemented *(33)*.

In 2008, malaria transmission was focalized and limited to single foci. There were only 18 indigenous cases of *P. vivax* malaria. Most were detected in the northern part of Kyrgyzstan (10 in Bishkek, four in Chuy province, one in Jalal Abad province, one in Naryn province), with two cases in Batken province in the south. Malaria incidence in formerly affected areas was very low. In the following years, there was a steady decline in indigenous cases of *P. vivax* malaria (four in 2009, three in 2010), which were the last indigenous cases registered in Kyrgyzstan (Fig. 11, Box 1) *(4, 5, 14)*.

There were no cases of locally acquired malaria reported in 2011 or the following years. Epidemiological surveillance showed that local transmission had been completely interrupted, and only imported cases of malaria were recorded. No cases of mortality due to malaria for the period of control and elimination following malaria resurgence in Kyrgyzstan were registered.

Box 1: The last indigenous *P. vivax* cases in Kyrgyzstan, 2010

The last three indigenous cases of *P. vivax* malaria in Kyrgyzstan were detected in Jalal Abad province in 2010. The last malaria foci were in the village of Kyzil-Kia (residual active focus) (Case 1) and the village of Jazi Jol (cleared-up focus), Nooken district (Cases 2 and 3).

Case 1

BI, aged 22 years, was a military officer working in the town of Mailuu-Suu, Jalal Abad province. His symptoms – headache, temperature 40 °C, sweating – began on 8 June 2010. The primary diagnosis was adenoviral infection. *P. vivax* malaria was detected microscopically on 28 June 2010, when treatment (chloroquine and primaquine) was started.

Epidemiological investigation revealed he regularly visited his relatives in his native village of Kyzil-Kia, Jalal Abad province, where, in September 2009, his nephew aged 2 years had malaria. No other cases were registered in the village in 2009.

Active case detection in Kyzil-Kia and at his workplace did not detect any other cases of malaria. The case was classified as indigenous. The assumption was that he contracted malaria during the previous transmission season in Kyzil-Kia, so it was probably a case with a long incubation period. Entomological investigation detecting the vector and indoor residual spraying were conducted in the focus.

Cases 2 and 3

TG, aged 41 years, and TJ, aged 44 years, were a family of agricultural workers living in the village of Burgundu, Jalal Abad province. The woman's symptoms – headache, high temperature, sweating, nausea and vomiting – started on 10 July 2010. She sought medical advice on 16 July, and a diagnosis of *P. vivax* malaria was confirmed microscopically on 19 July. Treatment with chloroquine for 3 days was started the same day, followed by primaquine for 14 days.

Her husband had the same symptoms on 31 July. He sought medical advice on 2 August, and a diagnosis of *P. vivax* malaria was confirmed microscopically on 4 August, when treatment started.

The conclusion of the epidemiological investigation was that both cases were epidemiologically linked, but their common source of infection was not detected. The infections were locally acquired, probably contracted in the village of Jazi Jol, where the family worked in the rice fields during the 2010 potential transmission season. Indoor residual spraying and active case detection were conducted in the focus. No additional cases of malaria were detected.

There was no epidemiological link between Case 1 and Cases 2 and 3. The two malaria foci were located in the same district, at a distance of about 30 km.

Prevention of malaria re-establishment and certification of malaria elimination, 2011 onwards

In the course of malaria elimination, NMCP conducted activities aimed at preventing malaria resurgence in areas already malaria-free. After successful realization of the elimination programme, the Kyrgyz Government began a programme of transition to prevent malaria re-establishment. In 2017, Kyrgyzstan signed the Ashgabat Statement: Preventing the Re-establishment of Malaria Transmission in the WHO European Region with nine other countries in the region that had experienced a malaria resurgence followed by malaria elimination *(34)*.

Kyrgyzstan had the opportunity to undergo international evaluation and gain validation of its interruption of local malaria transmission and applied for WHO certification. In 2016, Kyrgyzstan was certified by WHO as malaria-free *(6)* and is continuing to implement the Programme for Prevention of Re-establishment of Malaria in the Kyrgyz Republic.

During the period 2007–2009, no importation of malaria was reported. In the years 2010–2022, single imported cases of *P. vivax* and *P. falciparum* were detected. Other malaria species were not found.

Factors contributing to malaria re-establishment and epidemiological features of resurgence in Kyrgyzstan

Why did malaria come back?

The reasons for malaria re-establishment in Kyrgyzstan are complex. The main factors contributing its resurgence and to the 2002 epidemic are summarized below:

- Intensive introduction of malaria from malaria-endemic Tajikistan and probably Uzbekistan to villages in Batken, Jalal Abad and Osh provinces occurred as a result of the spring and summer influx of seasonal workers *(3–5, 24)*. Most of the affected population were residents of villages on the borders with Tajikistan and Uzbekistan, where Tajik and Uzbek ethnic populations predominate.
- Certain programmatic factors were relevant, generally exacerbated by the socioeconomic problems facing Kyrgyzstan after the collapse of the USSR:
  - delayed detection and case management due to weakening of NMCP;
  - low level of vigilance by general health services at provincial and district levels, with delayed primary diagnoses, inadequate clinical examinations, weak laboratory skills and late referrals;
  - lack of antimalarial medicines and laboratory consumables for microscopic diagnosis of malaria at the beginning of the epidemic;
  - understaffing of SSES, leading to delayed epidemiological investigations, reporting and responses;
  - insufficient transport to carry out epidemiological investigations and conduct control activities in malaria foci;
  - lack of insecticides and spraying equipment at the beginning of the epidemic.
- Public awareness and knowledge of malaria were inadequate – 52% of people with malaria delayed seeking treatment *(15)*.
- The spread of malaria was encouraged by customs in the southern parts of the country, such as sleeping outside in the summer *(3)*.

Epidemiological features of malaria resurgence

Affected population

During the period of low malaria burden (1981–2000), most people with malaria were men of working age (18–60 years). They were predominantly involved in agriculture, and many slept outside in the summer *(3)*. This group accounted for 74.9% of all cases of malaria. Children aged under 14 years accounted for 15% of all cases.

During the epidemic and in the following years (2001–2010), women (1818 cases, 45.4%) and children aged under 14 years (1334 cases, 33.3%) represented a high proportion of the infected population (Table 6). This indicates a high level of malaria transmission in the malaria foci that affected many households.

Table 6. Malaria among women and children, 2001–2010

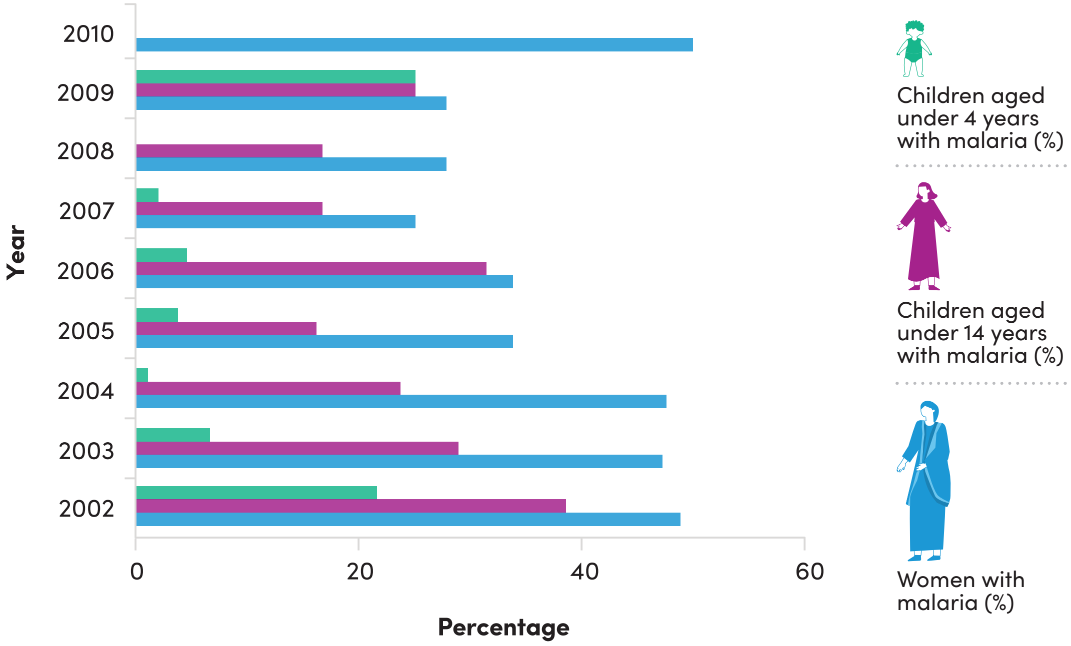
		Women		Children aged <14 years		Children aged <4 years	
Year	**Cases (*n*)**	***n***	**%**	***n***	**%**	***n***	**%**
2001	28	10	35.7	4	14.3	1	3.6
2002	2 744	1 333	48.6	1 051	38.3	591	21.6
2003	468	220	47.0	135	28.8	31	6.6
2004	93	44	47.3	22	23.6	1	1.1
2005	226	71	31.4	34	15.0	8	3.5
2006	320	108	33.8	68	21.3	15	4.7
2007	96	24	25.0	16	16.7	2	2.1
2008	18	5	27.8	3	16.7	0	0
2009	4	2	50.0	1	25.0	1	25.0
2010	6	1	16.6	0	0	0	0

Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

During the epidemic in 2002, almost half of people with malaria (48.6%) were women (Table 6, Fig. 13). A large proportion of cases (1051, 38.3%) were among children aged under 14 years, including 591 cases (21.6%) among children aged under 4 years. This change in the sex and age profile of people with malaria suggests that sustainable local transmission affecting many households and numerous family members had become established.

It should be noted that malaria was widespread in rural areas of southern Kyrgyzstan, where children aged up to 15 years made up 66.5% of the total population in Batken province, 68.1% in Jalal Abad province and 69% in Osh province. In rural areas, the number of births was more than twice as high as in urban areas *(15)*.

Fig. 13. Proportion of women and children with malaria, 2001–2010



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

In 2006, when the total annual number of cases rose because of the outbreak in Tashkomur city, many women (33.8%) and children were affected, although less so compared with the epidemic of previous years. Children aged under 14 years and under 4 years accounted for 21.3% and 4.7% of all cases, respectively (one child aged under 1 year, three children aged 1 year, 11 children aged 2–4 years). The proportion of women and children with malaria can probably be attributed to the same reasons as in the 2002 epidemic – distribution of malaria in households. In the years following the epidemics, there was a decrease in the proportion of women and children with malaria.

During the period in which malaria was resurgent, and especially starting from the epidemic year of 2002, the proportion of women decreased from 48.6% of reported cases of malaria in 2002 to 25% in 2007. The proportion of children aged under 14 years decreased from 38.3% of cases in 2002 to 15.0% in 2005. The proportion of children aged under 4 years decreased from 21.5% of cases in 2002 to 0% in 2008.

Distribution of malaria

In the first years of malaria resurgence in Kyrgyzstan, the most affected areas were in the south of the country, where an epidemic was registered in 2002. Osh province reported a total of 1644 cases (891 locally acquired cases in Osh city, 743 in Osh province), Jalal Abad 734 locally acquired cases, and Batken 347 locally acquired cases (Table 7).

In the north, 10 people with malaria were detected in Bishkek city and nine in Chuy province due to internal migration. Ten of these cases (two in Bishkek, eight in Chuy), however, were classified as locally acquired, indicating limited local transmission was also appearing in the north.

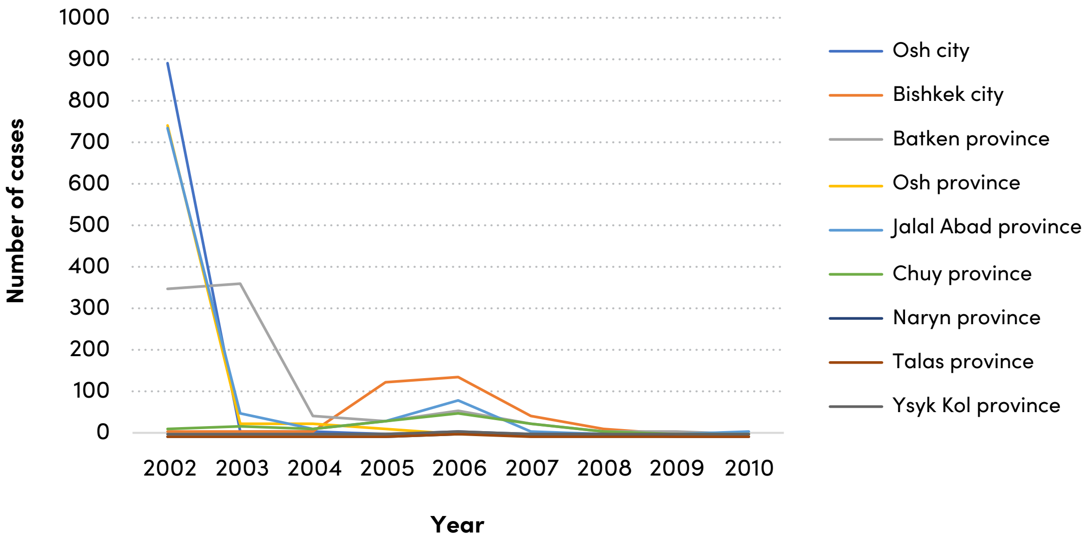
Table 7. Malaria cases by province, 2002–2010

Province or city	2002			2003			2004			2005			2006			2007			2008			2009			2010		
	Total	Imported	Locally acquired	Total	Imported	Locally acquired	Total	Imported	Locally acquired	Total	Imported	Locally acquired	Total	Imported	Locally acquired	Total	Imported	Locally acquired	Total	Imported	Locally acquired	Total	Imported	Locally acquired	Total	Imported	Locally acquired
Batken province	347	0	347	362	0	362	39	0	39	31	0	31	53	0	53	22	0	22	2	0	2	3	0	3	0	0	0
Bishkek city	10	8	2	11	4	7	3	0	3	125	0	125	133	0	133	42	0	42	10	0	10	0	0	0	2	2	0
Chuy province	9	1	8	17	1	16	13	1	12	31	0	31	48	2	46	24	0	24	4	0	4	0	0	0	0	0	0
Jalal Abad province	734	0	734	49	0	49	8	0	8	28	0	28	80	0	80	6	0	6	1	0	1	1	0	1	3	0	3
Naryn province	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	1	0	1	0	0	0	0	0	0
Osh city	895	4	891	4	0	4	4	1	3	1	0	1	2	0	2	1	0	1	0	0	0	0	0	0	0	0	0
Osh province	749	6	743	24	1	23	26	0	26	9	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Talas province	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Ysyk Kol province	0	0	0	1	1	0	0	0	0	1	0	1	2	0	2	0	0	0	0	0	0	0	0	0	1	1	0
Total	2 744	19	2 725	468	7	461	93	2	91	226	1	225	320	2	318	96	0	96	18	0	18	4	0	4	6	3	3

In 2003, the most affected provinces were Batken (362 cases), Jalal Abad (49 cases) and Osh (24 cases). Surveillance data showed that local malaria transmission had expanded into the north as a result of internal importation by migration from the south (Table 7). The number of locally acquired cases in the north increased in 2003 to 16 in Chuy province and seven in Bishkek.

In 2005 and 2006, Bishkek (where cases were detected at the periphery of the city) had the highest malaria burden (125 and 133 locally acquired cases, respectively) (Fig. 14), but malaria remained in Chuy province and in the southern Batken and Jalal Abad provinces.

Fig. 14. Locally acquired malaria cases in Kyrgyzstan by province, 2002–2010



Source: NMCP.

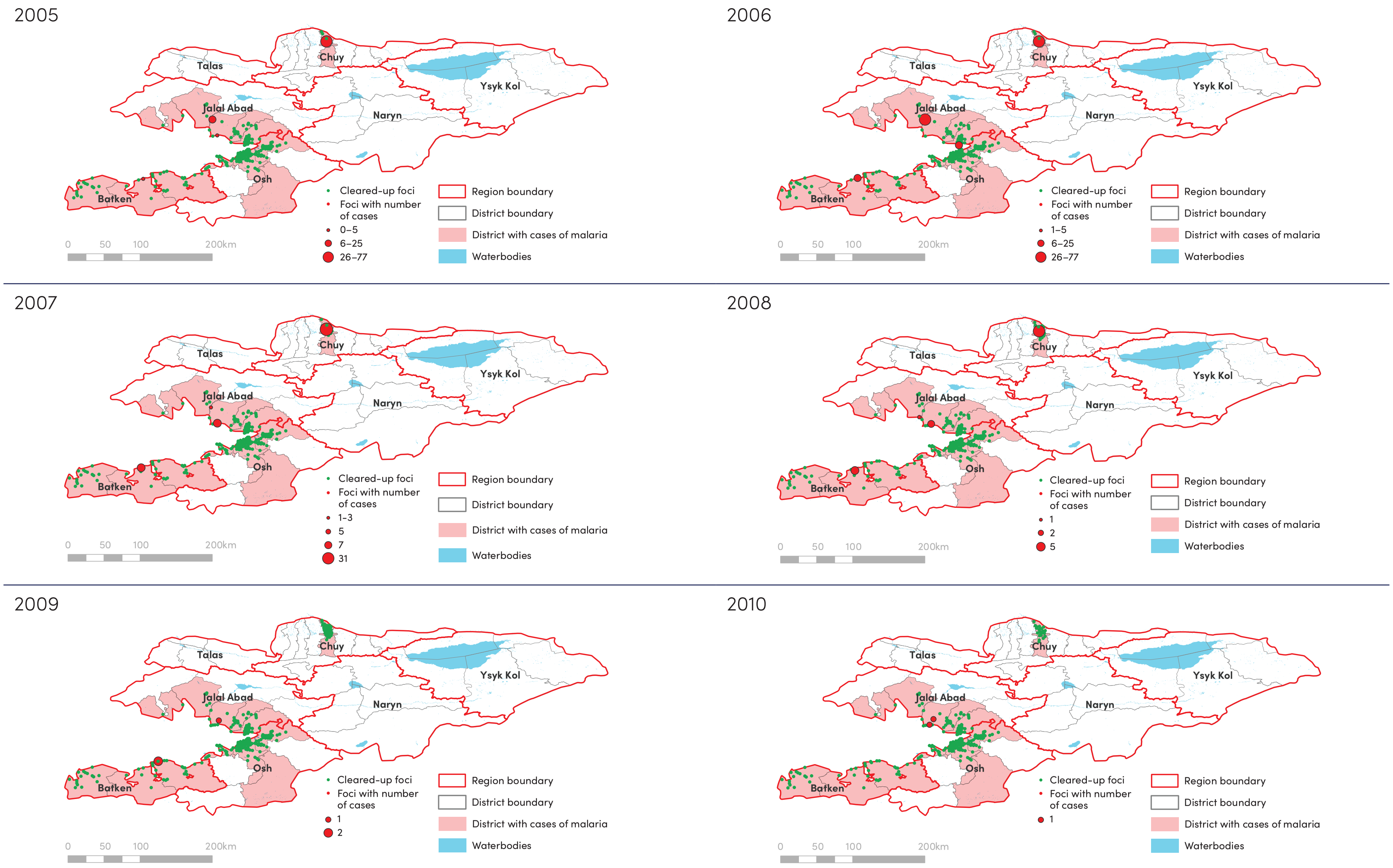
During the epidemiological season of 2006, malaria cases were registered in two cities (Bishkek, Osh) and six provinces and 13 districts (Batken province – Batken, Kadamjay; Chuy province – Alamudun, Chuy, Moscow, Panfilov, Sokuluk; Ysyk Kol province – Ysyk Kol; Jalal Abad province – Ala-Buka, Aksy, Tashkomur; Naryn province – At-Bashi; Talas province – Kara-Buura).

In 2007–2008, malaria transmission was focalized, mainly in the north. Bishkek had 42 indigenous cases in 2007 and 10 in 2008, and Chuy province had 24 and four cases, respectively (Table 7, Figs 14 and 15). Few cases were reported in the southern province of Batken (27 cases in 2007, two cases in 2008).

The last year of local malaria transmission in Kyrgyzstan was 2010, when the last three indigenous cases were reported in the province of Jalal Abad.

Active and cleared malaria foci in the period 2005–2010 are shown in Fig. 15.

Fig. 15. Malaria foci in Kyrgyzstan, 2005–2010



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

How was malaria controlled and eliminated again?

How the 2002 epidemic was controlled

When malaria returned, and especially when the epidemic in the south erupted in 2002, rapid mobilization of specialized and general health services and massive scale-up of control and surveillance activities in the affected areas were critical in containing the epidemic.

Policies and strategies were guided by key government documents dealing with measures for controlling and preventing malaria *(28, 29)*. Comprehensive plans of action for containment of epidemics were developed by the Ministry of Health and transmitted to local governments and related organizations through meetings and roundtables.

An integrated approach helped to contain the epidemic and clear up the foci. Table 8 summarizes the interventions implemented with the technical and financial assistance of WHO.

Table 8. Strategic approaches used to contain the malaria epidemic in 2002

Strategic approach	Sample activities
Eliminating sources of infection	• Intensified active and passive case detection • Microscopic confirmation of cases followed by free-of-charge radical treatment with chloroquine for 3 days and primaquine for 14 days • Passive case detection conducted by screening for malaria all people with fever seeking treatment • Active case detection was carried out in all malaria foci through house-to-house visits once per week with fever screening and blood sampling of people with fever; passive case detection was combined with mass blood surveys among residents of the home villages of identified malaria cases • Prompt and comprehensive investigation of every case and focus • Timely notification of cases and reporting • Interseasonal preventive treatment with primaquine (15 mg/day for 14 days) of all people with malaria from previous year

Strategic approach	Sample activities
Integrated, evidence-based (guided by foci investigations) vector control and improved entomological surveillance	• Indoor residual spraying in affected areas in 2003 • Larviciding – mainly distributing fish (*Gambusia affinis*) in mosquito breeding sites, especially rice fields, to reduce mosquito density • Reducing number of breeding places through environmental measures (mainly infilling non-productive water bodies) • Reducing human–vector contact through housing improvements and health education • Use of locally manufactured mosquito nets • Improved entomological surveillance
Prevention measures among populations in malaria foci	• Seasonal chloroquine prophylaxis during malaria transmission season in some active foci • Health education • Increased community awareness and engagement of whole population in malaria control and prevention
Good guidance and coordination by NMCP supported by appropriate legislation	
Strengthening institutional capacity of health-care facilities	
Intersectoral collaboration	

In response to the 2002 epidemic, in 2003 the WHO Regional Office for Europe established a malaria field office with international and national staff in Osh province, one of the three most affected provinces. The joint work of the local and international teams was helpful in containing the epidemic in the south, by improving malaria case detection and disease management, strengthening surveillance and vector control activities, and capacity-building.

At-risk groups were identified as the populations of the foci in the southern provinces close to the border with Tajikistan and the populations of nearby settlements. The first interventions, directed at eliminating the source of infection and decreasing or interrupting transmission, were concentrated in these areas.

Cases were identified by intensive proactive case-finding through weekly house-to-house visits in affected areas and a mass blood survey among the local population. Radical treatment of all people detected with malaria (with and without clinical symptoms) was carried out, allowing the sources of infection to be eliminated.

Seasonal chemoprophylaxis was implemented in some active foci. In 2002, in Ak-Suu in Leilek district of Batken province, on the border with Tajikistan, seasonal chemoprophylaxis with chloroquine was implemented for nearly 5000 local people.

Interseasonal treatment was implemented. All people diagnosed with *P. vivax* malaria and treated in 2002 (2744 people) were given a treatment course of primaquine in spring 2003 so they would have full coverage if there were any gaps during initial treatment.

Comprehensive epidemiological investigation of all cases and foci provided timely information for prompt and adequate responses, containment of the outbreak, prevention of the spread of transmission, and future planning of activities in the malaria foci.

At the beginning of the epidemic in 2002, a lack of insecticides meant that indoor residual spraying was not carried out. In 2003, however, treatment with imagocides was conducted in the southern region (Batken, Jalal Abad and Osh provinces, and Osh city). Almost 2 million m^2 of facilities were treated with the insecticide cyfluthrin. Indoor residual spraying contributed to the reduction of transmission in the new malaria foci. In 2002, larviciding was carried out by treating ponds and rice fields with diflubenzuron. After 2003, *G. affinis* fish were used.

A good practice that proved to be efficient in promoting social mobilization and assistance in malaria control and prevention was the establishment of village health committees.

In combination, these activities brought about a dramatic drop in the caseload, and only 461 locally acquired cases were recorded in 2003.

Control and elimination of malaria across the country

After containment of the 2002 epidemic, a complex of activities covering the whole country, in the form of the National Strategic Plan to Combat Malaria in the Kyrgyz Republic, was developed and put in place in 2006 to prevent further distribution *(35, 36)*.

The National Strategic Plan was based on current experience and contemporary approaches and methods of epidemiological and entomological surveillance and control of malaria, as recommended by WHO. The National Strategic Plan sought to find a comprehensive solution to malaria in Kyrgyzstan and was associated with other national and state programmes. It aimed to reduce the impact of malaria on health by making use of available financial and human resources and existing technologies and tools.

The main objectives were to make a further substantial reduction in the incidence and prevalence of *P. vivax* malaria and to prevent resurgence of local transmission and epidemic spread of malaria in the country.

There was a consistent political commitment to eliminate malaria. Combating and overcoming malaria, which was one of the eight Millennium Development Goals adopted in 2000, was a priority of the Kyrgyz Government and covered in the national health-care reform programme *Manas Taalimi*, 2006–2010.

As the malaria situation improved, and in line with the WHO guidelines and WHO Regional Office for Europe malaria elimination strategy *(30, 32, 37–39)*, the Kyrgyz Government reoriented the malaria programme towards interrupting local malaria transmission, eliminating the last foci and preventing re-establishment.

In 2005, the Kyrgyz Government signed the Tashkent Declaration: the Move from Malaria Control to Elimination in the WHO European Region *(30)*, showing political commitment to achieving and maintaining interruption of malaria transmission through large-scale elimination interventions aimed at improving the health of the people.

An elimination programme centred on intense malaria surveillance was developed, implemented and supported by a number of resolutions, decrees, regulations and guidelines to ensure consistency in policies and strategies, and successful implementation of malaria elimination activities *(33, 40)*.

Internal organization and political support

NMCP was coordinated and implemented by the Sanitary Epidemiological Service of the Ministry of Health:

- at the national level by DDPSSES, accountable directly to the Chief Medical Officer and the Deputy Minister of Health;
- at the provincial level by seven CDPSSESs, with coordinating functions in provinces and CDPSSESs in Bishkek and Osh cities;
- at the district level by 42 territory CDPSSESs, combining district and city centres with coordinating functions in districts and cities.

General health services and other relevant ministries and organizations took an active part in NMCP activities. Understanding that well-qualified staff were crucial for the success of the campaign, Sanitary Epidemiological Service facilities were upgraded and a widescale continuous education programme was implemented for training and retraining of malaria programme staff, including parasitologists, epidemiologists, laboratory specialists and entomologists. Clinicians, general practitioners and others were also covered by the training programme.

Staff participating in malaria control and elimination activities included 179 epidemiologists, 45 parasitologists, 284 assistant epidemiologists and assistant parasitologists, 60 laboratory physicians and technicians, and 34 entomologists and assistant entomologists (Annex 4).

Key malaria control and elimination strategies and approaches

The approach involved an integrated complex of antimalarial activities directed at eliminating sources of infection, reducing transmission and protecting the healthy population (Table 9).

Table 9. Strategic directions followed in malaria control and elimination interventions

Strategic approach	Sample activities
Surveillance, case detection and management	• Passive and active case detection and confirmation of each case by free-of-charge quality-controlled microscopy • Epidemiological investigation of cases and foci • Classification, registration and monitoring of foci • Maintenance of efficient information system, with compulsory notification of cases of malaria; recording and reporting; and maintenance of national, provincial and district databases including registers of cases and foci • Data collection and analysis • National programme of quality assurance for malaria laboratory diagnosis • Free-of-charge radical treatment of people with malaria and carriers • Chemoprophylaxis for people from at-risk groups
Vector control interventions, entomological surveillance, and operational research on vector control	• Entomological surveillance of vectors and breeding sites • Environmental management and preventive supervision of construction and operation of irrigation facilities • Indoor residual spraying, biological methods of larviciding (*G. affinis* fish) and long-lasting insecticidal nets

Strategic approach	Sample activities
Monitoring of determinants of malaria situation	• Analysis of meteorological data • Analysis of sociodemographic situation (human migration, economic activities) • Determination of malaria potential and stratification of territory by malaria risk
Training of health personnel on diagnosis, treatment, epidemiology, entomology and prevention	
Public health education and community mobilization	
Monitoring and evaluation of effectiveness of interventions	
Interagency and intersectoral integration and coordination of antimalarial interventions	
Active cooperation with neighbouring countries on malaria-related matters	• Participation in cross-border meetings, exchange of information and planning of joint activities
Operational research	

Strengthening malaria surveillance

Epidemiological surveillance in malaria control and elimination was guided by Ministry of Health orders directed at scaling up surveillance, and especially by the guidelines for malaria epidemiological surveillance *(36)*.

Case detection

Passive and active case detection were given special attention. Peripheral general health services were central to this. Vigilance was reinforced throughout the country, so that all people presenting with fever, anaemia or other suspect symptoms, or a history of travel to a malaria-endemic country or an endemic area of Kyrgyzstan, were examined for malaria as soon as they contacted the health services.

The common profile for suspected malaria in high-risk areas included all people who:

- presented with fever of more than 3 days, anaemia or other suspect symptoms;
- had fever up to 2 months after blood transfusion;
- were blood donors;
- had a fever and had previously had malaria;
- had a history of travel to a malaria-endemic country or a local malaria endemic area.

Proactive case detection through household visits by local health-care providers was conducted in active foci (every week during the transmission season, every 2 weeks out of season), with blood sampling and examination of all people with fever and people suspected to have malaria.

Reactive case detection was performed in the process of epidemiological investigations of cases in living and work places by interviewing and microscopy-screening contacts.

In years with lower incidence rates of malaria, active case detection dropped to 3–5%. During the peak incidence of malaria (2002–2008), 73% of cases were detected by active case detection.

In 2006–2007, 208 392 blood samples from people suspected to have malaria were examined. In 2009 and 2010, the numbers of people examined decreased to 33 983 and 30 190, respectively, giving an annual blood examination rate of 0.6% *(15)*.

Laboratory support for surveillance

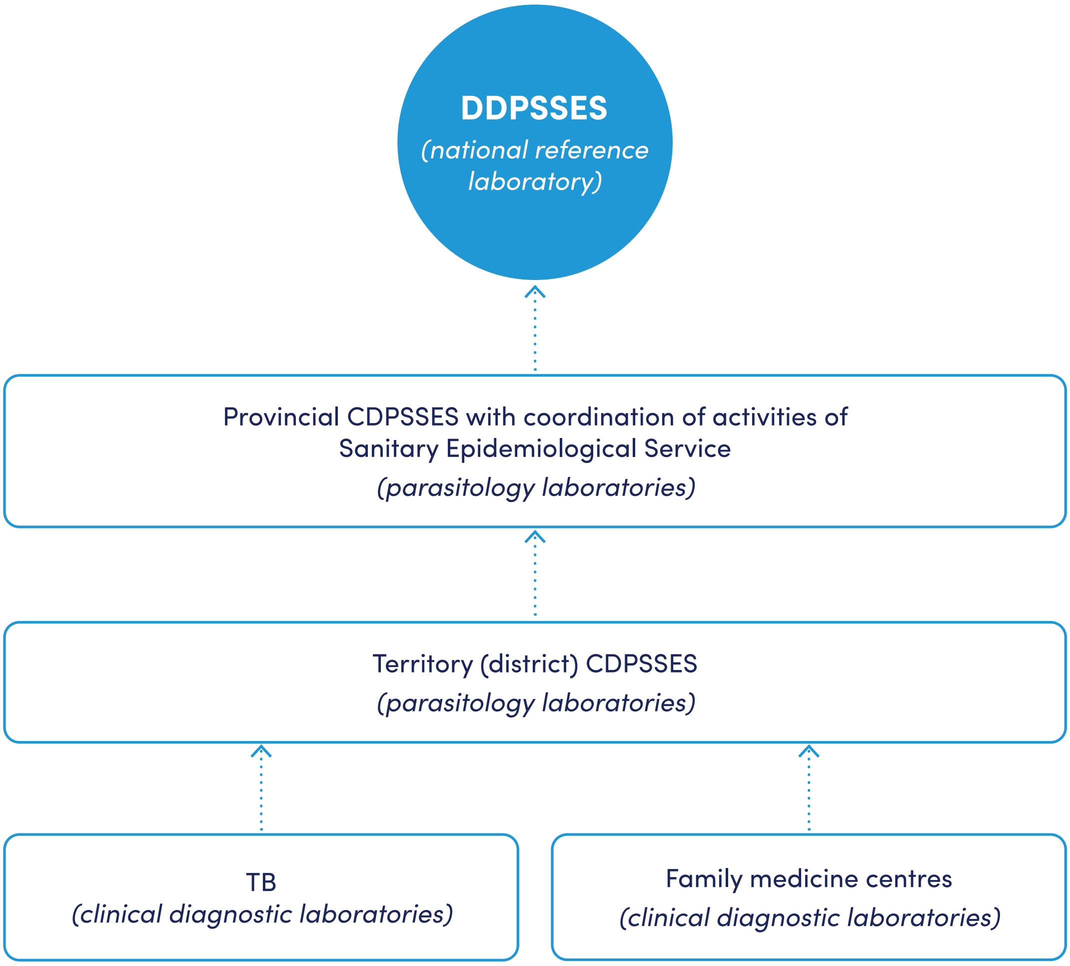
By the end of 2007, 224 laboratories provided examination for parasitic diseases, including malaria. These laboratories, located in hospitals, outpatient facilities, polyclinics and CDPSSES units, were upgraded. They were equipped and regularly supplied with reagents and consumables by the Government, with financial support from the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund), the United States Agency for International Development (USAID), WHO and other organizations. The laboratory staff consisted of 135 laboratory physicians and 364 technicians with expertise in microscopic diagnosis of malaria (Annex 4). There were also 10 private laboratories conducting malaria microscopy.

All cases of malaria were confirmed microscopically by examination of Giemsa-stained thick and thin blood films in line with standard operation procedures *(36)*. In the private sector, suspected cases of malaria were sent for confirmation to government laboratories. Rapid diagnostic tests were not applied. Improved laboratory equipment and training of specialists enhanced the quality of sampling and examination, with laboratory confirmation of malaria cases reaching 100%.

A national reference laboratory for malaria diagnosis, based at DDPSSES in Bishkek, was established and adequately equipped, with 40 binocular and 10 entomological stereomicroscopes. This laboratory was also used as a training centre. The national reference laboratory participates in an international external quali ty assurance programme and has been certified by the reference laboratory of the National Centre for Infectious and Parasitic Diseases of the Ministry of Health of the Republic of Bulgaria.

The national programme for external quality assurance and control of malaria laboratory diagnosis, which covers malaria laboratories at all levels, is in operation *(36)*. The programme includes confirmation of all positive slides and monthly cross-checking of at least 10% of all negative slides at the district (territory CDPSSES laboratories), provincial (CDPSSES laboratories) and national (DDPSSES national reference laboratory) levels (Fig. 16). In addition, the national reference laboratory sends blind malaria slides to Sanitary Epidemiological Service laboratories in the provinces.

Fig. 16. Scheme of external quality assurance and control national programme for malaria diagnosis



A quality assessment of microscopy was carried out by the polymerase chain reaction (PCR) method in the Vavilov Institute of General Genetics, Moscow, Russian Federation. In a joint study, 250 blood samples from people with malaria and their contacts were examined. The results given by microscopy and PCR were 100% in agreement. In the same study, 1000 blood samples from people with fever were studied with both PCR and malaria microscopic examinations, and no discrepancies were found *(41)*, indicating good expertise of laboratory staff in malaria microscopy.

Disease management

Case management was guided by clinical, diagnostic and treatment protocols in line with WHO recommendations *(36, 40)*. All people with malaria were treated free of charge on an inpatient basis, in a department of infectious diseases. Appropriate treatment, in accordance with the national protocol that is in line with WHO guidelines, was offered to all people with malaria.

P. vivax malaria was treated radically with chloroquine (600 mg base initially, 300 mg base in 6 hours, and 300 mg base daily over the next 2 days) and primaquine (15 mg/day for 14 days).

For introduced *P. falciparum* malaria, artemisinin-based combination therapy (artemether + lumefantrine), mefloquine or quinine plus doxycycline were given.

There was regular central provision of antimalarial medicines, and a stock of medicines was maintained at the central level and at provincial hospital pharmacies. No antimalarial medicines were available at private hospitals or general pharmacies. Provision of antimalarial medicines was supported financially by the Global Fund and WHO and the Polish and Turkish Governments.

Conducting mass primaquine preventive treatment (MPPT) of the population in outbreak foci, under strict supervision of primary health-care staff and CDPSSESs, made a significant contribution to the fast clear-up rate. During the outbreak in Tashkomur city in 2005–2006, MPPT with primaquine (15 mg/day for 14 days), in parallel with other complex interventions, brought about a dramatic decrease in the number of locally acquired cases, and only two cases were detected in 2007 (Box 2) *(28, 29)*.

The experience in Kyrgyzstan supports the concept of MPPT of the population in *P. vivax* foci, in conjunction with other antimalarial interventions, in dramatically reducing the caseload and clearing up the foci *(42)*.

Box 2: MPPT in Tashkomur city

In 2005, an outbreak of *P. vivax* malaria was registered in Tashkomur city, Jalal Abad province (population 25 920 people), on the border with Osh province. In September and October 2005, 28 cases of locally acquired malaria were detected. In June to October the following year, the number of cases reached 75; most were detected in the autumn.

To contain the outbreak and clear up the focus, NMCP used MPPT and other complex interventions in February to March 2006. The decision to use MPPT was based on the fact that most of the cases were registered in September and October 2005, at the end of the malaria season, and on data indicating that a large proportion of cases had a long incubation period.

The use of MPPT was well organized through the joint efforts of special mobile teams, all health facilities, local administrations and other organizations in the city. It was supported by a special order and plan of action drawn up by the town council of Tashkomur.

Thirty mobile teams comprising 74 people, including physicians, other health staff and teachers, were set up. Training for team members and other health staff was carried out. Health education sessions were used to inform the population about MPPT.

Based on epidemiological data, the borders of the focus were determined and a list of 6897 people earmarked for MPPT drawn up. People with contraindications to MPPT were not included.

Administration of medicines was supervised directly by physicians from the mobile teams. A total of 6241 people were treated (90.5% of the planned population), because some people were absent or chose not to participate. MPPT was interrupted in 134 people because mild side-effects (nausea, vomiting, skin allergies) appeared on the fourth or fifth days after administration began.

MPPT in the spring of 2006, before the start of the malaria transmission season, brought about a dramatic decrease in the number of locally acquired cases – only two cases were recorded in 2007. This intervention was supported by the Global Fund *(28, 29)*.

Epidemiological investigation and management of cases and foci

Every malaria case and focus was investigated epidemiologically within 24–48 hours of case notification by local CDPSSES parasitologists, epidemiologists and entomologists. They filled in a unified recording form that included essential information to allow conclusions to be reached on the place and time of malaria contraction, and a case definition and focus categorization to be made according to WHO definitions. All forms were kept at district CDPSSESs and copies sent to DDPSSES.

The foci were monitored and reclassified periodically, and focus records with mappings were kept up to date. Since 2006, a national foci register has been established and maintained at DDPSSES.

Mapping of foci was made through a geographical information system. DDPSSES data on malaria foci in the country in recent years are presented in Table 10.

Table 10. Dynamics of malaria foci in Kyrgyzstan, 2005–2013

	Foci classification				
	Potential	New active	Residual active	Residual non-active	Cleared up[a]
2005	13	7	11	61	222
2006	20	11	7	35	241
2007	13	3	15	12	271
2008	2	0	7	14	291
2009	0	3	1	7	305
2010	1	2	3	1	312
2011	0	0	2	3	313
2012	0	0	0	2	316
2013	0	0	0	0	318

[a] These figures represent the cumulative total of foci cleared up since the beginning of malaria resurgence.

Source: NMCP.

Categorizing and monitoring the number of foci was helpful in characterizing the intensity of the epidemic process. The dynamic of the different foci categories in the period 2005–2013 showed a decrease in the number of potential and active malaria foci, although in 2010 two new active foci were recorded in Noken district, Jalal Abad province (Table 10). By 2013, 318 malaria foci had been cleared up since the malaria resurgence began.

Reporting and analysis

SSES is the operational core of malaria surveillance and control in Kyrgyzstan. Reporting of malaria has been mandatory since the launch of the Global Malaria Eradication Programme in 1955, when Kyrgyzstan was part of the USSR, and so strict and timely notification and reporting were already in place. The flow of information in malaria surveillance is simple and direct, based on vertical, detailed, compulsory reporting *(36, 40)*.

Malaria is a notifiable disease in Kyrgyzstan. Form 058-u is sent within 24 hours for all suspected cases of malaria by primary health-care facility staff to the territory CDPSSES. Each case is registered in the register of infectious and parasitic diseases on Form 060-u.

After completing epidemiological investigation of the case and focus, clearing up all the information on the case, including the laboratory confirmation of malaria, and conducting the complex of antimalarial activities, the epidemiologist or parasitologist submits the final report to the upper CDPSSES or DDPSSES. Only laboratory-confirmed cases are registered.

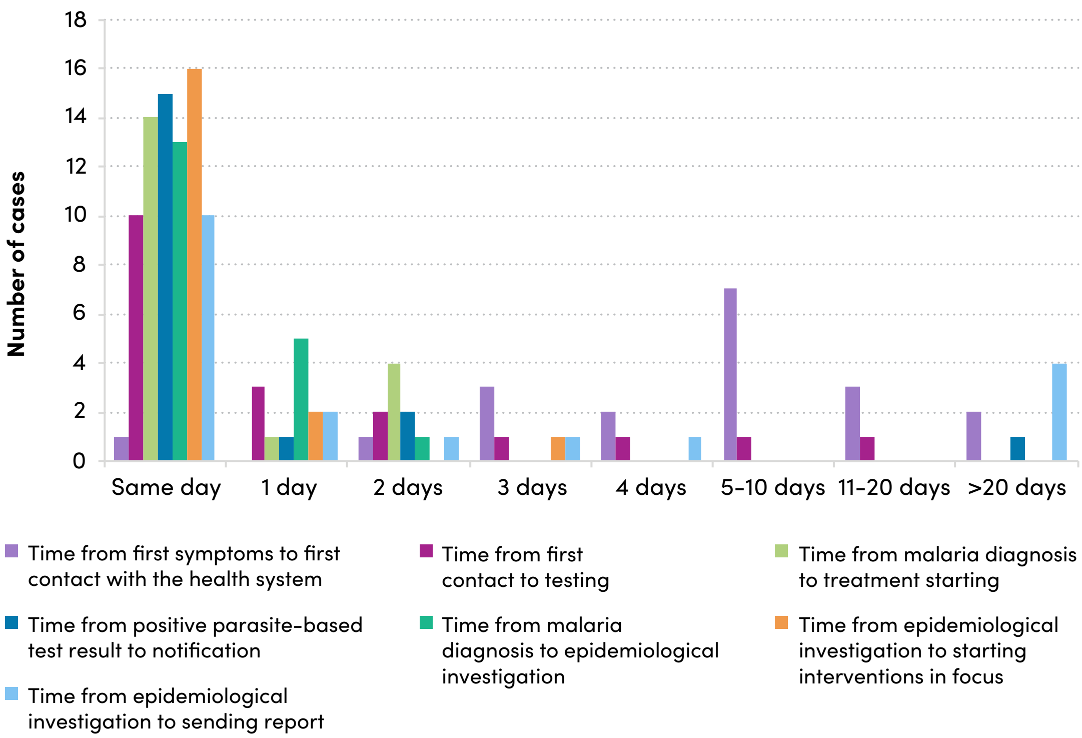
A legal basis regulating weekly and monthly electronic reporting of communicable diseases, including malaria, is in place. The reporting line is from district to province to the Republican Department of Statistics at DDPSSES. The feedback is in the form of a bulletin sent by the Ministry of Health to CDPSSESs at all levels and other related ministries and organizations. Routine data analyses are performed periodically at the district, provincial and national levels.

During the transition of the national programme to malaria elimination, registers of malaria cases and foci were set up and maintained at central, provincial and district levels. At the central level, this comprised a national register of cases and a national register of foci.

The monitoring and evaluation programme indicators demonstrated that the quality of malaria surveillance in Kyrgyzstan was high.

The results of monitoring surveillance timelines in the period 2009–2013 are shown in Fig. 17. In general, they show good timelines of laboratory diagnosis (the majority of cases were microscopically confirmed on the day of the person's first contact with the health system), and timely notification, epidemiological investigation of cases and foci, and start of antimalarial interventions, both during and after malaria elimination. It should be noted, however, that delays in diagnosis and response were reported in isolated cases.

Fig. 17. Timelines of surveillance, 2009–2013



Source: based on NMCP data.

Vector control and entomological surveillance

Vector control

Integrated vector control was used in Kyrgyzstan. The aim was to reduce the longevity of female mosquitoes below the time required for development of sporozoites (by means of indoor residual spraying); reduce larval density (by use of larvivorous fish and specific chemical larvicides); and reduce human–vector contact (by use of mosquito nets). Activities were focused on reducing and preventing transmission in new and residual active foci.

Indoor residual spraying interventions benefited from the Global Fund project. In the period 2006–2013, these activities were scaled up. National malaria programme staff and volunteer groups were trained in conducting indoor residual spraying, guidelines were developed and distributed, and spraying equipment and insecticides were purchased. Mapping of 1 412 896 households at higher risk was conducted by CDPSSES specialists and the Global Fund project implementation unit.

During the period 2006–2013, a total of 61 603 605 m^2 of facilities across the country were treated with alpha-cypermethrin (Fig. 18). Through a Global Fund grant, NMCP determined the number of vulnerable households and almost tripled the area covered with indoor residual spraying. Indoor residual spraying coverage has been dramatically reduced since 2012, reflecting the improving epidemiological situation (Fig. 20).

Fig. 18. Indoor residual spraying in Osh province, 2011

Source: courtesy of A. Zvantsov.

Additional treatment of breeding sites such as ponds and swampy areas with aerosol generators was conducted in Sokuluk district of Chuy province and Bishkek city (the area between the Ak-Bosogo and Kalys Ordo residential communities). Stocks of insecticides and sprays were maintained in case they were required in epidemic situations.

Mosquito nets were supplied as humanitarian aid in 2004. In the following year, the Agency for Technical Cooperation and Development (ACTED), financed by the French Government and operating in Tajikistan, delivered insecticide-treated nets to three Kyrgyz settlements on the border with Tajikistan and provided insecticide retreatment in 2006 and 2007.

Also in 2006 and 2007, under the Global Fund project, 20 000 WHO-prequalified long-lasting insecticidal nets were distributed in the southern region during the epidemic season by village health committees (Fig. 19). Priority was given to pregnant women and children aged 5 years and under. The project aimed to achieve full coverage in malaria areas based on the epidemiological situation in various settlements – Batken, Kadamjay and Lyailyak districts on the border with Tajikistan and some other districts at higher risk were fully provided with nets. During the 2005–2006 outbreak in Tashkomur, 4000 families were provided with long-lasting insecticidal nets. A monitoring study in 2006 revealed that 94.9% of pregnant women and 32.7% of children aged under 5 years were sleeping under bednets.

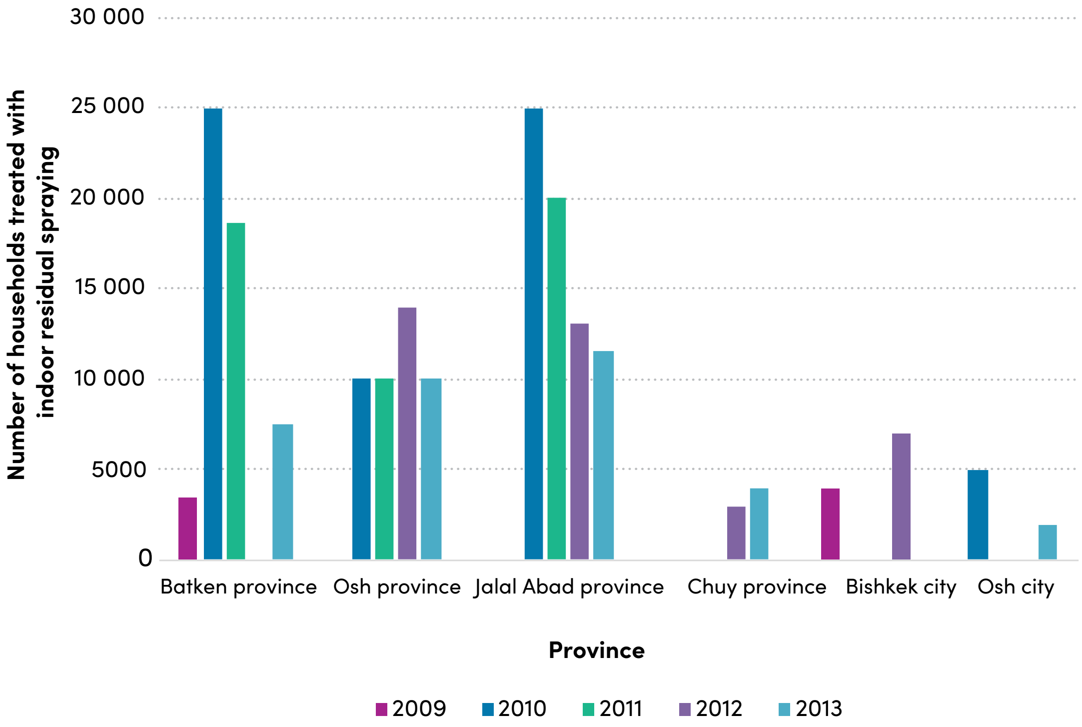
Since 2007, measures have been taken to provide agricultural workers in higher-risk communities who sleep in the fields with long-lasting insecticidal nets.

In 2009–2013, 226 800 long-lasting insecticidal nets were purchased and delivered in the provinces of Kyrgyzstan (Fig. 21).

Fig. 19. Use of long-lasting insecticidal nets in a household

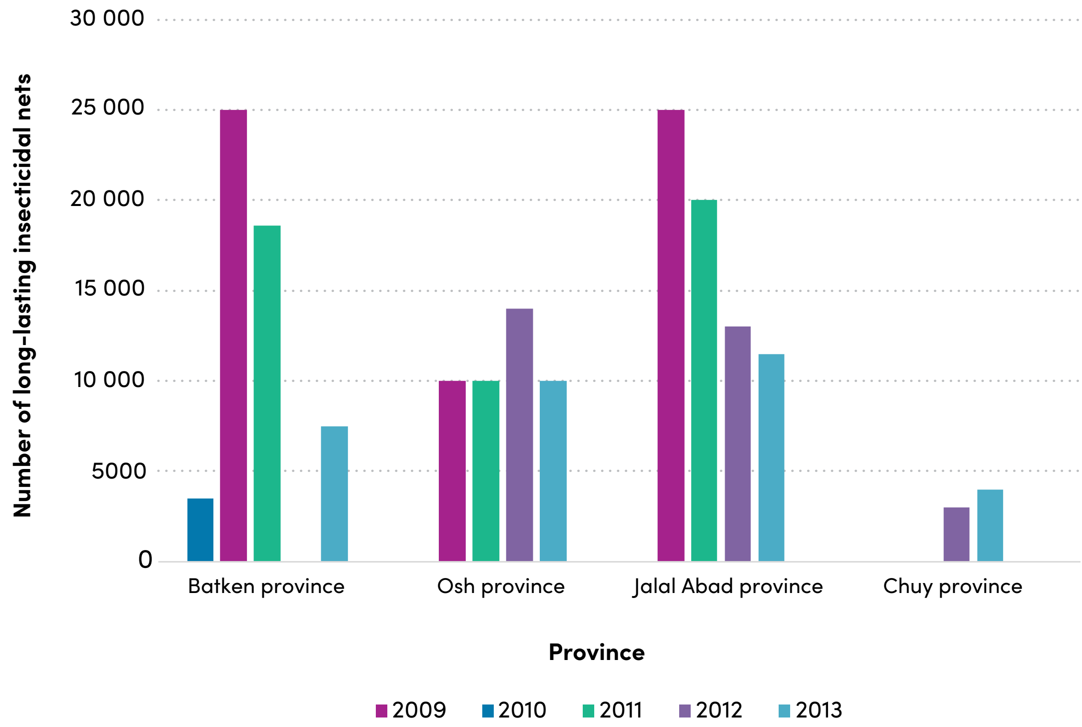
Source: NMCP.

Fig. 20. Indoor residual spraying coverage, 2009–2013



Source: NMCP.

Fig. 21. Distribution of long-lasting insecticidal nets, 2009–2013



Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

Communities played a significant role in the net programmes. Mobile teams were established; 6157 members of village health committees were trained to distribute and (re)process nets and monitor their use; and guidelines were distributed. Nets were also handed out by primary health-care workers. Local firms started to produce bednets and protective nets for windows and doors.

Kyrgyzstan has many years of extensive experience of larviciding. Breeding and distribution of *G. affinis* fish in water basins is a well-established practice. To control the larval source in water bodies during the malaria transmission season in vulnerable areas of Chuy, Jalal Abad and Osh provinces and Bishkek city, *G. affinis* fish were distributed across 1193 hectares (20.3% of total area of mosquito breeding sites).

G. affinis breeding pools with a total area of 100 hectares were established. Fish from these pools were distributed to the rice plantations in Aravan, Nookat and Uzgen districts, and Kadamjay and Kyzyl-Kia cities. The number of reservoirs where *G. affinis* was distributed annually increased from 63 in 2011 to 388 in 2012 (Table 11).

Use of this method continued after local transmission had been interrupted. Its simplicity, efficiency and lack of toxicity make it indispensable in Kyrgyzstan. Fish were placed only in rice fields and water reservoirs that are not connected with rivers and lakes. The possibility of using other fish such as grass carp for the same purpose is being studied.

Fig. 22. Release of *G. affinis* in rice field, 2011

Source: courtesy of A. Zvantsov.

Kyrgyzstan has developed an extensive irrigation network of 5440 km. Of this, 1605 km requires mechanical cleaning and 236 km washing. There is a large number of water reservoirs, ponds, lakes, springs, streams, overflows and swampy river floodplains. The high level of receptivity of many territories is exacerbated by a large number of rice plantations.

Many interventions have been applied to reduce receptivity, such as cleaning irrigation canals, draining water bodies, and locating rice fields 3–5 km away from human settlements. Several grants, including from the World Bank in 2013–2015 and the Ministry of Finance, have provided funding for maintenance of the irrigation system in the southern part of the country.

Table 11. Management of mosquito breeding sites, 2009–2013

Province or city	2009			2010			2011			2012			2013		
	Treated water reservoirs during year (*n*)	Reservoirs where G. affinis was distributed (*n*)	Drained breeding sites (*n*)	Treated water reservoirs during year (*n*)	Reservoirs where G. affinis was distributed (*n*)	Drained breeding sites (*n*)	Treated water reservoirs during year (*n*)	Reservoirs where G. affinis was distributed (*n*)	Drained breeding sites (*n*)	Treated water reservoirs during year (*n*)	Reservoirs where G. affinis was distributed (*n*)	Drained breeding sites (*n*)	Treated water reservoirs during year (*n*)	Reservoirs where G. affinis was distributed (*n*)	Drained breeding sites (*n*)
Batken province	185	170	20	73	47	31	45	29	33	41	79	18	45	45	34
Bishkek city	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chuy province	28	23	2	33	0	0	0	0	0	0	0	0	0	0	0
Jalal Abad province	54	36	10	8	24	10	11	27	8	38	47	9	32	51	5
Osh city	2	16	0	0	24	23	0	0	0	3	38	56	2	30	34
Osh province	171	43	3	7	10	18	7	7	0	62	174	136	4	4	30
Total for country	440	288	35	121	105	82	63	63	41	144	338	219	130	130	103

Source: NMCP.

Fig. 23. Small hydraulic engineering in Kadamzhai district, Batken province, 2004: the channels helped to divert water and drain the swamp

Source: courtesy of A. Zvantsov.

Entomological surveillance

Entomological surveillance activities were an important component of the malaria control and elimination programme and are still in use.

Breeding areas were monitored at sentinel sites every 10 days during the malaria season (Fig. 25). Registers of breeding sites were maintained by Sanitary Epidemiological Service entomologists at the district level and updated annually. Monitoring of adult *Anopheles* mosquito populations and their density, the density of larvae in larval habitats, vector bionomics and meteorological indicators provided valuable information that allowed malaria season periods to be defined and adequate vector control interventions to be planned. Insecticide resistance was also studied. A database on vectors was maintained.

Fig. 24. Rice fields, Karasu district, Osh region: place of breeding for *An. hyrcanus*, *An. pulcherrimus* and *An. artemievi*

Source: courtesy of A. Zvantsov.

Fig. 25. Monitoring of breeding sites in mountain riverbed near Kadamzhay, Batken region

Source: courtesy of A. Zvantsov.

Capacity-building

After the resurgence of malaria, it became clear that staff expertise played a key role in malaria control and elimination. NMCP initiated a programme of continuing education of Sanitary Epidemiological Service and other health facility staff. The training programme included surveillance, microscopic diagnosis, disease management and vector control.

With the technical assistance of WHO experts, courses for local trainers were conducted, followed by a cascade of basic and refresher courses at the provincial and district levels. In 2002, 160 health-care workers were trained in various aspects of malariology. Since 2006, following implementation of the Global Fund project, staff training has become more comprehensive, systematic and sustainable. With the participation of WHO consultants, training courses have been run for staff in the Border Service, the Ministry of Defence, the Ministry of Ecology and Emergency Situations, the Ministry of the Interior and the Ministry of Justice.

During the period 2002–2014, 3235 medical professionals (primary health-care physicians, paramedical staff, laboratory physicians, epidemiologists, parasitologists and entomologists) were trained, including 2089 (64.6%) within the framework of the Global Fund project. A total of 172 health-care managers were trained in programme management, effective programme implementation, and evaluation of activities for control and prevention of malaria.

During the period 2006–2014, 23 specialists received postgraduate training in malaria at the Institute of Medical Parasitology and Tropical Medicine in Moscow, Russian Federation.

Training curricula and promotional material on malaria aetiology, pathogenesis, symptomatology, diagnosis, treatment, epidemiology, entomology, surveillance and control, and programme management were developed for infectionists, parasitologists, epidemiologists, entomologists, clinical laboratory workers, primary health-care physicians and health-care managers. WHO teaching and learning materials on malaria were distributed, and publications were distributed to health-care facilities in the country.

Health education activities and community mobilization

The strategy of community action and community involvement in the control and prevention of malaria played a key role in achieving malaria elimination. It was implemented in conjunction with the Republican Centre for Health Promotion and with the support of the Global Fund, through the work of village health committees in Batken, Chuy, Ysyk Kol and Jalal Abad provinces and residential communities in Bishkek.

Village health committees proved to be a very effective approach in consolidating the efforts of government agencies and civil society and provided the community mobilization needed to achieve malaria control and elimination. Many members of the committees were former managers, physicians, nurses or teachers. The committees played an important role in all aspects of malaria control and elimination, especially in training the population, monitoring the performance of antimalarial activities, distributing long-lasting insecticidal nets and implementing indoor residual spraying.

Participation of rural communities and village health committees was seen in 686 settlements vulnerable to malaria. A total of 6157 volunteers received training to conduct antimalarial activities. Through community action, it was possible to extend the reach of health education and information programmes among the general population and to obtain feedback on the performance of antimalarial activities.

More than 1 million people were involved in the preventive work during malaria control and elimination after its resurgence. School programmes and training courses for professionals and rural activists involved more than 400 000 people – 16% of the population living in areas vulnerable to malaria.

Special attention was paid to health education in schools. Training courses were held for 409 teachers in Chuy and Ysyk Kol provinces, and more than 55 400 schoolchildren were trained in malaria prevention. Health education in schools included theatrical performances on malaria (Fig. 26). This novel approach was taken up by school drama groups in Bishkek and featured guest puppet performances in theatres in the Osh region.

Fig. 26. School performance on malaria in Bishkek organized by NMCP

Source: Courtesy of R. Kurdova-Mintcheva.

During the period 2006–2012, over 130 000 education and information materials were developed and circulated, including posters, brochures, student tutorials, guidance for village health committees, and advice on training volunteer groups. Videos and television and radio programmes were produced, and dozens of reports published and broadcast.

Intersectoral collaboration

The malaria programme benefited from multisectoral cooperation and coordination between all relevant ministries and administrative departments of the Government of Kyrgyzstan, regulated and directed by a number of key resolutions *(27, 33, 35)*. Ongoing collaboration between the ministries of agriculture, defence, education, health and internal affairs and local governments has played a key role in the success of the programme.

Intersectoral collaboration during the control and elimination of malaria was part of a mechanism set up to respond to the epidemics of HIV, TB and malaria. The Country Multisectoral and Coordination Committee was set up in 2005 to improve the national strategy in response to these epidemics, and to coordinate and manage the implementation of state and national programmes within the country. The Committee also had more general responsibility for strategic planning to prevent epidemics and provide long-term stability of coordination mechanisms.

Cross-border cooperation

As Kyrgyzstan shares its borders with China, Tajikistan and Uzbekistan – all countries where malaria was a problem during the resurgence in Kyrgyzstan – developing cross-border collaboration was a main priority. Kyrgyzstan took part in cross-border meetings organized by WHO in Azerbaijan (1999, 2000) *(43, 44)*, Tajikistan (2001) *(45)*, Afghanistan (2006) *(46)*, Turkmenistan (2007) *(39)* and Türkiye (2008) *(47)*.

In 2010, a cross-border meeting on malaria elimination took place in Bishkek, with the participation of country officials from Kazakhstan, Kyrgyzstan and Tajikistan, and representatives from the Global Fund (Kyrgyzstan, Tajikistan) and the WHO Regional Office for Europe. A joint statement on cross-border cooperation on malaria was discussed, agreed and signed by Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan *(48)*.

Within the framework of cooperation covering NMCP services at the border areas of Kyrgyzstan, Tajikistan and Uzbekistan, a good practice was established of developing joint plans for antimalarial activities, conducting joint roundtable meetings, exchanging information, and organizing meetings in the border areas.

Collaboration with WHO Regional Office for Europe and other organizations

Kyrgyzstan has benefited greatly from assistance from the WHO Regional Office for Europe in developing strategies, approaches, programmes and plans of action and training health staff. Many experts and consultants from the WHO Regional Office have worked with local staff since the resurgence of malaria.

In response to the outbreak of malaria in the south, in 2003 the WHO Regional Office set up a malaria field office with international and national staff in Osh province, one of the three most affected provinces. The field office helped to organize anti-epidemic activities, case management, surveillance vector control and staff training. The WHO Regional Office provided antimalarial medicines, insecticides, microscopes and other equipment, and educational materials.

In 2003, USAID provided funding to train malaria specialists and health personnel in disease management and prevention.

Kyrgyzstan received technical and financial support from international donor organizations to implement the Ministry of Health comprehensive target programme on malaria (2001–2005) and the National Strategic Plan to Combat Malaria (2006–2010) *(31)*.

The Polish Government provided humanitarian aid in the form of antimalarial medicines and microscopes. The Turkish Government provided antimalarial medicines and insecticides. Financial assistance from the Centers for Disease Control and Prevention (CDC) for the Central Asian Region, Medical Emergency Relief International (Merlin) and USAID was directed to support antimalarial activities in the border regions with other states and to purchase reagents, laboratory glassware, antimalarial medicines and insecticides.

The United States Government conducted insecticide spraying near the transit centre at Manas (Ganci Air Base), a United States military installation in the Chuy valley. ACTED, financed by the French Government, delivered mosquito nets to three settlements in the border areas with Tajikistan in 2005 and provided them with insecticide impregnation in 2006 and 2007.

In 2006, Kyrgyzstan received a Global Fund Round 5 grant to strengthen its national health capacity for malaria control. A second Global Fund grant extended funding to the end of 2014. Within the framework of these grants, Kyrgyzstan received essential technical and financial assistance on malaria control and elimination.

Applied field research

Joint cytogenetic studies of vectors and malaria parasites were conducted with the research group of the Vavilov Institute of General Genetics in Moscow, Russian Federation. Within the framework of the regional research projects in 2003–2007 of the WHO Regional Office for Europe, these studies focused on the following areas:

- Study of the species composition of pathogens in various malaria foci and study of the presence of mixed infections (*P. vivax* and *P. falciparum*): molecular genetic studies of 285 blood samples from 60 people with malaria and 157 of their contacts were conducted, based on DNA and the 18S rRNA gene of parasites of the *Plasmodium* genus. The primary structure of the dihydrofolate dehydrogenase *P. vivax* gene was determined. A malaria DNA bank was established in Kyrgyzstan.
- Molecular genetic analysis of the main malaria vectors in different regions of Kyrgyzstan: laboratory culture of vectors was created; primers were defined; a study of the *An. artemievi* habitat was conducted; the *An. messeae* habitat was clarified; and the composition and geographical distribution of twins of the maculipennis complex and other species of malarial mosquitoes were clarified. *An. messeae* inhabits Chuy and Ysyk Kol provinces. In the vicinity of Tashkomur city, during the outbreak in 2006 only the species *An. superpictus* was found. Vector resistance to residual insecticides was examined.
- Study of sensitivity to antimalarial medicines, treatment efficacy, epidemiological aspects of *P. vivax* malaria resurgence in Kyrgyzstan, and improvement of the national malaria control programme: based on analysis of the primary structure of the dihydrofolate dehydrogenase gene, it was revealed that in all people infected with *P. vivax*, wild-type allele sensitive to antimalarial medicines (chloroquine, sulfadoxine, pyrimethamine) was present.

The results of applied scientific research were used in implementation of the malaria programme:

- Studies of the samples from the parasites bank (genotyping of the local strain of *P. vivax*) permitted the distinguishing of imported cases of malaria from locally acquired cases.
- Diagnosis was improved through introduction of molecular genetic techniques that facilitated parasite identification (including *P. falciparum*) in people with low parasitaemia and absence of clinical signs.

- Clarification of data on the distribution and species composition of vectors provided an evidence basis for appropriate planning and more effective antimalarial activities.
- Determination of sensitivity to antimalarial medicines was an integral part of the quality and efficiency of malaria treatment during elimination.

Research results, including more than 15 scientific articles and a PhD thesis, were published or presented at various scientific conferences and meetings *(29, 41)*.

Programme funding

The Kyrgyz Government allocated funds backed by the Global Fund and a number of international organizations to address malaria resurgence (Table 12). Total funding for the malaria programme increased from US$ 113 446 in 2002, to US$ 1 132 245 in 2006, to US$ 1 464 485 in 2010. The funds were directed to upgrade the SSES network, to build capacity, and to strengthen malaria control and preventive interventions.

It is difficult to determine the proportion of government funds for the general surveillance system and health-care facilities that went specifically to the malaria programme. As there was good intersectoral collaboration, the allocation of financial resources to malaria control by other agencies, including the Ministry of Agriculture, the Ministry of Defence and local state administrations, increased. It is also difficult to assess the contribution of private entities, communities and volunteers.

Community-based organizations, individuals and private agencies made significant contributions to the prevention of malaria. Village health committees ensured dissemination of information and monitored implementation of antimalarial activities at the level of village councils and communities, such as by monitoring use of mosquito nets. To prevent mosquito breeding in water reservoirs, private agencies carried out drainage and proper use of larvicides, either on a voluntary basis or with funds allocated by private entities. Civil society resources such as volunteer labour and private business contributions have not been assessed.

Kyrgyzstan received financial support from international donor organizations to implement the Ministry of Health comprehensive target programme on malaria (2001–2005) and the National Strategic Plan to Combat Malaria (2006–2010) *(35)*. The Polish and Turkish Governments provided humanitarian aid. Essential financial assistance was provided by ACTED, CDC, Merlin, the United States Government, USAID and WHO.

The main donor was the Global Fund. The Global Fund Round 5 grant (Control of Malaria in Kyrgyzstan) was implemented on 1 April 2006. It amounted to US$ 3 426 125, covering 79% of the total budget of the National Strategic Plan (US$ 4 322 425). The grant allowed major objectives set out in the National Strategic Plan to be achieved, providing funding for all strategic directions – prevention, treatment, capacity-building of medical and other workers, and improving equipment of health-care facilities. Activities covered by the grant were carried out in all regions of the country, with the highest priority given to vulnerable areas.

Programme funding for malaria increased from US$ 0.02 per capita (total US$ 113 446) in 2002 to US$ 0.18 per capita (total US$ 965 736) in 2007. The potential for action for organizations involved in implementing the National Strategic Plan, including government agencies and the civil and private sectors, was enhanced, leading to a change in people's attitudes to malaria.

Funding for malaria elimination during the period 2008–2010 was stable (Table 12). The Government provided around US$ 70 000 annually, but the main donor was the Global Fund, with a contribution of US$ 1 394 485 in 2010. After interruption of local malaria transmission in 2010, financial support from the Global Fund to prevent reintroduction continued until 2014 *(48, 49–52)*.

The expenditure breakdown shows that all activities necessary for malaria control and surveillance were covered financially. In 2010, a high proportion of funds was allocated to training, procurement of insecticides and insecticide-treated nets, human resources and technical assistance. In the following years, stocks of antimalarial medicines and insecticides were procured, with a view to maintaining epidemiological preparedness and meeting possible emergencies. Additional long-lasting insecticidal nets were procured to protect the population, and funds were allocated to ongoing malaria training.

Table 12. Malaria control programme funding, US$, 2002–2014

	2002	2003	2004	2005	2006	2007	2008[a]	2009[a]	2010[a]	2011[a]	2012[a]	2013[a]	2014[a]
Government contribution[b]	59 095[c]	59 095[c]	59 095	63 190	67 900	75 100	68 500	70 000	70 000	70 000	70 000	65 000	72 300
Global Fund					834 145	781 036	647 245	546 245	1 394 485	1 114 124	850 061	434 351	511 055
WHO[d]			98 900	170 500	127 000	105 600						25 000	25 000
USAID,[d] CDC, Merlin			64 439	27 561									
Other donors[e]	54 351[f]		12 500	28 000[f]	4 000	4 000							
Total	113 446	59 095	234 934	289 251	1 132 245	965 736	715 745	616 245	1 464 485	1 184 124	920 061	524 351	608 355

[a] Figures for 2008–2014 are derived from World Malaria Reports 2012, 2013 and 2014 (Geneva: World Health Organization; https://apps.who.int/iris/handle/10665/78945, https://apps.who.int/iris/handle/10665/97008, https://apps.who.int/iris/handle/10665/144852).

[b] Estimated amounts of public funding are taken from the application of Kyrgyzstan for the Global Fund Round 5 because funds are allocated to support the SSES system as a whole, without division into nosology, and the actual funds allocated by the state budget for malaria are not recorded.

[c] The amounts allocated from the state budget for 2002 and 2003 are taken from 2004 data from the application for the Global Fund Round 5.

[d] Information on allocation of USAID and WHO funds was obtained from the application for the Global Fund Round 5.

[e] Figures for other donors do not include funds from other government agencies or contributions from community-based organizations and the private sector.

[f] Information on financing of malaria programmes by other donors in 2002 and 2005 was obtained from DDPSSES.

Programme transition towards prevention of malaria re-establishment

Risk of re-establishment of malaria

The risk of re-establishment of malaria in territories where it has been eliminated is related to receptivity, vulnerability and efficiency of the health system *(31, 37, 53, 54)*.

In the past, vulnerability (risk of importation) in Kyrgyzstan was much higher, due to intensive external migration to and from neighbouring Tajikistan and Uzbekistan, where malaria was widespread, and internal migration from the malaria-affected southern region to receptive areas in the northern region.

More recently, neighbouring countries have had major successes in malaria control and elimination. The last reported locally acquired cases were in 2010 in Uzbekistan and in 2015 in Tajikistan *(50, 55)*. In 2018, Uzbekistan was certified by WHO as a malaria-free country *(56)*. Kazakhstan was added to the WHO supplementary list in 2012 *(50)*.

The provinces of China that border Kyrgyzstan have not experienced serious malaria problems in the years since elimination in Kyrgyzstan. In 2021, China was certified by WHO as a malaria-free country *(57, 58)*.

After interruption of local transmission in 2010, malaria importation was low. During the period 2011–2022, only 28 imported cases (21 *P. vivax*, seven *P. falciparum*) were officially registered in three provinces and in the cities of Bishkek (19 cases) and Osh (Table 13, Figs 27 and 28). The conditions for malaria transmission and outbreaks are less favourable in big cities than in smaller settings and rural areas, although some small outbreaks in big cities have been described (New York in 1993; Moscow in 1972–1973, 1981–1982, 1999–2005) *(59)*.

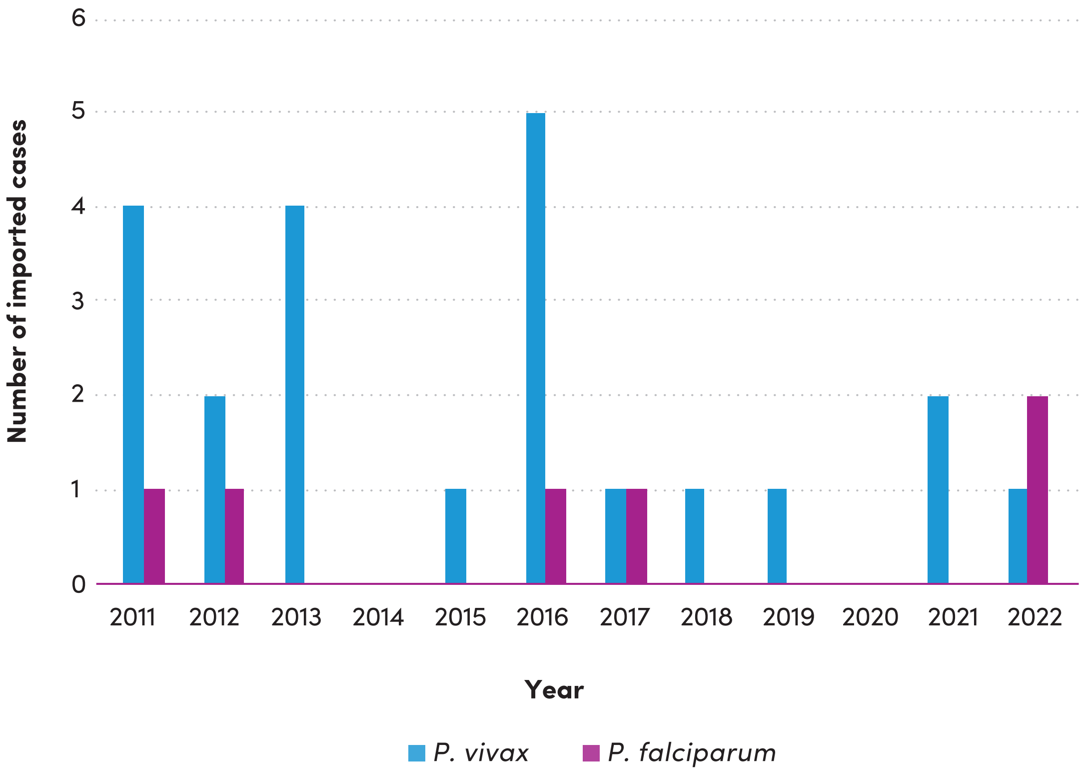
After 2010, single imported cases were registered in Chuy and Osh provinces (Fig. 28), where there had been local transmission in the recent past. This is cause for concern and highlights the importance of keeping a high level of vigilance in the country. Another factor to consider is that the risk of importation may change in the future as international relations in the fields of economics, trade, tourism and culture expand.

Table 13. Locally acquired and imported cases of malaria in Kyrgyzstan, 2002–2022

	Number of locally acquired cases (*P. vivax*)	Number of imported cases		
		Total	*P. vivax*	*P. falciparum*
2002	2725	19	19	0
2003	461	7	7	0
2004	91	2	2	0
2005	225	1	1	0
2006	318	2	2	0
2007	96	0	0	0
2008	18	0	0	0
2009	4	0	0	0
2010	3	3	3	0
2011	0	5	4	1
2012	0	3	2	1
2013	0	4	4	0
2014	0	0	0	0
2015	0	1	1	0
2016	0	6	5	1
2017	0	2	1	1
2018	0	1	0	1
2019	0	1	1	0
2020	0	0	0	0
2021	0	2	2	0
2022	0	3	1	2

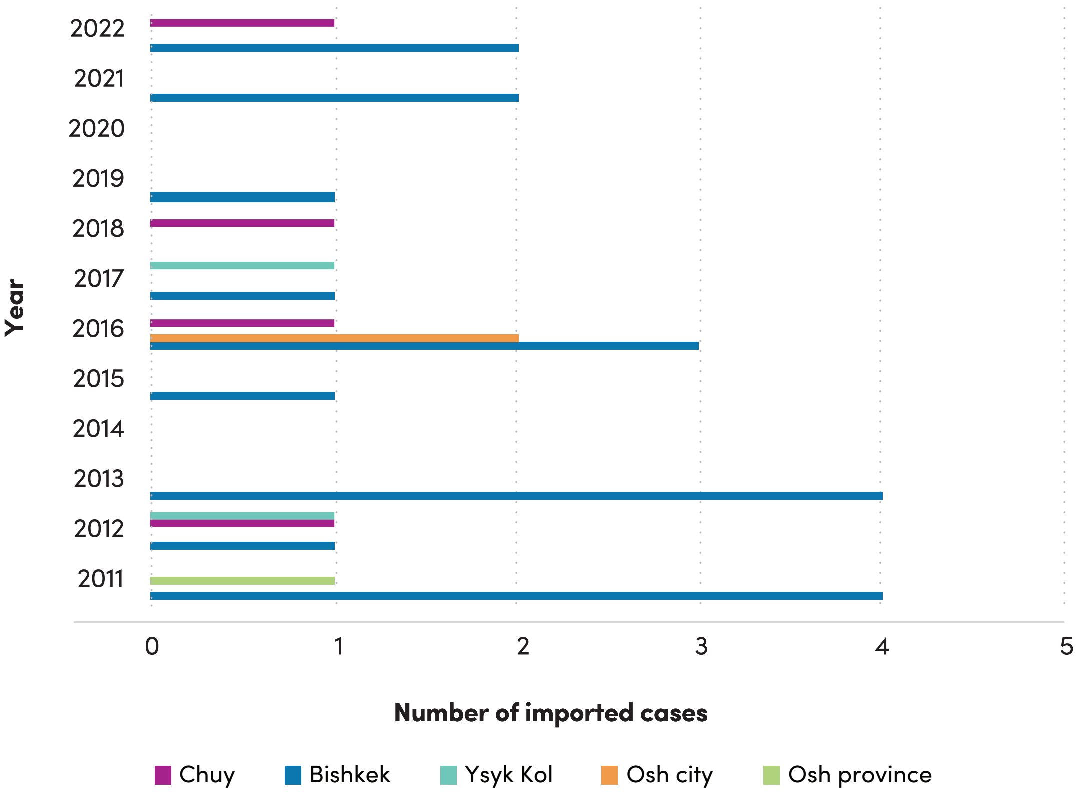
Source: NMCP.

Fig. 27. Imported cases of malaria in Kyrgyzstan, 2011–2022



Source: NMCP.

Fig. 28. Imported cases of malaria in Kyrgyzstan, by province, 2011–2022



Source: NMCP.

Stratification

Part of Kyrgyzstan is prone to malaria because of its specific landscape and climatic conditions. Numerous vector breeding areas, including rice fields, irrigation systems and other water bodies, are favourable for mosquitoes, as are the temperature conditions. The southern region, especially the Fergana Valley, has particularly high receptivity.

Taking into account receptivity indicators, the malaria situation in the recent past, and risk of malaria importation (which is currently low but may change over time), NMCP stratified the country according to the risk of re-establishment of malaria in 2010 (Table 14):

- High risk – southern region, Fergana Valley, Batken, Jalal Abad and Osh provinces, Osh city:
  - Indicators: high receptivity; duration of potential malaria transmission season around 6 months; re-establishment of malaria and epidemic reported in recent past; single imported cases of malaria reported.
  - Activities: enhanced surveillance, with monitoring of receptivity and risk of importation and special attention paid to imported cases, is conducted and should be maintained in these areas, to prevent re-establishment of malaria.
- Mild risk – Chuy and Talas provinces, Bishkek city:
  - Indicators: mild receptivity; duration of potential malaria transmission season around 5 months; re-establishment of malaria with isolated locally acquired malaria cases and outbreaks reported in recent past; single imported cases.
  - Activities: enhanced surveillance is conducted and should be maintained.
- Low risk – Ysyk Kol and Naryn provinces:
  - Indicators: no locally acquired malaria cases reported in recent past (due to low daily average air temperature).
  - Activities: set of preventive measures regarding imported malaria cases is applied.

After collection of additional data, NMCP conducted more comprehensive zoning related to malaria risk at the provincial and district levels (Table 15, Fig. 29). A points system based on the following indicators was used: presence of principal malaria vectors; average daily temperature (meteorological data for past 5 years and average annual number of days with temperature over 16 °C); humidity; and presence of rice fields.

Following analysis of these additional data, several degrees of potential risk of re-establishment of malaria transmission were formulated (low risk – 2 or 3 points; mild risk – 4 or 5 points; high risk – 6 or 7 points; very high risk –more than 7 points) *(15)*. Stratification provided a good basis for developing a plan of action for prevention of malaria re-establishment.

Table 14. Characteristics of malaria risk in Kyrgyzstan, by province

Province or city	Vector	Number of days with temperature >16 °C	Average daily temperature (°C)	Average humidity (%)	Number of generations	Total effective temperature required for completing sporogony	Number of possible cases of sporogony	Duration of malaria season (days)	Number of people living at risk of infection	Level of malario-genic potential
Batken province	*An. Pulcherrimus* *An. artemievi*	182	22.9	45	10	105.1	11	184	38 521	High
Jalal Abad province	*An. claviger* *An. artemievi* *An. superpictus*	185	23.2	45	11	104.3	13	196	45 449	High
Osh city	*An. Pulcherrimus* *An. artemievi* *An. superpictus* *An. hyrcanus*	174	23.4	44	10	109.1	12	182	21 453	High
Osh province	*An. pulcherrimus* *An. artemievi* *An. superpictus* *An. hyrcanus*	174	23.4	47	10	109.1	12	182	324 433	High
Bishkek city	*An. мesseae*	147	22.3	44	8	107.6	9	171	9 875	Mild
Chuy province	*An. algeriensis* *An. claviger* *An. superpictus* *An. hyrcanus* *An. мesseae*	171	22.3	45	8	107.6	9	171	86 756	Mild
Talas province	*An. claviger* *An. artemievi* *An. superpictus*	121	19.7	51	7	107.9	5	171	–	Mild
Naryn province	*An. artemievi* *An. мesseae*	182	22.9	45	10	108.7	4	141	–	Low
Ysyk Kol province	*An. мesseae*	174	23.4	44	10	104.1	4	114	–	Low

Source: NMCP.

Table 15. Additional characteristics of malaria risk (regarding receptivity) in Kyrgyzstan

	Level of malaria risk						
	Low		Mild		High		
	Naryn province	**Ysyk Kol province**	**Bishkek city, Chuy province**	**Talas province**	**Batken province**	**Jalal Abad province**	**Osh province**
Transmission season	May–August	May–August	April–September	April–August	April–September	April–October	April–September
Altitude (m above sea level)	2 000	1 600	750	1 200	1 050	800	1 000
Average temperature in July (° C)	19.6	19.5	25.6	22	25.8	26.4	24.5

Source: NMCP.

Fig. 29. Stratification of territory of Kyrgyzstan according to malaria risk points system

Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

Programme for Prevention of Re-establishment of Malaria in the Kyrgyz Republic

Activities aimed at preventing malaria re-establishment in malaria-free areas were in place before complete interruption of malaria transmission in Kyrgyzstan. Absence of local malaria cases in the country since 2010, indicating interruption of local transmission, led to the development of the comprehensive Programme for Prevention of Re-establishment of Malaria in the Kyrgyz Republic *(60)*.

Experience gained during elimination of malaria and the WHO guidelines *(31, 54)* provided the basis for the development and implementation of new programme strategies and policies aimed at maintaining a stable malaria-free status, preventing resumption of local malaria transmission, and establishing effective mechanisms for the post-elimination period.

The transition from elimination to prevention of malaria re-establishment can be accomplished by conducting continuous, adequate and effective surveillance that provides strong vigilance in the country. The strategic directions set out in the National Programme for Prevention of Re-establishment of Malaria in the Kyrgyz Republic are summarized in Table 16.

Table 16. Strategic directions of the National Programme for Prevention of Re-establishment of Malaria in the Kyrgyz Republic

Strategic approach	Sample activities
Malaria surveillance and response	• Early detection of all imported and locally acquired cases • Registration and timely mandatory notification • Epidemiological investigation of all malaria cases and foci • Management of foci • Maintenance of database
Efficient case management	• Maintenance of high level of external quality assurance of laboratory diagnosis of malaria • Free examination and treatment services for people with malaria, regardless of citizenship or residency status • Appropriate supplies and stocks of antimalarial medicines, equipment, laboratory reagents and other reserves
Continuing vector surveillance activities	• Monitoring of populations of *Anopheles* mosquitoes • Monitoring of breeding sites and of major changes in environmental parameters
Vector control activities	• Ensuring availability of larvivorous fish hatcheries and distribution of fish in *Anopheles* breeding sites • Indoor residual spraying in cases of massive malaria importation or possible infected mosquito transition at border areas
Cross-border collaboration	• Maintenance of cross-border collaboration • Conducting targeted activities jointly with representatives of neighbouring countries (meetings, conferences, sharing of information and experiences)
Maintaining malaria expertise	• Refresher training for specialists involved in malaria prevention
Maintaining epidemic preparedness	• Ensuring appropriate supplies and stocks of insecticides in case of outbreak • Ensuring appropriate supplies of antimalarial medicines • Ensuring appropriate supplies of laboratory reagents and consumables for malaria diagnosis
Keeping vigilance at high level	
Maintaining routine epidemiological observation of people from groups most at risk (e.g. students from endemic countries, tourists, residents of border territories, military personnel)	
Malaria examination of international students from endemic areas on arrival	
Continuing health education	

Goals and objectives

The goals of the programme are to maintain a stable malaria-free status and prevent the re-establishment of local malaria transmission. The objectives are:

- early diagnosis and notification and timely radical treatment of all cases of malaria;
- identification of all cases and causes in case of probable reintroduction of malaria transmission;
- immediate response in case of reintroduction of transmission;
- continuous training and retraining of health-care staff;
- ongoing social mobilization and intersectoral coordinated actions;
- partnerships with international and donor organizations;
- cross-border cooperation.

Key areas of activity and interventions

Following the strategic directions set by the National Programme for Prevention of Re-establishment of Malaria, Kyrgyzstan was active in certain key areas and responsible for a number of important interventions.

The malaria surveillance system operates efficiently throughout the country, regardless of the level of risk of malaria re-establishment. Its aim is to promptly identify and report all imported cases and possible resumption of malaria transmission, and to conduct a timely response. The former surveillance system active during malaria control and elimination operated in the presence of local transmission. Reorientation of the surveillance system involves redirecting efforts to early detection of imported cases of malaria and prevention of introduced cases in the absence of local transmission, which is more challenging.

Particular attention is given to laboratory services and quality control of diagnosis. Timely notification of all cases of imported malaria and possible cases of introduced malaria is of key importance. Mandatory epidemiological investigation of each imported case of malaria and maintaining a strong information system and updated database are specifically addressed.

Entomological surveillance is continued throughout the country. The results and quality of implemented vector control activities are regularly evaluated. Particular attention is paid by the entomological service to meteorological monitoring.

Key surveillance interventions in areas at high and mild risk of malaria re-establishment include:

- passive case detection;
- proactive and reactive case detection, depending on the situation (e.g. re-establishment of local transmission from imported cases or massive importation of malaria by migrants);
- hospitalization of all people with malaria and suspected malaria;
- radical treatment of people with confirmed malaria;
- epidemiological investigation and classification of all malaria cases and foci, notification and reporting.

Key surveillance interventions in areas at low risk of malaria re-establishment include:

- passive case detection;
- hospitalization of people with malaria;
- radical treatment of people with confirmed malaria;
- epidemiological investigation and classification of all malaria cases and foci, notification and reporting.

Key entomological surveillance and vector control interventions in areas at high and mild risk of malaria re-establishment risk include:

- entomological surveillance;
- hydrotechnical interventions aimed at steady improvement of areas and rational planning of hydraulic engineering and land reclamation projects;
- distribution of *G. affinis* fish in malaria mosquito breeding sites;
- other larviciding activities in sites where the effectiveness of *G. affinis* is reduced by strong vegetation overgrowth;
- indoor residual spraying (implemented only in exceptional cases of massive importation of malaria by migrants or in case of possible infected mosquito transition at border areas).

Key entomological surveillance and vector control interventions in areas at low risk of malaria re-establishment risk include:

- entomological surveillance;
- rational planning of hydraulic engineering and land reclamation projects;
- measures against *Anopheles* mosquitoes conducted as part of midge control.

An effective monitoring and evaluation system is very important for successful implementation of the programme. Monitoring is carried out periodically in accordance with approved indicators, with annual assessment of the programme implementation.

In view of the risk of importation of malaria and the possibility of resumption of local transmission, special attention is given to malaria training and retraining of national health-care workers. The focus is on improving the knowledge and skills of specialists and general health-care staff in malaria diagnosis, treatment and prevention, epidemiological surveillance, and public outreach. Training of laboratory service staff is a priority.

For successful implementation of a programme under management of the Ministry of Health, it is necessary to ensure rational use of health-care and financial resources and to combine the efforts of government sectors, ministries, organizations and administrative bodies. The programme makes efforts to organize close cooperation between the public and private sectors, and to use public participation in and support for its activities.

Health education and community involvement in implementing the programme facilitate malaria prevention activities, reduce costs, and increase the likelihood of success of preventive measures. Particular attention is paid to working with the general population, with the development of various educational programmes.

Involvement of nongovernmental organizations in malaria prevention activities, and publicity and transparency of the programme, are important.

The WHO Regional Office for Europe continues to provide technical assistance for planning and monitoring activities, evaluating results, and operational research studies in the post-elimination period. Within the framework of the Global Fund grants, a stock of insecticides, antimalarial medicines and consumables for parasitology laboratories has been provided.

It is important to improve coordination and cooperation with the health-care services of neighbouring countries to prevent re-establishment of local transmission. Particular emphasis is placed on analysis and identification of problems associated with malaria in border areas. Attention should be paid to development and implementation of joint action plans to synchronize antimalarial activities in border areas in case of malaria resumption.

Maintenance of malaria-free status depends on many factors, but sustainable funding is of key importance. The National Programme for Prevention of Re-establishment of Malaria in the Kyrgyz Republic has been officially approved by the Ministry of Health and all stakeholders. The Government gives priority status to this programme and allocates funding to the Ministry of Health budget as part of the overall financing of the health system.

The Government has made a number of commitments that must be undertaken throughout implementation of the programme. These apply not only to the necessary national personnel, logistical support and financial resources, but also to administration, organization and management of the programme. In 2017, Kyrgyzstan signed the Ashgabat Statement: Preventing the Re-establishment of Malaria Transmission in the WHO European Region, committing itself to this WHO initiative.

The available data indicate that the programme has adequate and sustainable funding. For the years 2011, 2012, 2013 and 2014, total fund from the Government and the Global Fund amounted to US$ 1 184 124, US$ 920 061, US$ 524 351 and US$ 608 355. WHO provided an additional contribution of US$ 25 000 in 2013 and in 2014 (Table 12). In subsequent years, the programme has been sufficiently funded by the DDPSSES budget.

Challenges and risks

If political commitment and support from the Government weakened, this could undermine vigilance and lead to a resumption of local malaria transmission, which would bring great social and economic damage.

Maintaining the malaria-free status of the country is a prerequisite for development of economic and social programmes in Kyrgyzstan. Return of malaria poses a threat to the planning and implementation of large projects in the broad context of international integration.

Development of the tourist industry depends on the healthy status of the country with respect to infectious and parasitic diseases.

Migration processes may also contribute to the reintroduction and spread of malaria. For this reason, monitoring is an essential part of implementation of the programme to prevent malaria re-establishing in the country.

Prevention activities focused on management of imported malaria and its consequences

Mitigating importation of malaria

The main task involved in mitigating importation of malaria is to prevent malaria being contracted by people travelling to malaria-endemic countries, its importation in the country after returning back and spread. At-risk groups include students, military personnel, international freight drivers, pilots, migrants and seasonal workers. It is important to contact people from at-risk groups and provide advice on protecting themselves in malaria-endemic countries. This advice may include recommending chemoprophylaxis. Advice sessions are mainly conducted in CDPSSES clinics for prevention of vector-borne diseases.

As malaria has been eliminated in all bordering countries, efforts can focus on exchange of information with respective health authorities.

Preventing consequences of importation of malaria

The consequences of importation of malaria may be clinical (development of severe disease and death) and epidemiological (resumption of local malaria transmission).

Key actions include early detection; timely diagnosis by quality-assured laboratories; radical treatment; prompt and comprehensive epidemiological investigation of cases among both local citizens returning to the country from malaria-endemic areas and citizens of malaria-endemic countries entering the country; foci investigations; and response.

To achieve prompt case detection and a timely response, the groups considered at higher risk have been identified as travellers, workers, students and others coming from malaria-endemic countries. Currently, the number of tourists to Kyrgyzstan from malaria-affected countries is low.

All international arrivals are required to be registered at the Ministry of Labour within 3 days, and information is sent to the Sanitary Epidemiological Service. All international workers and students from malaria-endemic countries are examined for malaria after arrival, and people with detected malaria are given radical treatment.

During their stay, international visitors are examined for malaria if they present with symptoms of fever, chills, anaemia or hepatosplenomegaly. Imported cases of *P. vivax* malaria are addressed as a priority because resumption of *P. vivax* malaria transmission is more likely to occur. Available data show that Afrotropic *P. falciparum* cannot effectively infect Palaearctic *Anopheles* species *(37)*. Monitoring of people from at-risk groups is carried out at student and outpatient clinics and at health facilities that treat migrant workers.

Establishing consulting rooms for prevention of vector-borne diseases at all CDPSSES levels, regulated by order of the Ministry of Health *(40)*, has contributed to preventing the consequences of malaria importation. Duties of consulting room staff include consulting with people leaving for or arriving from malaria-endemic countries; providing chemoprophylaxis medicines; analysing the epidemiological situation in Kyrgyzstan and neighbouring and other countries; providing information to CDPSSES, health facilities, travel agencies and other related organizations; and providing information on the latest WHO recommendations on malaria chemoprophylaxis.

NMCP surveillance data demonstrate that malaria vigilance has been maintained in the country. An example is the number of examinations and the annual blood examination rates for the period 2009–2013 (Table 17). The number of slides examined in 2012 and 2013, and the corresponding annual blood examination rates, were much higher than in 2009–2011. Even more strikingly, in former endemic areas, the annual blood examination rate was higher than the country average in 2013 (Jalal Abad, 1.5%; Osh city, 3.4%; Osh province, 1.2%) (Table 18). This indicates that NMCP efforts to find cases were more intensive in former endemic areas.

Table 17. Annual blood examination rate (ABER) in Kyrgyzstan, 2009–2013

2009		2010		2011		2012		2013	
Number of slides examined	ABER (%)	Number of slides examined	ABER (%)	Number of slides examined	ABER (%)	Number of slides examined	ABER (%)	Number of slides examined	ABER (%)
33 983	0.6	30 190	0.6	27 850	0.5	35 380	0.6	54 249	1.0

Source: NMCP.

Table 18. Annual blood examination rate (ABER) in Kyrgyzstan by province, 2012–2013

	2012		2013	
Province or city	Number of slides examined	ABER (%)	Number of slides examined	ABER (%)
Batken province	2 760	0.6	3 806	0.8
Bishkek city	3 379	0.4	471	0.1
Chuy province	3 849	0.5	7 808	0.9
Jalal Abad province	9 095	0.9	15 518	1.5
Naryn province	997	0.4	2 206	0.8
Osh city	6 194	2.4	8 900	3.4
Osh province	5 979	0.5	13 990	1.2
Talas province	1 513	0.6	22	0.01
Ysyk Kol province	1 614	0.4	1 528	0.3
Total/average	35 380	1.0	54 249	1.0

Source: NMCP.

All people with suspected malaria are provided with quality-assured microscopic diagnosis. Despite malaria transmission being interrupted, the total annual number of examined malaria slides was 35 380 in 2012 and 54 249 in 2013. The greatest proportion of examined slides was in former endemic areas of the country (Table 18).

The national quality assurance programme coordinated by the national reference laboratory is operating efficiently in all provinces. Table 19 demonstrates the cross-checking of negative slides and confirmation of positive slides by the national reference laboratory in the third step of the quality assurance programme, between 2008 and 2018. In the years of prevention of malaria re-establishment, maintaining a sufficient quantity of cross-checked slides and confirming all positive slides contributed to the good quality of diagnosis.

Table 19. Number of slides cross-checked in external quality assurance cycles of national reference laboratory, 2008–2018

Province or city	2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	Total	Positive	Total	Positive	Total	Positive	Total	Positive	Total	Positive	Total	Positive	Total	Positive	Total	Positive	Total	Positive	Total	Positive	Total	Positive
Batken province	22	2	21	3	10	0	6	0	12	0	10	0	39	0	86	0	35	0	59	0	124	0
Bishkek city	19	10	17	0	86	2	41	4	45	1	36	4	94	0	100	1	82	3	58	1	63	1
Chuy province	16	4	114	0	89	0	19	0	12	1	20	0	23	0	39	0	91	1	168	0	124	0
Jalal Abad province	13	1	26	1	49	3	56	0	33	0	30	0	19	0	31	0	42	0	13	0	20	0
Naryn province	6	1	11	0		0	12	0	18	0	18	0	28	0	12	0	20	0	17	0	24	0
Osh city	0	0	110	0	89	0	69	0	61	0	60	0	86	0	152	0		0	0	0	0	0
Osh province	50	0	52	0	128	0	46	1	52	0	20	0	63	0	51	0	144	2	152	0	100	0
Talas province	11		7	0	7	0		0		0	12	0	10	0	10	0	20	0	10	0	21	0
Ysyk Kol province	31		12	0	39	1		0	43	1	23	0	14	0	15	0	17	0	30	1	41	0
Total	168	18	370	4	497	6	249	5	276	3	229	4	376	0	496	1	451	6	507	2	517	1

Source: NMCP.

Vector control interventions to protect the population from mosquitoes by larval source management (*G. affinis* fish), long-lasting insecticidal nets and environmental management have been continued.

The Sanitary Epidemiological Service conducts regular entomological surveillance, with a focus on areas at higher risk of malaria re-establishment. In 2013, according to DDPSSES, there were 2974 water reservoirs registered in the country, of which 1492 were mosquito breeding sites that were being monitored (Table 20). On the basis of the entomological surveillance results and temperature records, parameters of the potential malaria season were defined (see Table 21 for an example).

Table 20. Monitoring of mosquito breeding sites in 2013

Places with water reservoirs under entomological surveillance	Number of water reservoirs	Number of *Anopheles* mosquito breeding sites
Reservoirs	981	520
Communal reservoirs	426	232
Basements	532	228
Children's organizations	361	214
Homesteads of people who have arrived from malaria-endemic areas	270	82
Control points	404	216
Total	**2 974**	**1 492**

Source: NMCP.

Table 21. Potential malaria season (entomological and epidemiological parameters), 2013

Province	Beginning of period of effective temperatures	Beginning of malaria transmission season	Probable time of occurrence of first cases of infection with *P. vivax* malaria	End of season	Number of cases of sporogony
Batken province	9 April	23 May	2 June	9 October	10
Chuy province (Bishkek city)	3 May	20 May	30 May	27 September	8
Jalal Abad province	9 April	13 May	23 May	21 October	11
Naryn province	3 May	1 July	11 July	12 September	5
Osh province (Osh city)	8 April	17 May	26 May	8 October	10
Talas province	11 April	7 June	17 June	27 September	7
Ysyk Kol province	24 May	29 May	9 June	12 September	5

Source: NMCP.

Although the receptivity of parts of the country remains fairly high, the national programme makes sustainable efforts to reduce it. The risk of importation of malaria is moderate, but the measures undertaken with respect to people arriving from endemic countries succeed in preventing the consequences of importation.

Epidemic preparedness

A national committee under the authority of the Ministry of Health is responsible for management of emergencies, disasters and epidemics. There are corresponding structures at the provincial and district levels tasked with responding in the event of a malaria epidemic.

An emergency information system covering all cases of suspected malaria has been devised. An electronic communication network linking regional structures has been set up, which allows continuous monitoring of the epidemiological situation and emergency planning of measures to contain outbreaks in at-risk zones. A special Ministry of Health budget is allocated to epidemic response, and stocks of antimalarial medicines and insecticides are maintained.

Lessons learned

The history of malaria in Kyrgyzstan is a good example of how malaria can be eliminated and then return. Time, effort and resources are required across the country to ensure it does not return. Valuable lessons can be learned from the experience of Kyrgyzstan in containing post-elimination epidemics, interrupting local transmission for a second time, and conducting activities to prevent re-establishment in the future.

Challenges posed by malaria resurgence

The surveillance system set up after elimination of malaria in Kyrgyzstan in 1960 kept the country malaria-free for 27 years. The long absence of malaria led to a weakening of the national malaria programme and to a low level of vigilance on the part of provincial and district general health services. These deficiencies resulted in a delayed response to the increased vulnerability to malaria in the 1990s.

Intensive importation of malaria from endemic Tajikistan was neglected, which led to delayed diagnosis and treatment of malaria, subsequent re-establishment of local *P. vivax* transmission and an epidemic. Insufficient expertise in malaria microscopy, shortages of antimalarial medicines, laboratory consumables and insecticides, and understaffing of the Sanitary Epidemiological Service resulted in a delayed response at the beginning of the epidemic and contributed to the spread of malaria.

The Ministry of Health scaled up its control and surveillance activities, upgraded the Sanitary Epidemiological Service system, and began capacity-building to contain the epidemic, limit further spread and interrupt transmission.

Complex strategic approaches to malaria control and elimination

Targeted comprehensive programmes and strategic plans of action for malaria control and elimination were implemented by the Ministry of Health. NMCP mobilized the network of public health facilities and scaled up interventions, with technical and financial support from ACTED, the Global Fund, Merlin, USAID, WHO and other organizations. This led to containment of the epidemic, significant reduction in malaria burden, clearing-up of the foci, and interruption of transmission.

The following key strategies and approaches were adopted and proved to be effective in malaria control and elimination:

- Intensified case detection was implemented through passive and active case detection. Passive case detection involved malaria screening of all people with fever seeking treatment. Active case detection took place in all malaria foci and involved weekly house-to-house visits during the transmission season, with fever screening and blood sampling of people with fever, combined with mass blood surveys among residents of the home villages of people identified with malaria. Case detection was followed by radical treatment with chloroquine and primaquine. These interventions led to timely detection of cases and elimination of the sources of infection. Disease management was well set up, malaria treatment was free of charge, and regular supplies of medicines were provided. MPPT, implemented before the start of the malaria season during the outbreak in Tashkomur city, brought about a dramatic decrease in the number of cases in the following year and helped to clear up the focus.

- Case-based surveillance, including prompt and comprehensive investigation of every case and focus and epidemiological classification by Sanitary Epidemiological Service staff, permitted appropriate planning and response implementation. Case registration, focus registration and monitoring were conducted. Case notification and a regular flow of information to the upper levels of the system, with feedback to lower levels, allowed rapid analysis of the situation and prompt evidence-based decision-making by the responsible authorities. This information was critical for the timely initiation of interventions if needed, and correct determination of their type, scope and period of application.
- Integrated and evidence-based vector control guided by focus investigations played an important role in epidemic and outbreak control and malaria elimination. This included indoor residual spraying in affected areas, distribution of long-lasting insecticidal nets and larviciding (mainly by distributing *G. affinis* fish in mosquito breeding sites, especially in rice fields) to reduce mosquito density and longevity. Alongside vector control, environmental measures (mainly infilling of non-productive water bodies) brought about a reduction in the number of breeding places.
- Malaria control and elimination benefited from entomological surveillance carried out by the Sanitary Epidemiological Service. Identification and mapping of breeding sites, use of representative sentinel sites for monitoring larval control, determination of larval and adult densities, and identification of *Anopheles* species were effective approaches. Records were maintained for breeding sites, which were updated regularly and their status periodically reviewed.
- Vigorous health education contributed to prevention of malaria in the population and to early case detection. NMCP adopted various approaches to health education. Special attention was paid to the way information was presented to schoolchildren. Training seminars with teachers and students were conducted, and information was conveyed through school drama groups and puppet theatres.
- Establishing village health committees increased community awareness and engaged the whole population in malaria control, elimination and prevention.

Upgraded and experienced NMCP network

The Ministry of Health SSES proved to be a strong and reliable system for malaria surveillance and control at the national, provincial and district levels. The Sanitary Epidemiological Service coordinated the activities of primary health-care services and other institutions in the programme, and was responsible for malaria surveillance, vector control, entomological surveillance and external quality assurance of laboratory diagnosis. Disease management was carried out by primary health-care services.

Staff expertise played a key role in malaria control and elimination. NMCP conducted continuous education of Sanitary Epidemiological Service personnel and other specialists. Instruction in the field of malariology included surveillance, microscopic diagnosis, disease management and vector control.

Upgraded laboratories provided strong support for malaria control, elimination and prevention. All cases of malaria were confirmed microscopically (rapid diagnostic tests were never used). The internationally certified national reference laboratory was responsible for the national external quality assurance programme, cross-checking 10% of negative slides and confirming all positive slides. Quality-assured laboratories provided reliable and timely diagnoses.

Strong political commitment

The high level of political commitment to, and Government support for, the national malaria programme played a key role in its success. Malaria control and elimination interventions were supported by policies and strategic programmes, plans, decrees and guidelines endorsed by the Ministry of Health. The Government provided sufficient funds for containment of the epidemic and outbreaks and to achieve the targeted goal for elimination. After 2006, there was also Global Fund financial support. There is currently sufficient Government funding for the programme to prevent the re-establishment of malaria.

Cross-border cooperation

During the resurgence of malaria in Kyrgyzstan, collaboration with neighbouring countries where malaria was a major health problem was of key importance. This collaboration took a number of forms, including a joint statement on cross-border cooperation on malaria signed by Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan; exchange of information and cooperation among NMCP services at the border areas of Kyrgyzstan, Tajikistan and Uzbekistan; and joint plans and actions developed and undertaken together.

WHO support and collaboration with other international organizations

Support from the WHO Regional Office for Europe was essential in containing the epidemic and outbreaks and achieving malaria elimination. The Regional Office assisted in developing strategies, approaches, programmes and plans of action, and supported capacity-building. The WHO malaria field office, set up in Osh province in 2003 with international and national staff, played an important role in containing the epidemic in the south.

The country benefited from the support of many other international organizations, including ACTED, CDC, Merlin and USAID. The two grants from the Global Fund in 2006–2014 contributed greatly to the success of malaria control and elimination in Kyrgyzstan.

Outlook for the future

Using contemporary evidence-based strategies, Kyrgyzstan managed to contain a malaria epidemic after resurgence of local transmission, to dramatically reduce the malaria burden and to achieve malaria elimination. This required strong political commitment, adequate funding, a well-developed surveillance system, and effort to set up and implement the malaria control and elimination programmes.

To maintain its malaria-free status, the country must maintain a high degree of vigilance and retain its rapid epidemic response system.

Lessons learned during the period of malaria control and elimination show that the activities and financial allocations made to the malaria programme should not be terminated, even though Kyrgyzstan is now malaria-free. The activities set out in the programme for prevention of malaria re-establishment should be continued efficiently and effectively.

Conclusions

The story of malaria in Kyrgyzstan shows that malaria can return to countries that have eliminated it if they allow vigilance to decline and antimalarial activities to be neglected. The story also demonstrates, however, that malaria elimination can be achieved again if certain elements are in place, including strong political commitment; adequate funding; correct policies, strategies and guidelines; well-developed systems, especially surveillance and laboratory services; rapid response capacity; technical and financial assistance; and domestic human resource capacity.

Kyrgyzstan managed to dramatically reduce its malaria burden, from 2744 cases in 2002 to 0 cases in 2011, and to set up and implement a malaria elimination programme and finally achieve elimination. In 2016, Kyrgyzstan was officially certified by WHO as a malaria-free country.

This achievement was the result of efforts on all sides: the entire health system network; Government ministries and departments; regional, district and city administrations; local authorities; nongovernmental organizations; village health committees; and the population as a whole. An invaluable role was played by international and partner organizations, including ACTED, Merlin, USAID and WHO, and donor organizations, especially the Global Fund.

Now that Kyrgyzstan has reached the stage of preventing malaria re-establishment, a system of malaria vigilance has been established and maintained. The country has a stable system for rapid epidemic response in the event of malaria introduction. Within the framework of the Programme for Prevention of Re-establishment of Malaria in the Kyrgyz Republic, a plan of action has been developed, with specific objectives and responsibilities for all relevant ministries, public administrations and local authorities. A set of regulations has been developed for implementation of the International Health Regulations 2005 in the country *(60)*. There is ongoing exchange of information on infectious and parasitic diseases with all Commonwealth of Independent States countries.

Kyrgyzstan needs to maintain adequate vigilance and ensure timely responses to potential changes in receptivity and vulnerability, prompt detection of any malaria cases, and preparedness for response actions when required.

In 2017, Kyrgyzstan signed the Ashgabat Statement: Preventing the Re-establishment of Malaria Transmission in the WHO European Region, thereby committing to keep the region malaria-free.

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Annex 1: Data sources and analysis

Data were collected and analysed from the following sources:

- Country data:
  - country publications and manuals;
  - Ministry of Health data – reports, laws, regulations, orders and guidelines;
  - National Malaria Control Programme documentation – reports, registers of cases and foci, maps and guidelines;
  - Order of the Ministry of Health of the Kyrgyz Republic "On strengthening measures to combat and prevent malaria in the Kyrgyz Republic" of 4 July 2007, no. 260;
  - Resolution of the Government of the Kyrgyz Republic "On approval of the Programme for the Elimination of Malaria in the Kyrgyz Republic for 2010–2015" of 30 March 2010, no. 188;
  - Sanitary Epidemiological Service reports and registers;
  - National Report on the Elimination of Malaria in the Kyrgyz Republic.
- World Health Organization (WHO) data:
  - review of malaria-related materials in the WHO Registry and Archives collection of reports of technical missions, records, reports of WHO Regional Office for Europe meetings, Centralized Information System for Infectious Diseases, and other information on Kyrgyzstan up to 2018;
  - literature review of WHO publications;
  - review of country data reported to WHO Headquarters and to the WHO Regional Office for Europe as part of the annual reporting cycle, including information submitted for the annual World Malaria Report.
- Scientific publications on malaria in Kyrgyzstan identified using PubMed and Google and by screening scientific journals and other sources.
- Authors' materials and data collected during the study, and from various WHO Regional Office for Europe technical support missions in the country.

All data collected were analysed from an epidemiological perspective, with the aim of characterizing the malaria situation during different periods and the effect of interventions. The analysis used the main epidemiological parameters and indicators, such as the annual number of cases (locally acquired and introduced); malaria morbidity and mortality; distribution of cases by age, sex and other parameters; geographical distribution of malaria; number, category and transition of malaria foci; and parasites and vectors.

Annex 2: Organization structure of the Ministry of Health of Kyrgyzstan

Minister of Health

Collegium

Deputy | Deputy | Deputy | Deputy

Human resource management, records management, and legal support department

- Legal unit
- Personnel and records management unit
- Medical education and science unit

Financial policy department

- Accounting and Reporting unit
- Financing and planning unit

Public health, licensing of medical and pharmaceutical services department

- Medical and pharmaceutical services licensing sector

Medical care and drug policy department

- Specialized and inpatient care unit
- Medical services quality and drug policy unit
- Primary healthcare unit

Strategic planning and program implementation department

- Program monitoring and international cooperation unit

Procurement management sector

Commissioner on prevention of corruption

Press secretary

First sector

Chief Specialist for Civil Protection and Mobilization Work

Assistant to Minister

Advisor to Minister

Source: Based on structural units described on the Ministry of Health website (https://med.kg/ministry/structure?locale=en).

Annex 3: Fauna, ecology and geographical distribution of *Anopheles* mosquitoes

Anopheles **mosquito**	**Geographical areas of distribution**
An. messeae Falleroni, 1926	Bublikova points to widespread distribution of the species in the Chuy valley, mainly in the foothill zone *(1)* Plishkin indicates the presence of this species in the internal Tien Shan, in the floodplain of the Naryn river at an altitude of 2000 m above sea level *(2)* NMCP staff detected widespread distribution of this species in the Ysyk Kol region (Balykchy, Cholpon-Ata, Karakol), north of the Naryn region (Kochkorka, the highest point, where this species was found at 1879 m above sea level) in 2006–2007 Malaria vectors are observed in all these areas of Kyrgyzstan, where potential malaria transmission is possible in accordance with temperature conditions
An. artemievi Gordeev et al., 2005	According to NMCP data, this species is spread all over the Pre Fergana, Naryn region, at altitudes up to 1600 m above sea level; Ugyut; Talas region (Talas city, 1216 m above sea level, Bakay-Ata district, Ak-Dobo, 1050 m above sea level) Bublikova points out a few findings of *An. martinius* in the lowlands of the Chuy region (Kaindy, Kara-Balta) and single detections around Bishkek *(1)* – these data probably refer to *An. Artemievi*
An. algeriensis Theobald, 1903	There are indications of findings of this species in Pre Fergana in the literature *(3)* Bublikova describes single specimens caught in the floodplain of Chuy at an altitude of 1000 m above sea level in the Ivanovka village, Issyk-Ata district *(1)*, but it is not a malaria vector on account of the small size of the mosquitoes and weak contact with human
An. claviger Meigen, 1804	Plishkin *(3)* note the presence of this species throughout the territory of Kyrgyzstan at altitudes up to 2200 m above sea level Bublikova considers the species as dominating in the Chuy valley *(1)* Konurbaev considers the species rare in the Ysyk Kol region *(4)* *An. claviger* prefers ponds with cool water, mostly of spring origin; for the breeding sites in the plains located at relatively low altitudes above sea level (Pre Fergana, the lowland part of Chuy valley), the population density of this species declines in the hot season It is considered a rare vector on account of exophilic features and low population density at the hottest epidemic-prone time of the – but if breeding sites are located near settlements, it can become an efficient malaria vector In August 2006, NMCP staff recorded an attack of mosquitoes of this species during self-testing in Talas city

Anopheles mosquito	Geographical areas of distribution
An. hyrcanus Pallas, 1771	Bublikova points out the high density of this species in the lowlands of the Chuy region (Belovodskoe, Kara-Balta and Sokuluk villages) *(1)* NMCP staff noted a high intensity of attacks "on ourselves" at registration of this type in the Kara-Suu district of Osh region at the end of July 2003 (more than 300 attacking females per hour) and at the end of August 2006 (250 females per hour) The species is considered a secondary malaria vector due to its food preference for small mammals, but the high population density of this species in the areas mentioned above and intensive contact with humans indicate the efficiency of this vector
An. plumbeus Stephens, 1828	There is only one report of a finding of this species in the area of Manas airport Mamedniyazov did not confirm findings of this species in Kopetdagh and suggested that the closely related species *An. barianensis* James is distributed in central Asia *(5)* Further study of this is needed in Kyrgyzstan
An. (Cellia) pulcherrimus Theobald, 1902	NMCP staff detected this species in 2003–2007 in the Kara-Suu district of Osh province, where it actively attacked humans It was found inside settlements, preferring open barns during the day It is found quite focally in Kyrgyzstan, but it can be an efficient malaria vector (also in other lowland areas of central Asia)
An. (C.) superpictus Grassi, 1899	Principal (often the main and only) malaria vector in mountainous and pre-mountainous areas of southern Kyrgyzstan Widespread distribution of this species was reported in the floodplain of Naryn and Pre Fergana (Tashkomur) by NMCP and Plishkin *(3)* Bublikova described single findings of this species in the Chuy valley (Bystrovka village, at an altitude of 1000 m above sea level) *(1)* In 2006, this species was detected in Talas city, indicating it can also be found in the northern part of Kyrgyzstan (Chuy and Talas region)

Source: National report on the elimination of malaria in the Kyrgyz Republic. Bishkek: Ministry of Health of the Kyrgyz Republic; 2015.

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Annex 4: Staff of the National Malaria Control Programme

Table A4.1. Numbers of staff participating in malaria control and elimination activities in Kyrgyzstan, 2013

Specialists	Provinces	Capital	Country total
Assistant epidemiologists and assistant parasitologists	257	27	284
Epidemiologists	166	13	179
Laboratory technicians	50	3	53
Parasitologists	40	5	45
Assistant entomologists	17	1	18
Entomologists	15	1	16
Laboratory physicians	5	2	7

Source: NMCP.

Table A4.2. Numbers of malaria laboratories, specialists and microscopes in Kyrgyzstan, 2013

	Laboratories			Laboratory specialists			
	Sanitary Epidemiological Service (*n*)	Hospitals (*n*)	Clinics (*n*)	Laboratory physicians (*n*)	Laboratory technicians (*n*)	Trained specialists (*n*)	Available microscopes (*n*)
Batken province	5	4	4	5	21	23	51
Bishkek city	1	22	19	60	93	137	112
Chuy province	8	7	7	9	21	93	15
Jalal Abad province	11	12	27	12	106	56	50
Naryn province	5	5	5	3	8	4	20
Osh city	1	12	4	11	18	23	42
Osh province	7	7	21	18	58	24	27
Talas province	4	4	3	4	9	12	7
Ysyk Kol province	7	6	6	13	30	6	30
Total	49	79	96	135	364	378	354

Source: Republican Medical Information Centre, Kyrgyzstan.

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