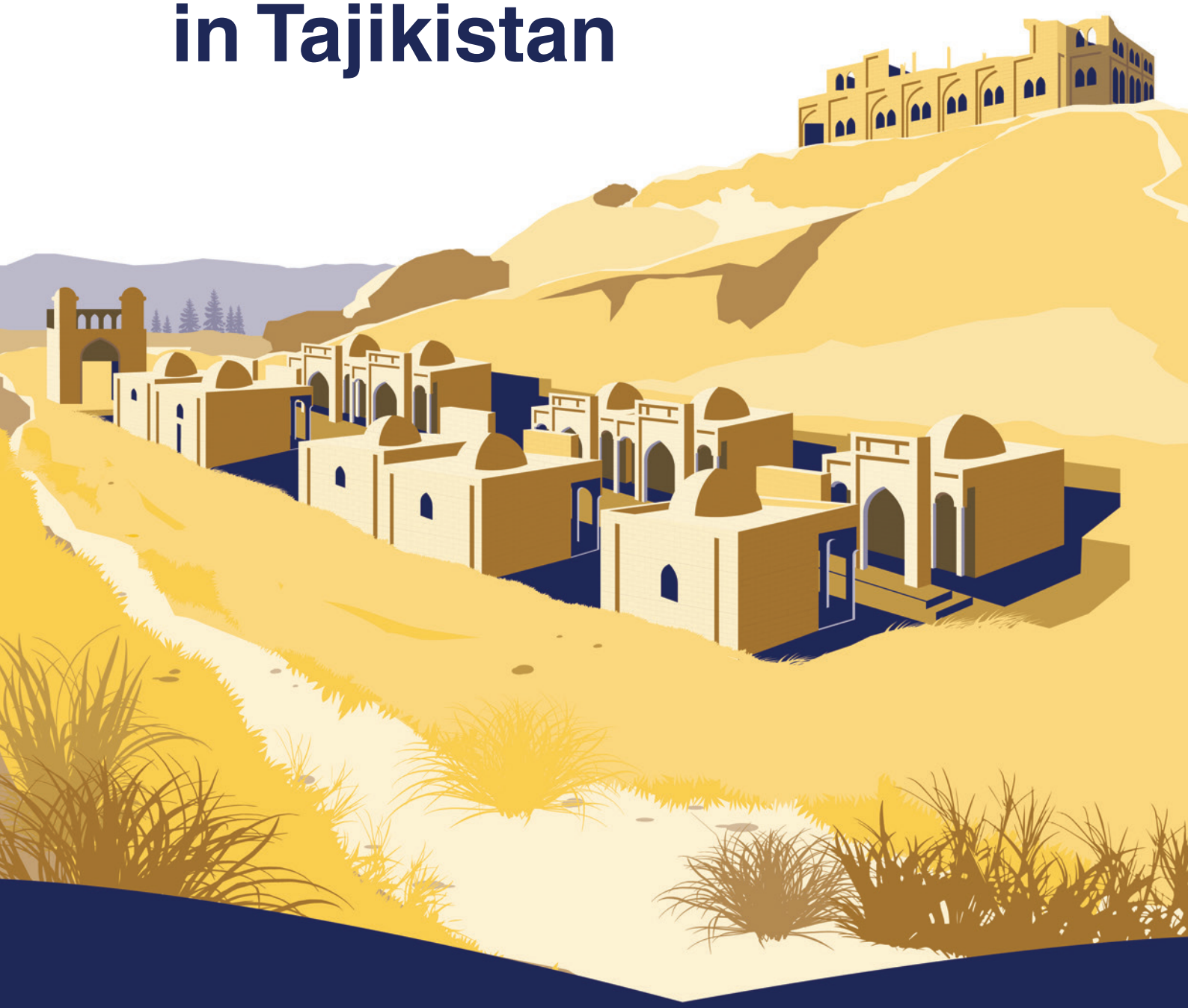
Towards a malaria-free world

Elimination of malaria and prevention of re-establishment in Tajikistan



World Health Organization

Towards a malaria-free world

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Abbreviations

ABER	annual blood examination rate
ACD	active case detection
CSSES	Centre of State Sanitary and Epidemiological Surveillance Service
CTDC	Centre for Tropical Diseases Control
EQA	external quality assurance
EQC	external quality control
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
IRS	indoor residual spraying
LLIN	long-lasting insecticide-treated net
M&E	monitoring and evaluation
MoHSPP	Ministry of Health and Social Protection of the Population
NMCP	National Malaria Control Programme
NRL	national reference laboratory
PCD	passive case detection
PCTDC	provincial centres for tropical diseases control
RCD	reactive case detection
RTDC	Republican Tropical Diseases Center
RDT	rapid diagnostic test
SES	Sanitary and Epidemiological Service
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
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 three 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 presents the history of malaria in Tajikistan, focusing on the evaluation of the policies and strategies applied to contain malaria epidemics in the 1990s and early 2000s after the re-establishment of local transmission, to eliminate malaria and after that to maintain a malaria-free status of the country. The main objective of this publication is to document the expertise accumulated in Tajikistan on achieving malaria elimination and maintaining malaria-free status. Lessons are distilled for countries embarking upon elimination or on prevention of re-establishment of malaria.

History of malaria

In the past, all of the country's lowlands populations were affected with *Plasmodium vivax* and *P. falciparum* malaria. Following the foundation of the Tajik Soviet Socialistic Republic in 1929, the first health care facilities for malaria control were established and in 1934, the National Malaria Control Programme (NMCP) was launched. An elimination programme introduced after the Second World War – during the Global Malaria Eradication Programme – led to a drastic decrease of the malaria burden and by 1960, malaria was no longer considered a public health concern in Tajikistan. However, isolated cases and small outbreaks were still reported at the border with Afghanistan, which were successfully controlled.

The epidemiological situation worsened following military operations in Afghanistan during 1980–1989 with a peak of 571 *P. vivax* cases in 1984 registered mainly in the districts bordering Afghanistan. The situation deteriorated further in 1991–1992, due to: armed conflicts and social unrest; the hampered public health system and almost ceased antimalaria activities in the newly independent Tajikistan; increase of the vector breeding grounds and vector densities because of the increase in the cultivation of rice and marked decrease in pesticides treatment of cotton plantations (due to a shortage of chemicals). It was followed by large-scale malaria epidemics in 1993–1997, with an explosive rise in the number of officially reported *P. vivax* cases due to an influx of Tajik refugees from malaria-endemic areas of Afghanistan, resulting in mass importation of *P. vivax* and *P. falciparum* malaria to receptive areas of Kurgan-Tyube. The peak of the epidemic with 29 794 cases was reached in 1997. In addition, the first locally acquired cases of *P. falciparum* were detected in 1994–1995 followed by disease spread in the country reaching a maximum of 831 cases in 2000. Tajikistan was the only country of central Asia and the entire World Health Organization (WHO) European Region where local transmission of *P. falciparum* was re-established. The health system did not respond adequately to the increased risk of importation and receptivity, and the malaria epidemic affected almost all cities and districts of the country.

Control of epidemic after re-establishment of local transmission

In response to the complicated situation, the National programme for control of tropical diseases (malaria) (1997–2005) was developed with WHO technical assistance and implemented in the country.

Strategic approaches to intensify malaria activities targeting the containment of the epidemic included:

- vector control, including indoor residual spraying (IRS), larviciding (including settlement of *Gambusia affinis* in anophelogenic water bodies) and environmental management, as well as entomological surveillance;
- scaled-up epidemiological surveillance – active (household visits) and passive case detection, improvement of laboratory diagnosis, registration and reporting, prompt response and epidemiological investigation of cases and foci;
- mass prophylactic treatment of the population in active malaria foci and prophylactic treatment of demobilized military personnel with primaquine and their follow-up over three years;
- strengthening human resources, training and re-training of the staff and deployment of antimalarial mobile teams in regions bordering Afghanistan; and
- health education of the population and social mobilization.

Strengthened antimalaria activities led to a reduction in the number of officially reported malaria cases by more than 50%, from 29 794 cases in 1997 to 13 493 cases in 1999.

The complex activities were aligned with WHO recommendations, and local regulations conducted by the mobilized malaria network were further scaled up, which resulted in stabilization of the epidemiological situation at the Afghanistan border and improvements in the rest of the country. The total number of reported malaria cases progressively dropped – from 2390 in 2005 to 1344 cases in 2006 and 108 cases in 2010. *P. falciparum* transmission was interrupted in 2009.

Malaria elimination

Sound results in malaria control inspired the country to develop a programme for malaria elimination (2011–2015) in line with the WHO Tashkent Declaration, which was signed by the country. Successful implementation of the programme and the plan brought about steady decrease of *P. vivax* cases to 56 in 2011 and 2 (last locally acquired cases) in 2014. Since 2015, only imported cases have been detected in the country.

The absence of locally acquired cases after 2015 encouraged the Government to apply for WHO recognition of the country's success and in 2023 Tajikistan was certified malaria-free by WHO.

The main directions of strategies and approaches that proved to be efficient for reaching elimination are as follows:

- Legislation supporting complex activities directed to the source of infection (i.e. case detection and radical treatment), vector control and protection of the population, and assuring adequate coverage and good performance by general health services and specialized services were all important steps.
- Recognizing the key role of human resources, specialized services and laboratories were upgraded and capacity-building conducted – staffing and training/re-training were crucial for reaching the malaria control goals.
- The malaria surveillance and response system was enhanced and it functioned throughout the country, regardless of the level of the malariogenic potential and epidemiological situation.
- Case detection was one of the core surveillance functions. Efforts were made to detect malaria cases by active case detection (ACD) and passive case detection (PCD) as early as possible and, when detected, they were treated promptly and adequately. The effectiveness of the proactive case detection through household visits (e.g. every week or every two weeks during the transmission season) by

primary health care facilities and mobile teams in active foci – with blood sampling and examination of all people with fever and those suspected to have malaria – should be highlighted. Reactive case detection (RCD) performed in the process of epidemiological investigations of cases in living and workplaces with interviews and screening for malaria by microscopy the respective contact people also contributed much to timely finding of cases.

- Laboratory support was crucial for reaching elimination. Testing in quality assurance/quality control (QA/QC) laboratories was important for the confirmation of every malaria case. Timely and adequate treatment in accordance with the national policies and guidelines contributed to a drastic reduction in sources of infection and preventing further distribution of the disease in the country.
- Attention was paid to case and foci investigation by filling a case record form, and a focus record form ('passport') with detailed information. Particular attention was given to foci management, one of the core surveillance functions. As a malaria focus was considered the minimum unit for antimalarial action, comprehensive investigation of foci, classification and monitoring and evaluation of their functional status were scaled up and foci inventories/registers were updated and maintained. On the basis of this information, and considering the type of the foci, stratification of the territory, selection, planning and application of appropriate interventions targeting clearing up of foci were done.
- Timely recording and reporting of confirmed malaria cases to the national malaria programme (NMP) played an important role in undertaking prompt actions. The network of electronic communication with provincial structures that has been put in place during elimination enabled continuous monitoring of the epidemiological situation and planning of emergency measures to contain the outbreaks in the risk zones.
- The NMP benefited significantly from the good entomological surveillance that was extremely important in the control of malaria resumption and elimination, because inadequate control of vector populations might have worsened the malaria situation dramatically. Entomological activities were conducted by the Centre for Tropical Diseases Control (CTDC) staff countrywide but especially addressing receptive areas such as the south of the country in the areas bordering Afghanistan, the districts of central Tajikistan, northern districts of Sugdh province and some areas of the Gorno-Badakhshan Autonomous Oblast (GBAO). The CTDC staff conducted identification, registration and mapping of all vector breeding sites of *Anopheles*, entomological monitoring in representative sentinel sites, with maintenance and regular updating of a breeding site records. Entomological investigations were carried out during investigation of malaria foci and of new confirmed cases. The information collected was used for stratification of the national landscape by levels of receptivity and planning vector control actions.
- Integrated vector control was well planned and implemented by the district CTDC and Sanitary and Epidemiological Services (SES) staff. IRS was conducted in targeted districts in accordance with the epidemiological situation and data from entomological surveillance, mostly in the districts bordering Afghanistan. Widely used *Gambusia affinis* in water bodies and rice fields proved to be very efficient in the larval control of *Anopheles*. LLINs were used as a supplementary tool to protect the population from mosquito bites in malaria-affected areas, especially at the border with Afghanistan. Environmental management contributed to reducing areas of mosquito breeding sites.
- Tajikistan conducted extensive work for strengthening intersectoral and international collaboration in the field of malaria, as well as to raise awareness about malaria by improving health education of the population and community mobilization. Cross-border cooperation with neighbouring countries where malaria was endemic or has returned, and especially with malaria-endemic Afghanistan, was of key significance.
- Strong political support played a key role in accomplishment of malaria elimination in the country.

- The success of the malaria control and elimination programmes was greatly related to the technical, operational and financial support of many international agencies and organizations: WHO, the Global Fund to Fight AIDS, Tuberculosis and Malaria, MERLIN (international organization for health care in crisis), the United Nations World Food Programme, the Agency for Technical Cooperation and Development, France, United States Agency for International Development, United Nations Children's Fund and the United Nations Development Programme. The WHO Regional Office for Europe provided technical support to: developing strategies, plans and guidelines; in operating a field office in Khatlon province; by conducting, monitoring and evaluation of interventions, training health staff, etc. The Global Fund provided major financial support to Tajikistan during 2006–2015, which played a key role in achieving the goals.

Programme for prevention of re-establishment of local malaria transmission

Following elimination, Tajikistan launched a programme for the prevention of re-establishment of local malaria transmission and has managed to maintain the malaria-free status to date, although the risk of re-establishment of malaria transmission remains, since most of the country's territory is receptive and vulnerable to the disease. The area along the border with Afghanistan is considered by local malariologists to be at higher risk. At present, malaria importation is low but Tajik specialists believe there is a possibility of active flight of infected mosquitoes from the adjacent Afghan malaria-endemic territory to Tajik settlements located in the 3-km frontier zone. Although the period of maintaining a malaria-free status has not been long, the main strategies and approaches that brought about the success should be highlighted:

- To enable timely and adequate interventions, a stratification of the territory of Tajikistan according to the risk of malaria re-establishment was developed. This was based on the analysis of receptivity and risk of importation indicators and taking into account the former malaria endemicity. It forms the basis for planning and conducting ongoing malaria prevention activities.
- It is crucial that the epidemiological surveillance and responses to malaria are maintained at effective levels to assure prompt detection and treatment of imported cases, as well as timely responses to any emergency.
- The profiles of high-risk populations have been identified and respective populations specifically addressed. High vigilance, PCD supported by proactive case detection (i.e. household visits in the potential malaria transmission season and selective screening in the high-risk groups, if epidemiologically indicated) and RCD as a response to the epidemiological investigation of imported cases, has led to timely detection of imported cases.
- Timely, quality-assured diagnosis and good case management are maintained.
- A number of activities (e.g. medical consultation and recommendations for local citizens leaving for or coming back from malaria-endemic countries, examination of foreign students from malaria-endemic countries, etc.) mitigate malaria importation into the country and prevent its consequences.
- Special attention is given to addressing preventive activities at border areas with malaria-endemic Afghanistan. This represents a significant risk for malaria re-establishment in neighbouring countries including Tajikistan, and maintaining the case-based surveillance at a high level, provision of border troops with medicines, laboratory consumables, insecticides and LLINs to protect them from mosquito bites, etc., ensure protection in this territory.
- Entomological surveillance has been continued, and provides valuable information for monitoring any changes in the receptivity of the territories.

- Aiming at a reduction of receptivity, the use of *Gambusia affinis* larvivorous fish in mosquito breeding habitats continues, as well as some IRS activities, primarily in districts adjacent to Afghanistan, as a barrier treatment.
- A system of outbreak detection and rapid response and outbreak preparedness are in place.
- Maintaining expertise in malaria and updating knowledge of the staff is actively addressed.
- Multisectoral and cross-border collaboration, particularly with malaria-endemic Afghanistan, contribute to the prevention of re-establishment of malaria transmission.
- The high political commitment and ensuring of the strategic plan for the prevention of re-establishment of malaria transmission in Tajikistan with sustainable funding is of key importance for the success.

Conclusions

In Tajikistan, the target of eliminating malaria following its resurgence has been achieved through the coordinated efforts of the health system, other sectors, and the entire population. This success was made possible by well-designed, meticulously organized interventions and sustained financial investments over an extended period. This demands continued and sustained malaria prevention activities in the post-elimination period to prevent future re-establishment of local transmission.

Although after elimination, malaria importation in the country is not high, and the neighbouring Uzbekistan, Kyrgyzstan and China have been certified as free of malaria, the malaria situation in Afghanistan presents an essential threat considering the remaining receptivity of the territory of Tajikistan.

After reaching malaria elimination, a well-organized surveillance system and preventive activities were maintained at effective levels, as this is crucial for prevention of malaria resurgence. Activities are guided by the NMP and national strategic plan for the prevention of the re-establishment of malaria, aiming at a prompt and timely response, maintaining high vigilance, timely detection of any malaria case and undertaking the necessary response actions. Continued entomological surveillance addressed to priority, high-risk areas monitors and changes in malaria receptivity. Monitoring the risk of importation contributes to mitigating its potential consequences. Any weakness of the system would prevent the prompt and timely response to changes in receptivity and risk of importation of the country territory, which may lead to the resumption of local transmission and possible epidemic outbreaks.

In 2023, Tajikistan was certified by WHO as malaria-free. Maintaining the status of a malaria-free country is an important condition for the development of economic and social programmes in the country. The re-establishment of malaria would create a threat to planning and implementing of major projects of international integration. Development of the tourist industry also depends on the favourable infectious and parasitic diseases situation in the country.

Introduction

The goal of the *Global technical strategy for malaria 2016–2030*, endorsed by the World Health Assembly in 2015 and updated in 2021 *(1)*, is to have a world free of malaria. The strategic targets for 2030 are eliminating malaria in at least 35 countries and preventing the re-establishment of malaria in all countries that are malaria-free. Globally, there is good progress towards malaria elimination in recent years *(2,3)*.

The countries of the World Health Organization (WHO) European Region achieved great success in fighting malaria during the WHO Global Malaria Eradication Programme launched in 1955. Local malaria transmission was interrupted in almost all countries of the region in the 1970s and 1980s *(4)*.

In the 1990s, malaria returned to some European countries. There were epidemics in Azerbaijan, Tajikistan and Türkiye, which expanded to Armenia, Georgia, Kyrgyzstan, Turkmenistan and Uzbekistan. Locally acquired cases of malaria were reported in Kazakhstan, the Russian Federation and some other countries. Malaria resurgence was due to various factors, including changes in political and economic conditions; post-Soviet economic collapse; military conflicts; mass migration; extensive development projects; degradation of public health systems; and the near or complete discontinuation of malaria prevention and control activities *(4–9)*.

The malaria-affected Member States of the WHO European Region joined the Roll Back Malaria initiative launched by the United Nations Children's Fund (UNICEF), the United Nations Development Programme (UNDP), WHO and the World Bank in 1998. They rapidly scaled up and sustained malaria control and surveillance, and achieved marked reductions in the levels of malaria transmission and morbidity. The success achieved brought about a transition from malaria control to malaria elimination programmes. In 2005, 10 countries of the region endorsed the *Tashkent Declaration: "The Move from Malaria Control to Elimination" in the WHO European Region (10)*.

In the following years, malaria-free status was certified by WHO in Turkmenistan (2010), Armenia (2011), Kyrgyzstan (2016), Uzbekistan (2018), Azerbaijan (2023) and Tajikistan (2023) *(11–17)*. The last indigenous case of *Plasmodium falciparum* malaria in the region was reported in 2008; *P. vivax* transmission was interrupted later, with no indigenous cases of *P. vivax* or other species reported in the region in 2015 *(16–17)*.

On 20 April 2016, the WHO Regional Director for Europe declared the region had achieved interruption of indigenous malaria transmission.

The countries of the region subsequently scaled up their activities to prevent malaria reintroduction, keeping a high level of malaria surveillance and response in accordance with their national programmes and plans, in line with the Regional framework for prevention of malaria reintroduction and certification of malaria elimination 2014–2020 *(16–18)*.

In 2017, the *Ashgabat Statement: Preventing the re-establishment of malaria transmission in the WHO European Region* was signed by 10 countries of the region that had experienced malaria resurgence followed by malaria elimination *(19)*.

P. vivax and *P. falciparum* malaria were historically widespread diseases in Tajikistan. An elimination programme (1946–1960) was launched, and local transmission had ceased by

1960, although single cases and outbreaks were registered at the border with Afghanistan in the following years and were successfully controlled *(4,8)*.

The number of imported and locally acquired cases increased during the military operations in Afghanistan in 1980–1989 followed by a large-scale malaria epidemic in 1993–1997 due to a mass importation of *P. vivax* and *P. falciparum* by Tajik refugees from malaria-endemic areas of Afghanistan. Transmission of both *P. vivax* and *P. falciparum* were re-established in Tajikistan *(4,8,9)*.

It was a long road to obtaining malaria elimination again, requiring huge efforts and funding for the implementation of malaria control and elimination programmes through scaling up antimalarial activities supported by the Global Fund and other international organizations. The epidemic was contained and by 2015 malaria was eliminated. In 2023, WHO certified Tajikistan as malaria-free *(15–17,20,21)*.

This publication describes analysis of malaria's resurgence in Tajikistan, and the strategies and approaches used to contain the epidemic, to achieve malaria elimination and ultimately to maintain malaria-free status. The best practices in epidemiological surveillance, vector control and entomological surveillance, as well as malaria prevention are highlighted and lessons learned distilled. Special attention is paid to the efficient prevention of re-establishment, including strategies and approaches that are typical of the region's countries that faced malaria resurgence.

Country background information

Geography, climate and vegetation

Tajikistan is a landlocked country in central Asia bordering in the north with Kyrgyzstan, in the east with China, in the south with Afghanistan, and in the north-west with Uzbekistan (Fig. 1), occupying a territory of 143 100 square kilometres (km^2). It is located between 36°40′ and 41°05′ N and 67°31′ and 75°14′ E. The territory by length (from west to east) is 700 km, and by width (from north to south) 350 km *(21).*

Fig. 1. Political map of Tajikistan

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

The vast majority of the country (93%) is mountainous and parts of some of the highest mountain ranges in the world are located in Tajikistan, including the Himalayan, Kunlun, Pamir and Tianshan ranges. The mountain ranges are cut by canyons and gorges with large rivers located in the valleys, where the majority of the population lives and works *(22)* (Fig. 2).

Fig. 2. Physical map of Tajikistan

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

Plains are common along the Amu Darya, Kafirnigan, Vakhsh, Pyanj and Yaksu rivers and their tributaries. The south-western part of Tajikistan is occupied by low, roughly north-south ridges and wide flat valleys located between them (e.g. Gissar, Vakhsh, Lower Kafirnigan, Kulyab, etc.). In this zone, there are many permanent and temporary water bodies that well heated by the sun and rich in organic matter and aquatic vegetation. There are also swampy lowlands with favourable conditions for mosquitoes' habitation and breeding. Part of the Fergana Valley, the most densely populated region in central Asia irrigated by the Syr Darya River in its upper course, spreads across northern Tajikistan.

In the sub-mountainous region (mostly districts of the Rasht Valley and Kulyab zone of Khatlon province) there is a belt of hills, forming a transitional strip from the plains to the ridges. Hills often form plateaus.

The landscapes of intermontane and foothill steppes are represented by slopes of ridges, saddles and rocky formations of peaks in southern Tajikistan *(21,22)*.

There are about 600 rivers in Tajikistan, and many temporary water streams are part of the largest central Asian river basins – Amu Darya and Syr Darya. The largest of the rivers are Amu Darya, Syr Darya, Vakhsh, Pyanj and Zeravshan. More than 2000 lakes are spread out mainly in mountains in the scenic gorges *(21)*.

The irrigation system of Tajikistan is divided into several systems by the geographical location of the major rivers. Tajikistan has over 756 000 hectares of productive land that is irrigated by natural gravity irrigation and by conditional irrigation via open-type and closed-type collector and 13 drainage systems. Irrigated land accounted for 5690 km^2 (2020) *(21, 23)*.

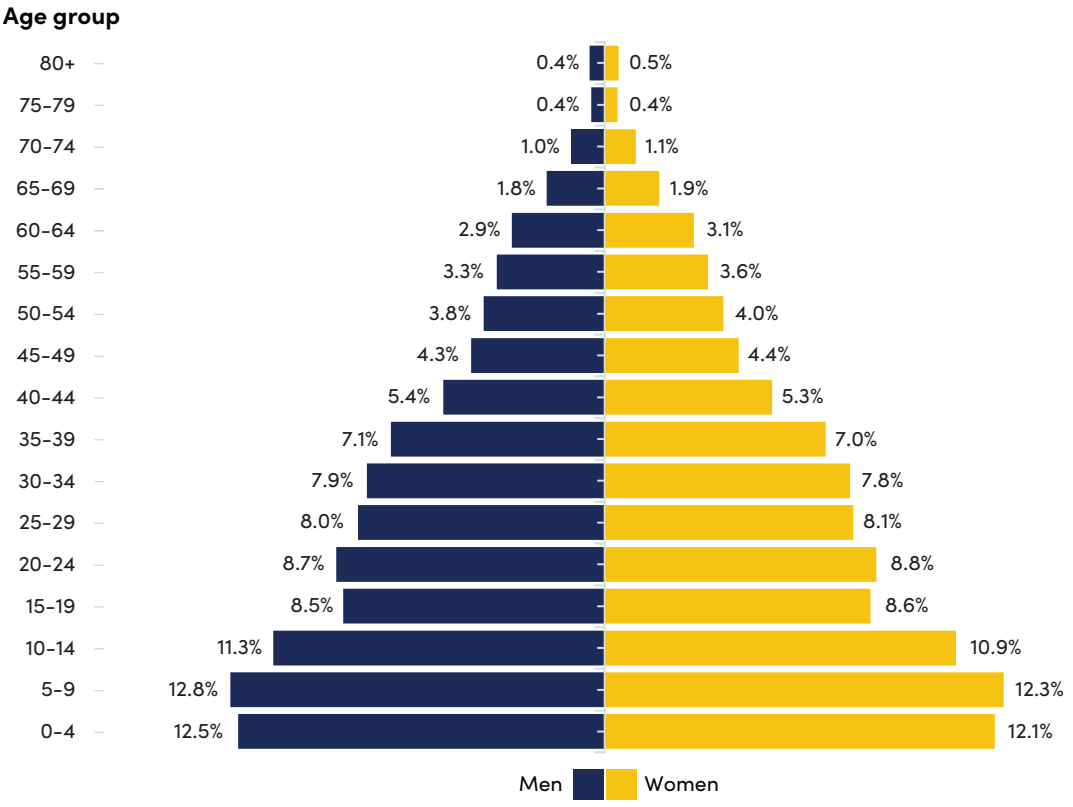
Tajikistan's climate is continental, subtropical and semi-arid, depending on elevation. Annual mean temperature is 17 °C in the south but -6 °C in the lower Pamirs. The hottest month is July when maximum surface air temperature may exceed 40 °C in the south; the coldest month is January with minimum temperatures below -50 °C in east Pamir. The annual precipitation can exceed 1800 mm, while in lowlands, hot deserts of northern Tajikistan and cold mountain deserts of east Pamir, it is 70–160 mm *(24)*.

Population and demography

The resident population of Tajikistan amounted to 10.1 million people in 2023 *(25)*. The age composition of the resident population is presented in Fig. 3. In 2021, the crude birth rate was 27 per 1000 people; life expectancy at birth was 72 years (males: 70 years, females: 74 years). Life expectancy has improved in recent years and is moderately higher than the Central Asia average; however, it lags behind the WHO European Region average. The annual population growth in 2022 was 2.1%; the proportion of urban population was 28% and of rural population 72% *(26)*. The share of the proportion of men and women was almost equal at 49.7% and 50.3%, respectively (*2021*) *(23)*.

The ethnic structure of the population is characterized by a predominance of Tajiks (84.3%), including Pamiri and Yagnobi, followed by Uzbeks (13.8%) and others (2%), including Kyrgyz, Russian, Turkmen, Tatar and Arab people) (*2014*) *(23)*.

Fig. 3. Tajikistan age population pyramid (2024)



Source: Electronic versions of publications (archive) *(27)*.

Note: 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.

Political organization and economy

Under its constitution, Tajikistan is a democratic state. The head of state is the President. The supreme representative body of the state is the bicameral parliament consisting of a Council of Representatives (the lower house) and a National Council (the upper house) *(28)*.

The Republic of Tajikistan consists of the city of republican significance Dushanbe (capital), the Gorno-Badakhshan Autonomous Oblast (GBAO), Sughd and Khatlon regions, 17 cities, 62 districts (including 13 districts of republican subordination), 55 settlements and 368 rural jamoats (rural communities) (Fig. 1) *(29)*.

Tajikistan is classified as a lower middle-income country. In 2021, the gross domestic product (GDP) was US$ 8.75 billion (a rising trend, compared to US$ 2.31 billion in 2005, US$ 5.64 billion in 2010 and US$ 8.27 billion in 2015) with an annual reported growth of 9.2%. The GDP per capita in 2021 was US$ 897 *(30)*.

Health care system, policies and health profile

Health system

The Ministry of Health and Social Protection of the Population (MoHSPP) is the central executive body of the Republic of Tajikistan that governs and manages health care and the health industry. The ministry is responsible for the development and implementation of unified state policy and regulation of legal norms in the health and social protection sector of the population in Tajikistan, including the public health system. It coordinates the activities of other ministries and departments, enterprises and organizations, regardless of their ownership form and departmental affiliation, as well as local executive authorities on issues falling under its competence *(31,32)*.

The comprehensive *National Health Strategy for 2010–2020* laid the foundations for fundamental health system reforms. It placed emphasis on improving access to services and bringing medical training and practice in line with international principles. The strategy also aimed to strengthen health promotion and disease prevention, step up measures to combat infectious diseases, prevent noncommunicable diseases, and support family medicine in primary care *(33)*. This strategy was upgraded and further developed by the *Strategy for protecting the health of the population of the Republic of Tajikistan, 2021–2030 (34)*.

Health services to the population including those for malaria are provided by a well-run network of health care facilities at all administrative levels (i.e. primary, intermediate – provincial and district, and central/republican) (Table 1) including:

- Republican level: Ministry of Health and Social Protection of the Population.
- Provincial (viloyat, oblast) and Dushanbe city level: health departments within province and Dushanbe city executive authorities.
- District (rayon) or city level: central, rayon or city hospitals, which also perform the functions of previously existing district or city health care departments.
- Primary (jamoat) level: commune/municipality peripheral primary health care.

Table 1. Health facilities in Tajikistan

Number of health facilities	2018	2019	2020
Total	4340	4372	4533
Primary health care	2848	2860	2890
Hospitals	490	494	526
Private sector	72	76	86
Rural	844	854	866
District health centres	54	54	54
City health centres	53	53	53

Source: (21).

Local government bodies at the provincial (viloyat/oblast) and city/district (rayon) levels are responsible for health service provision at respective levels. Generally, decentralization of policy-making from the national to the local government is limited.

Health care providers are mainly public. In urban areas, basic primary care is delivered by district or city health centres, and more complex or specialist care through either provincial or national hospitals. In rural areas, primary care is delivered through health houses, rural health centres and rural hospitals. The primary health care network includes 2890 facilities under the guidance of managers based at the district level.

The ratios of health workers to population are relatively low. In 2020, there were 213 physicians per 100 000 population compared with an average of 358 in the WHO European Region in 2019, and 617 nurses per 100 000 population compared with 741 in the WHO European Region and 876 in Central Asia overall (Table 2) *(21,32)*.

Table 2. Health staff in Tajikistan

	2018	2019	2020
Number of physicians	19 080	19 268	20 221
Physicians per 100 000 population	209	207	213
Number of nurses	53 982	55 584	58 614
Nurses per 100 000 population	591	597	617

Source: (21).

Service provision is fully managed via subnational health facilities such as health houses, rural health centres, city health centres and district-level family medicine centres; however, vertical services are also operated from the national level to the district level through specialized structures *(32)*.

A basic benefit package of publicly paid health services focused on essential primary and emergency care was first introduced in 2005 and revised in 2007; it covers 31 of 65 districts of the country. In the remaining districts, where the package has not yet been introduced, health services are provided under a similar programme but with 80% co-payments or fees for services. Out-of-pocket payments are common for patients. The introduction of a mandatory health insurance system has been envisaged for many years but, as yet, has not been realized.

The central government is the main public health funder in Tajikistan. Public spending on health has been traditionally one of the lowest in the region, but has increased from 0.9% GDP in 2000 to 1.9% in 2019, matching the Central Asian average, although the large role of private out-of-pocket payments should be also considered. Tajikistan's health expenditure per capita is the lowest in the WHO European Region, amounting to US$ 251 per capita in 2019, less than half the Central Asian average (US$ 552) and less than a tenth of the average of the WHO European Region (US$ 3226) *(32)*.

Malaria network

The MoHSPP has been the central body responsible for health care including malaria.

Following the establishment of the first malaria station in Dushanbe in 1928, and after the formation of the Tajik Soviet Socialist Republic (SSR) (*1929*), a network of medical institutions, including those focused on malaria, began to grow rapidly. The Sanitary and Epidemiological Service (SES) was established in 1930 *(33)*. The malaria station was transformed into the Institute of Tropical Diseases (*1931*) (later renamed as the Institute of Malaria and Medical Parasitology) that played a leading role in malaria control. Under the Institute of Tropical Diseases, tropical stations were established in malaria-affected

areas, for example in Gissar, Farkhor, Pyanj, Moscow and other districts, which were engaged in conducting research, and taking preventive and anti-epidemic measures.

Following this, tropical stations in the provinces were closed and their functions were assigned to the parasitology departments of the SES established in the provinces and districts, which were responsible for carrying out preventive and control activities against malaria and other parasitic diseases in the Republic.

During the first malaria elimination campaign (1950–1960) in Tajikistan, the key structures were part of SES, and were responsible for planning, organization and implementation of antimalaria interventions. Antimalaria activities were carried out jointly with the basic health services and with the participation of municipalities and community members. They jointly conducted capacity building, large-scale indoor residual spraying (IRS), supported by anti-larval measures, case detection and treatment and selective mass drug administration. Laboratory support by a network of reference parasitological laboratories at the central and provincial levels, and primary laboratories, ensured timely detection and treatment of cases. With the assistance of the Ministry of Health of the Union of Soviet Socialist Republics (USSR), particularly the Moscow Institute of Malaria and Medical Parasitology, in 1954, the Republic started the implementation of complete malaria elimination *(21,20)*.

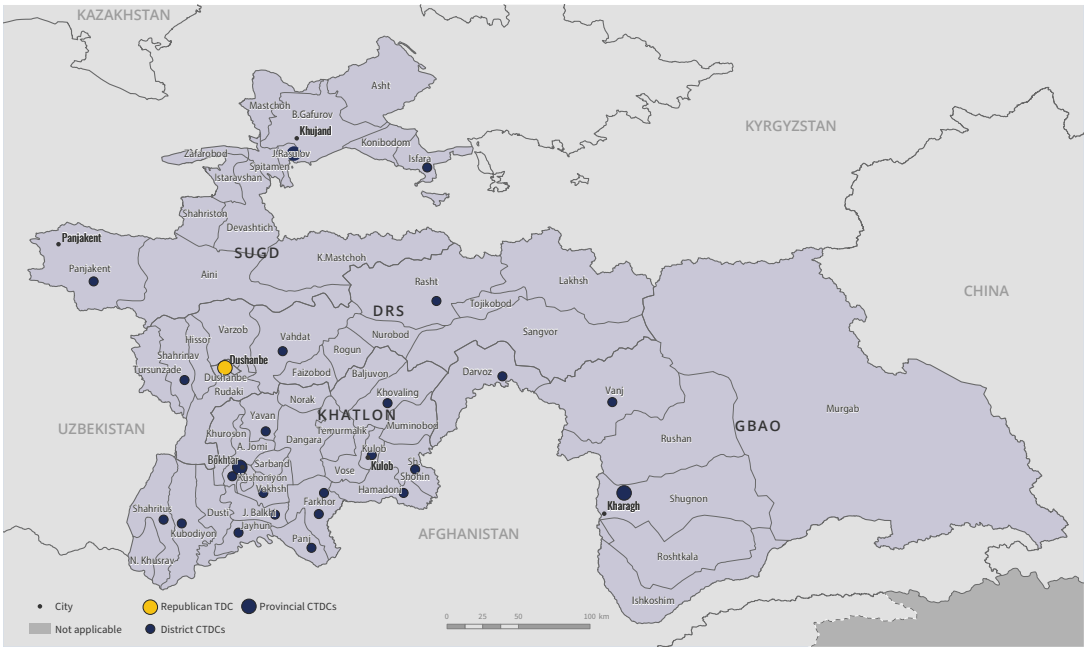
After the resumption of local malaria transmission, the Republican Tropical Diseases Center (RTDC) was established in 1997, founded on the parasitological department of the SES, together with the Centres for Tropical Diseases Control (CTDCs) in other provinces and districts that were more affected by tropical diseases including malaria. A total of 25 CTDCs have been organized in the Republic: one centrally, three provincially and 21 in district centres (Fig. 4).

Of the countries of Central Asia that have faced resumption of malaria transmission in the 1990s, CTDCs have been established only in Tajikistan. Other countries managed to cope with this problem by the leading role of SES. However, the magnitude of malaria epidemic in Tajikistan (29 794 officially reported cases in 1997 but according to some experts there were more than 200 000 cases *(12)*), the re-establishment of local *P. falciparum* transmission and distribution of malaria all over the country prompted the government to establish special structures at the national level and in most affected areas at the subnational level assigning them a leading and coordinating role in the fight against malaria. The results obtained – containment of the explosive malaria epidemic and interruption of local malaria transmission – are proof of the efficiency in malaria control and elimination of these structures. The CTDCs are still functioning today (with the exception of the Isfara CTDC, which was closed), and are engaged in prevention of re-establishment of malaria.

The malaria control and elimination programme in Tajikistan was coordinated and conducted by the RTDC and the Centre of State Sanitary and Epidemiological Surveillance Service (CSSES) under the Department of Sanitary and Epidemiological Safety of Emergencies and Emergency Medical Assistance (Fig. 4).

There was a close collaboration in managing the malaria programme during elimination. CTDCs planned and coordinated all activities of the specialized and general health facilities at various administrative levels; in areas where CTDCs did not exist, antimalarial interventions were entrusted to the parasitology departments of CSSES. Guided by the epidemiological surveillance of CTDCs, case management, vector control and surveillance were strengthened during the period of elimination, together with the involvement of communities.

Fig. 4. Centres for Tropical Diseases Control in Tajikistan



Source: RTDC.

After the interruption of local transmission, the health structures engaged in malaria activities were maintained, and malaria prevention remains closely related to the control and prevention of tropical and parasitic diseases. The RTDC continued to be responsible for the prevention of tropical diseases, including malaria, and CSSES continued to be responsible for infectious and parasitic diseases, also encompassing malaria.

The responsibilities and functions of the health structures engaged in the malaria programme during elimination and prevention of re-establishment of local transmission are presented in Box 1 and Fig. 5.

Box 1. Responsibilities and functions of the health structures engaged in the malaria programme during elimination and prevention of re-establishment of local transmission

National level: The Republican Tropical Diseases Center (RTDC) was responsible for malaria control and surveillance, and acted as the national coordinator of the malaria elimination campaign. Presently, the RTDC, the national executive body authorized to perform the surveillance of tropical diseases, including malaria, is jointly responsible – together with CSSES – for coordination, technical guidance, planning, implementation and monitoring and evaluation of the programme for the prevention of re-establishment of malaria transmission in Tajikistan. These central structures have branches at the subnational level (Fig. 5).

Provincial level: the Provincial Centres for Tropical Diseases Control (CTDC), and the Provincial State Sanitary and Epidemiological Surveillance Services (CSSES) in Khatlon, Sugdh and GBAO, have overall responsibility for all malaria-related activities in respective provinces. This includes planning, monitoring and control, external quality assurance (EQA) of laboratory diagnosis, data collection and analysis, evaluation and distribution of information, provision of technical support in epidemic situations, health education of the population and staff training, and maintenance of malaria databases, etc.

District/city level: District CTDCs and district CSSES are responsible for equivalent malaria prevention activities as the provincial structures, but at the level of each district/city. For example, they conduct early detection and epidemiological investigation of malaria cases and foci, and manage response interventions including vector control activities, entomological surveillance, foci monitoring and maintenance of district malaria databases. The parasitology departments of district CSSES play a key role in malaria activities.

Some districts in provinces of central subordination are also under the direct oversight of the RTDC and CSSES.

The same public health structures that were engaged during malaria control and elimination are now responsible for conducting prevention of re-establishment activities, as part of their broader responsibility for control and prevention of parasitic and tropical diseases.

Some malaria prevention activities have been integrated with the interventions of other programmes. For example, malaria vector control and entomological surveillance have been integrated with the comprehensive environment-friendly vector control programme for vector-borne diseases in Tajikistan for 2016–2020, covering sandflies transmitting leishmaniasis, ticks transmitting relapsing fever (an endemic disease in Tajikistan), as well as ticks transmitting Congo–Crimean haemorrhagic fever.

The general health services that played a crucial role in malaria elimination – as well as other relevant ministries and organizations, national public health institutes, research institutes and academic institutions – are also involved in activities focused on the prevention of malaria re-establishment.

Primary health care: Health houses, rural health centres, city health centres and district-level family medicine centres, etc. are responsible for malaria case detection (active and passive), laboratory diagnosis, registration and notification, follow up of patients and travellers, health education of the population on the prevention of malaria, etc.

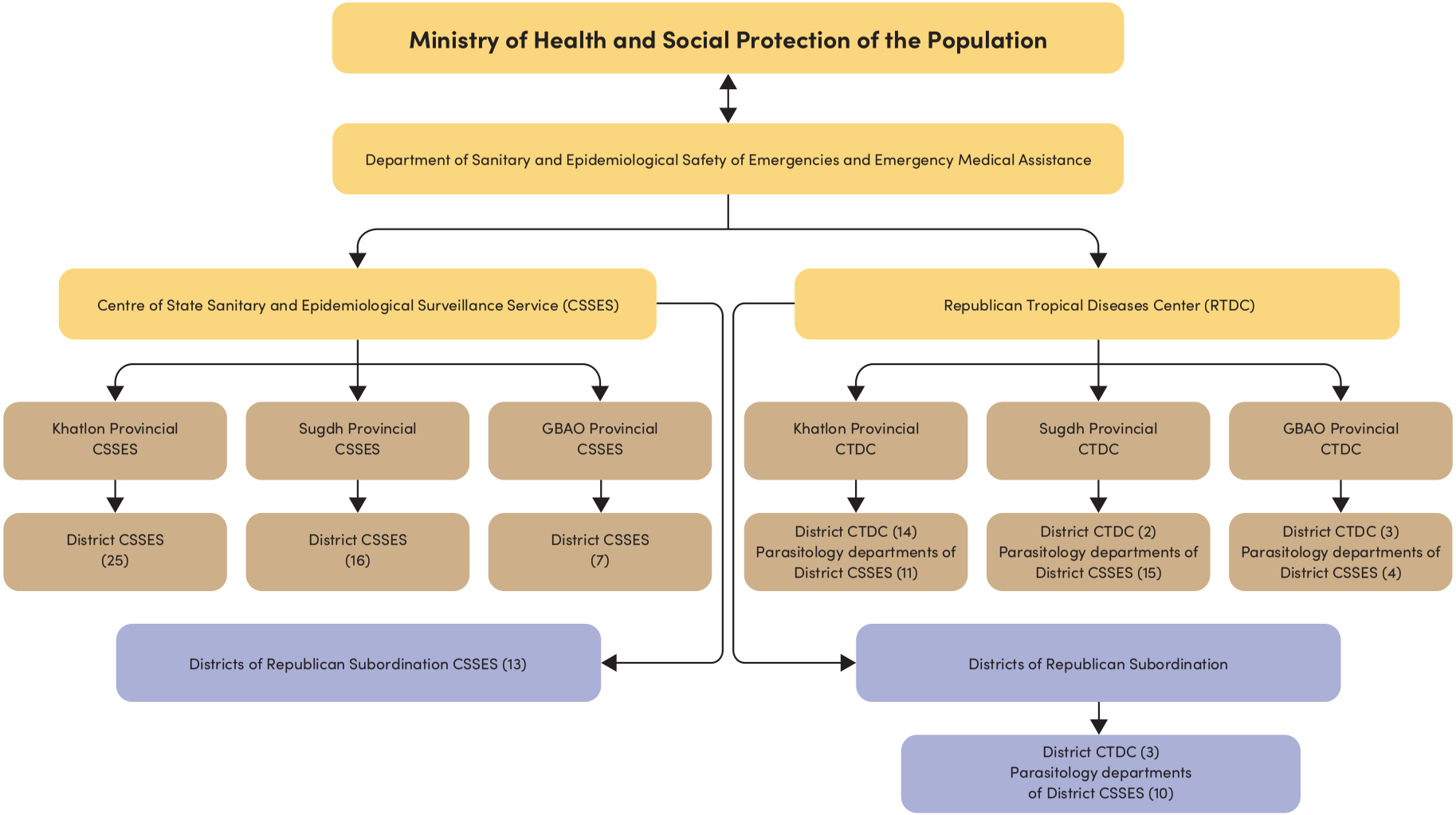
Hospitals: Central, rayon or city hospitals conduct passive case detection (PCD), laboratory diagnosis, registration and notification.

Infectious disease hospitals/wards: Conduct PCD, laboratory diagnosis, registration and notification, hospitalization of malaria patients and treatment.

Private health care facilities: Carry out PCD, laboratory diagnosis, registration and notification.

Mobile teams: Composed of an epidemiologist, parasitologist, laboratory specialist, clinician and entomologist, and are assigned to affected areas that substantially facilitated the malaria activities.

Fig. 5. Organization of structures engaged in antimalaria activities



Human resources of the malaria network

For over 25 years since the resurgence of local transmission, numerous experts from both specialized and general health networks have actively contributed to malaria control and elimination efforts. The MoHSPP has made efforts to ensure full staffing of CTDCs and SES. Recognizing the key role of staff expertise in malaria control, the National Malaria Control Programme (NMCP) strengthened staff capacity in laboratory diagnosis, disease management, surveillance, vector control and entomological surveillance and prevention. The NMCP conducted continuous education of CTDCs and SES personnel and other specialists, both in the country (through national and subnational trainings) and abroad.

Mobile teams composed of epidemiologists, parasitologists, laboratory specialists, clinicians and entomologists were assigned to the affected areas to facilitate antimalarial activities.

The health staff engaged in malaria elimination, although with some reduction, is now focused on prevention of re-establishment of malaria transmission.

After malaria elimination, however, many specialists unfortunately left the malaria network, and the programme is now challenged by a shortage of staff in some areas of work, where there are unoccupied positions of epidemiologists, parasitologists and entomologists (Table 3). The staffing allocation included 88.5 full-time equivalent (FTE) positions for epidemiologists and assistant epidemiologists out of a total of 115 FTEs in CSSES and CTDCs. Parasitologists and assistant parasitologists accounted for 136 FTEs out of 207, while entomologists and assistant entomologists comprised 67 FTEs out of 105.25. Of the 49 positions for entomology assistants, only 30 are currently occupied. Laboratory diagnosis of malaria is provided by 255 laboratory staff, 85 (33.3%) of which are based in CTDCs and CSSES, 66 (25.9%) in hospitals, 89 (34.9%) in clinics, and 15 (5.9%) in other medical institutions. The laboratory staff positions are fully occupied. Maintaining the expertise is ensured by training of newly appointed staff and re-training of the existing personnel.

Table 3. Malaria staff (positions according to the staffing table/occupied positions) at central and subnational levels, 2021

Administrative unit	Epidemiologists and assistant epidemiologists	Parasitologists and assistant parasitologists	Laboratory staff[a]		Entomologists	Assistant entomologists
			CSSES and CTDCs[b]	Hospitals, clinics, etc.[b]		
RTDC	0	12/8.5	-	-	4/4	2/0
Dushanbe city	6/4.5	5/4	4	36	2/2	2/2
Khatlon	29/17.5	91/44.5	36	53	20.75/15	21.5/15.5
Sugdh	43/39.5	33.5/29	17	53	11/7	10.5/4.5
GBAO	17/9	33.5/29	10	-	5/4.5	5/5
DRS	20/18	32/21	12	8	13.5/4.5	8/3
Total	115/88.5	207/136	85	170	56.25/37	49/30

[a] Laboratory physicians and technicians.

[b] All positions are occupied.

Source: RTDC.

General health profile

In Tajikistan, in 2016–2020, there was a small decreasing trend in the birth rate (26.6 per 1000 population in 2016 and 25.8 per 1000 population in 2020) and of the natural population growth (22.3 in 2016 and 21.7 in 2020) (Table 4) *(21)*.

Life expectancy at birth (years) in Tajikistan has improved by 6.2 years, from 65.6 years in 2000 to 71.8 years in 2021 *(36)*. This should be compared with worldwide life expectancy, which improved by 4.6 years: from 66.8 years in 2000 to 71.8 years in 2021 *(36)*.

Top causes of death for females (per 100 000 population) in 2021 were: ischaemic heart disease (90.2); stroke (53.8); COVID-19 (52.6); lower respiratory infections (20.4); preterm birth complications (16.2); hypertensive heart disease (12.6); congenital anomalies (11.4); cirrhosis of the liver (11.3); chronic obstructive pulmonary disease (10); stomach cancer (9.2). And for males were: ischaemic heart disease (79.6); COVID-19 (66.7); stroke (41); lower respiratory infections (26.8); preterm birth complications (23.4); road injury (21.9); congenital anomalies (16.2); cirrhosis of the liver (13.3); stomach cancer (12.5); chronic obstructive pulmonary disease (10.3) *(36)*.

In 2021 57% of all death were caused by the noncommunicable diseases, 31% by communicable diseases, 7% by road injuries and 4% by other COVID-19 pandemic-related outcomes. Ischaemic heart disease was the top cause of death in both 2000 and 2021. COVID-19 was responsible for most of deaths in the communicable disease category in 2021 *(36)*.

The health care-seeking incidence rate (per 100 000) was higher among patients with respiratory system diseases, alimentary diseases, urogenital diseases, haematological diseases, etc. (Table 4) *(21)*.

Table 4. Basic health indicators, 2016–2020

Indicator	2016	2017	2018	2018	2019	2020
Birth rate (per 1000 population)	26.6	25.4	25.6	25.6	25.4	25.8
Death rate (per 1000 population)	3.9	3.6	3.6	3.6	3.6	4.5
Natural population growth	22.7	21.8	22.0	22.0	21.8	21.3
Children under 1 year mortality rate (per 1000 live births)	15.8	13.3	14.3	14.3	14.8	13.7
Health care-seeking incidence rate (per 100 000)	19 500.7	20 498.9	19 117.1	18 547.2	16 739.6	16 739.6
Endocrine diseases (per 100 000 population)	641.2	641.6	671.7	643.1	644.5	644.5
Respiratory system diseases (per 100 000 population	4874.5	5188.8	4657.2	4556.9	4624.8	4624.8
Urogenital diseases	1771.7	1899.7	1766.8	1720.6	1372.8	1372.8
Injuries and poisoning (per 100 000 population)	771.3	720.4	567.5	620.1	528.2	528.2
Oncological diseases (per 100 000 population)	35.9	35.0	34.6	40.0	31.6	31.6

Source: National report on malaria elimination in Tajikistan, 2022 *(21)*.

History of malaria

Malaria parasites and vectors

Two malaria species have been previously reported in Tajikistan: *Plasmodium vivax* and *P. falciparum.*

From 1961 to 1994, *P. vivax* was the only malaria parasite known to be transmitted in the country. Local transmission of *P. falciparum* was re-established in 1994 and interrupted by 2010. *P. vivax* malaria was eliminated in 2015.

In Tajikistan, malaria mosquito vectors include nine species:

Anopheles (Anopheles) algeriensis
An. (An.) barianensis
An. (An.) claviger
An. (An.) hyrcanus
An. (An.) lindesayi
An. (An.) marteri sogdianus
An. (An.) artemievi
An. (Cellia) pulcherrimus
An. (Cellia) superpictus.

Two species of the *Cellia* subgenus (*An. superpictus* and *An. pulcherrimus)* are significant vectors that are common in subtropical areas and in the most torrid regions of the temperate zone (Fig. 6). Studies conducted over an extended period indicated that the populations of *An. superpictus* and *An. pulcherrimus* remained susceptible to alphacypermethrin, cyfluthrin, lambda-cyhalothrin, deltamethrin and malathion, and there was no progressive decrease in vector sensitivity to the insecticides in use *(21).*

An. superpictus is common across the entire country (Fig. 6). It is distributed up to the altitude of 2800 m above sea level, frequently found in mountainous areas and in places where rivers (gullies) outflow to lowlands. The preferred breeding sites are small water bodies with pebble floors, riverbeds of mountain streams with still or slowly running water, accumulated water under the rocks, usually with high calcium salts concentrations. *An. superpictus* can breed in rice fields if these are irrigated with water rich in calcium salts. This species is thermophilic with optimal temperature of 30–35 °C for its larvae. The population typically increases after mid-summer and stays high in September. This species is endophilic and endophagic: mosquitoes attack people primarily indoors. They are able to fly large distances for feeding, and hibernate for winter indoors, in warm premises, with blood meals throughout the entire diapause. In Tajikistan, *An. superpictus* is the main and highly effective malaria vector, particularly for *P. falciparum.*

An. pulcherrimus is present in Tajikistan's plains and lowlands where advanced rice planting occurs (Fig. 6). Larval development occurs in still water bodies with thick vegetation, and rice paddies are particularly favourable. Optimal temperature is +30 °C. Larvae are resistant to nitrous pollution and can develop in saline water. Mosquito imagoes are adapted to live in the hottest arid areas. They are semi-exophilic.

Common daytime rest sites include livestock sheds, open barns, clay fences, bushes, grass, dry ditches, and pits. Female mosquitoes do not avoid direct sunlight and often

sit in sunlit places. They are concentrated in settlements. In search of meal, female mosquitoes are capable of long-distance flights. Mosquito populations peak in July, with a second possible peak in September. They hibernate during the larval stage.

The following five species fall into the *Anopheles* subgenus and have varying significance in malaria transmission.

An. artemievi. Until the 1970s, this was believed to be the most widespread species in southern Europe, western Asia and the Caucasus – *An. sacharovi* was common in northern Tajikistan. Later publications showed that Leninabad (now Sughd) region of Tajikistan was inhabited by *An. martinius* – the central Asian sibling species of *An. sacharovi*. However, cytogenetic analysis showed that only *An. maculipennis s. s.* was found in Sugdh region. Subsequently, a new species – *An. artemievi*, homosequent to *An. maculipennis s. s.* but identifiable by its molecular genetic markers and egg exochorion – was described *(37). An. artemievi* is considered to be a sibling species of *An. martinius* (which is not found in Tajikistan, according to recent studies), from which it is practically indistinguishable by the appearance of imagoes, larvae and the structure of the outer surface of eggs. *An. artemievi* is found in many areas of northern Tajikistan but not in the south of the Turkestan Range (Fig. 7). The larvae develop in well-warmed water bodies with temperatures up to 38– 40 °C – in puddles, ditches, swamps and rice paddies. It is referred to as a 'minor' vector in northern Tajikistan.

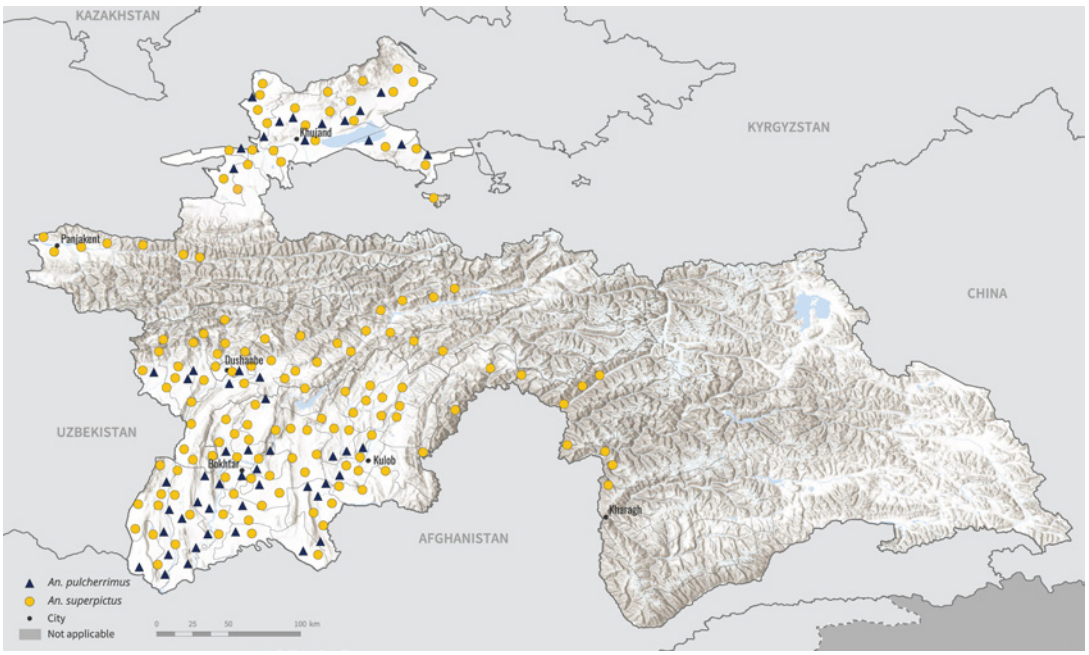
An. claviger is a widespread species in Tajikistan (Fig. 7). The larvae develop in cold spring water bodies fed by groundwater. The optimal water temperature is 14–16 °C. The number of larvae is often significant, especially in mountainous areas, but decreases greatly during the hot season. Adult mosquitoes are hydrophilic and exophilic, daytime rest sites are mainly humid cool places in vegetation. It attacks mainly outdoors and waits for its prey near the breeding sites. Despite its large distribution, it rarely plays an important role in malaria transmission because the adult mosquitoes do not fly far from their breeding sites, and their population significantly drops during the hottest time, the most significant period for malaria transmission. However, if their favourable breeding sites are located near dwellings, mosquitoes of this species are capable of intensive transmission. In Tajikistan, the largest population of this species was found in the vicinity of Dushanbe, as well as in Varzob, Nurek, Rushan and Vanj districts.

An. hyrcanus is found throughout southern Europe, in the Transcaucasia and in central Asia. In Tajikistan, fairly large populations are found in plains areas. The larvae develop at an optimal temperature of 25–30 °C. Female mosquitoes attack humans indoors and outdoors. Daytime rest places are usually grass, bushes, banks of irrigation canals, and mudbrick fences, and winter hibernation sites are natural shelters – such as cracks in the ground, reed beds and bushes. This species is considered a minor vector due to its meal preference for wild animals, exophilic nature and lower susceptibility to infection with malaria pathogens.

An. algeriensis is a rare species. Adult mosquitoes stay in reed thickets, single individuals of this species have been found in southern Tajikistan in the Tigrovaya Balka nature reserve. It very rarely comes into contact with people and has no epidemiological significance in Tajikistan.

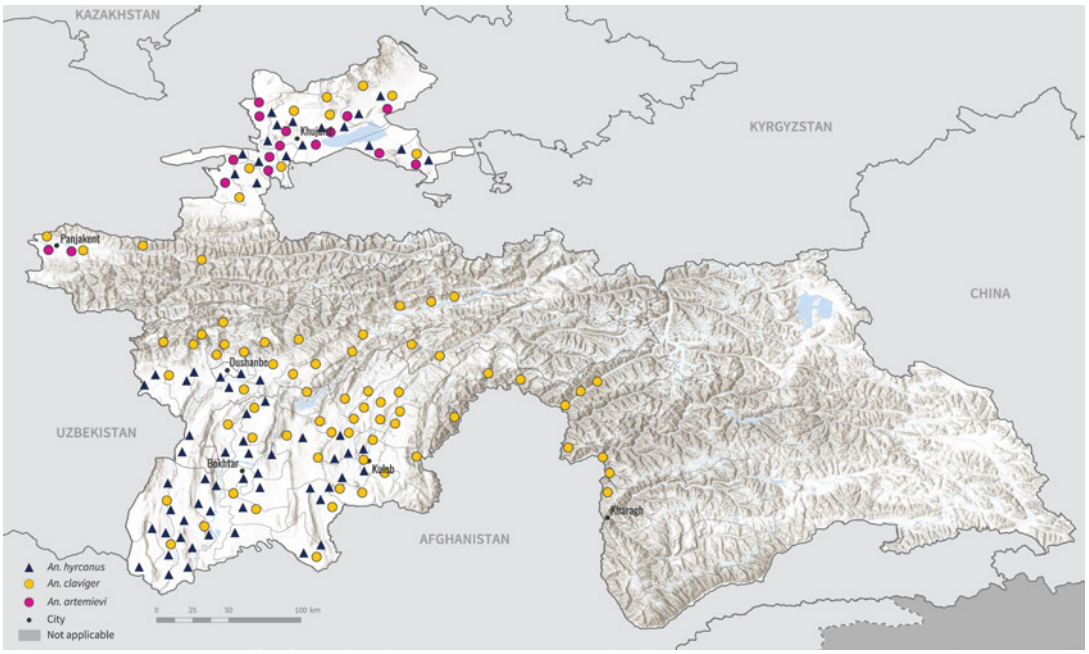
An. barianensis was previously found only in Varzob and in the gorges of the Gissar region at an altitude of 1300 m above sea level. The presence of this species in the Kamarob gorge of the Rasht region was also discovered in the Sayyod tract at an altitude of 1465 m above sea level. Larvae (but no imagoes) have been found in water accumulated in walnut tree hollows. This species has no epidemiological significance in the transmission of malaria *(21,38).*

Fig. 6. Geographical distribution of *An. superpictus* and *An. pulcherrimus* mosquitoes in Tajikistan



Source: National report on malaria elimination in Tajikistan, 2022 *(21)*.

Fig. 7. Geographical distribution of *An. claviger, An. hyrcanus* and *An. artemievi* mosquitoes in Tajikistan



Source: National report on malaria elimination in Tajikistan, 2022 *(21)*.

Malaria in the past

Historically, malaria has been a widespread disease in Tajikistan, with considerable negative influences on the social and economic development of the country up to the mid-20th century. Studies in 1925–1926 showed that all the country's lowlands populations were affected by *vivax* and *falciparum* malaria with a high fatality rate of the latter. Central Tajikistan and Gissar valley were greatly affected *(21)*.

The following main stages and periods may be defined in the process of controlling and eliminating malaria (Fig. 8):

Control of malaria (1928–1945)

Setting up of antimalaria network, launch and implementation of malaria control activities (1928–1940)

In 1928, a malaria station was established in Dushanbe and a special parasitological mission lead by specialists from Moscow, Russian Federation, conducted first studies on malaria and its vectors. Following the foundation of the Tajik Soviet Socialistic Republic in 1929, an intensive development of network of health care facilities – including some focused specifically on malaria– was started, including establishment of the Tropical Diseases Institute in 1931. In 1930–1940, the malaria services were established and improved detection and diagnosis of malaria cases brought about the registration of a high number of cases – around 200 000 cases every year (e.g. 176 125 cases in 1932)[1] (Fig. 8). In 1934, the NMCP was launched, which focused on limiting the source of infection through administration of quinine to patients, vector control by reducing the *Anopheles* breeding habitats (e.g. drainage of swampy lands and their adaption to cotton plantations, and rebuilding of the irrigation network), larval control by distribution of larvivorus fish (*Gambusia affinis)* in water bodies (the latter started in 1934), as well as health education of communities on malaria protection. These activities resulted in some decrease in the annual number of malaria cases by 1940 (80 000 cases according to the archives of the NMCP) *(21)*.

Malaria during the Second World War (1941–1945)

A rise in malaria burden (to around 90 000 cases in 1941) occurred during the war due to the difficulties that the country and malaria network faced, such as increased migration with movement of evacuated population from the western parts of the former Soviet Union to Tajikistan, worsened provision of medicines, decreased intensity of antimalaria interventions, etc. However, the country tried to control malaria outbreaks and prevent further drastic increases in malaria burden, and towards the end of this period an insignificant increase in reported cases was observed (to around 100 000 cases in 1945) *(8,21)*.

Large-scale antimalaria campaign aiming at malaria eradication (elimination) (1946–1960)

In the post-war years, extensive and complex measures were launched to control and eliminate malaria in Tajikistan. In the 1950s – during the period of the during early phase of the WHO Global Malaria Eradication Programme – the Tajikistan NMCP was part of the National Malaria Eradication Programme of the USSR.

A major intervention at the time was the wide use of powerful insecticides such as dichlorodiphenyltrichloroethane (DDT) and hexachlorane. Indoor spraying with DDT, the

[1] Case data by years provided by the RTDC.

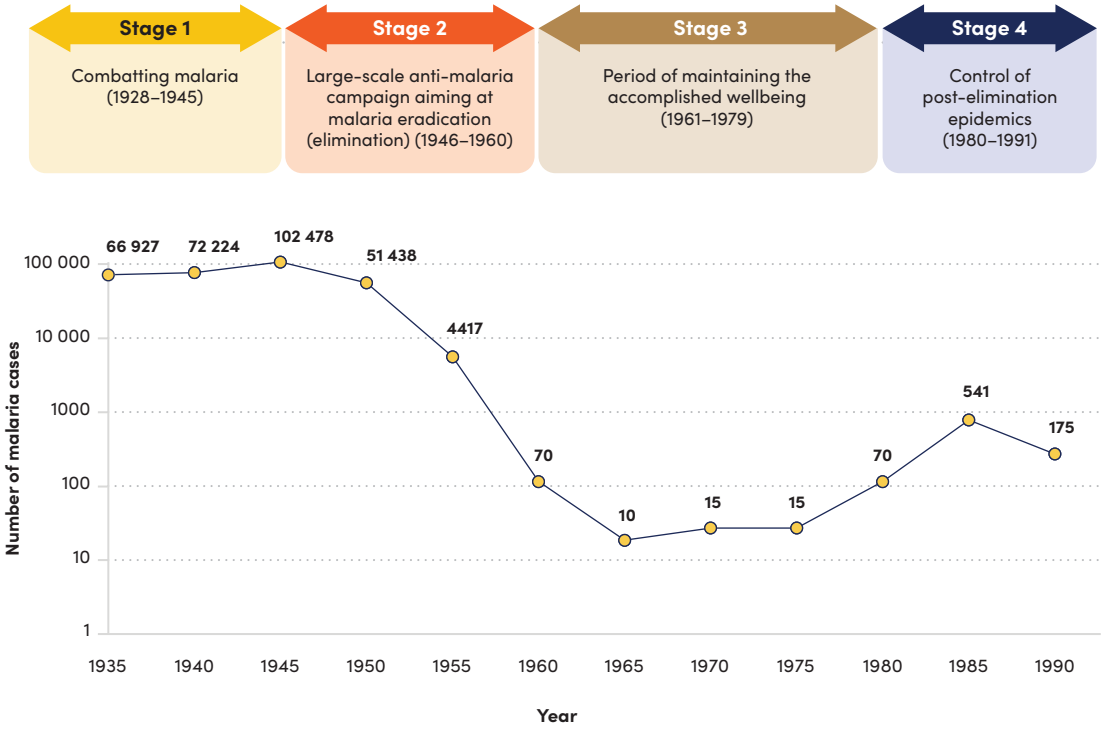
application of *Gambusia affinis* larvivorous fish in mosquito breeding sites, as well as environmental management, were used for vector control *(4,20,21).*

Case management and surveillance were also strengthened. Active case detection, case registration and follow up, and foci management were made a high priority. Radical treatment for people with *P. vivax* infection included blood schizontocidal and tissue schizontocidal (anti-relapse) medicines such as acrichine, plasmocid and bigumal. Malaria control also benefited much from the appointment of sanitary workers in villages, who responsible for distribution of malaria (and other) medicines to patients.

These activities contributed to the decrease of malaria incidence and limited the spread of infection. The number of reported malaria cases gradually but steadily fell to around 50 000 in 1950, 8000 in 1955, and 70 in 1960 (Fig. 8). By the end of the 1950s the malaria burden was drastically decreased in Sugdh province, for example, and in many districts in southern Tajikistan.

By 1960, malaria was no longer considered a public health concern in the country, despite isolated cases still being reported in border areas with Afghanistan *(4,21).*

Fig. 8. Stages of malaria control and elimination in Tajikistan, 1935–1991



Sources: Lysenko AY et al. Malariology. WHO; 2003 *(8)* and RCDTD.

Maintaining malaria declines (1961–1979)

In 1961–1979, the malaria situation was stable in the country, except for the border area with Afghanistan where isolated *P. vivax* cases and some outbreaks were reported that were thought to be related to the infected mosquitoes entering from the neighbouring endemic country. Malaria outbreaks did occur in the 1970s, and the number of annually reported malaria cases varied from seven (in both 1973 and 1974) to 103 (in 1978). Between 1963 and 1979, malaria cases were detected in roughly 25 settlements in seven out of eight districts bordering Afghanistan (i.e. situated within 3 km of the border rivers of Pyanj and Amu Darya). It was feasible that infected mosquitoes could fly across such river boundaries. In 1971–1972, an outbreak of vivax malaria (40 reported cases) occurred in the

village of Kevron, and in 1978–1979 in the city of Kulyab (102 reported cases). Maintaining malaria declines that has been achieved was largely dependent on the malaria situation in Afghanistan, and containing outbreaks and preventing malaria distribution. This was achieved by conducting indoor insecticide spraying, use of larvivorous fish (*G. affinis*), seasonal chloroquine chemoprophylaxis and mass primaquine preventive treatment in settlements near the border with Afghanistan and where malaria cases were detected *(4,8,21).*

Control of post-elimination epidemics (1980–2009)

During the 1980s, sporadic detection of malaria cases continued in Tajik villages along the border with Afghanistan, particularly within the mosquito flying range over the boundary Pyanj River from the neighbouring Afghan malaria foci. The epidemiological situation worsened with Soviet military operations in Afghanistan in 1980–1989 and also following the subsequent withdrawal of troops from Afghanistan. Malaria incidence progressively increased in Tajikistan – 70 locally acquired *P. vivax* cases were registered in 1980, 122 in 1981, and a peak of 571 cases was reached in 1984 (Fig. 9). Most of the cases were registered in the districts bordering Afghanistan (e.g. Kulyab, Moskovsky, Pyanj, Parkhor and Vosey) and a total of 54 settlements were affected by 1982. The rising trend continued until 1985.

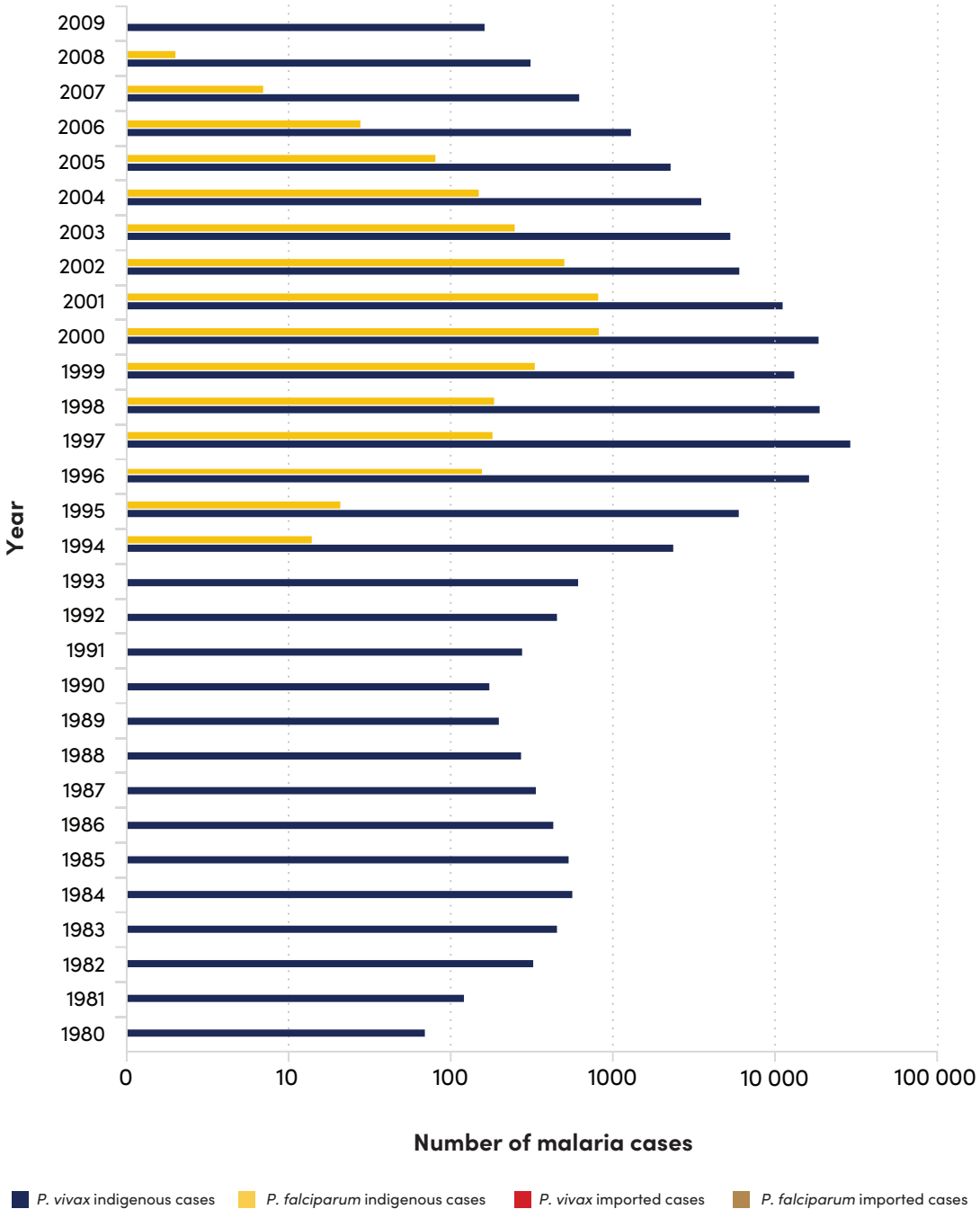
Use of indoor residual spraying, intensive case detection, mass drug administration, training of local medical staff and health education of the population led to a progressive reduction in malaria incidence until 1990 (when 175 cases were reported).

The epidemiological situation deteriorated soon after Tajikistan gained independence in 1991, partly due to armed conflicts and civil war, the disrupted public health system and interruption of antimalaria interventions. In 1993, an influx of returning Tajik refugees – who had migrated from the country during the civil war to Afghanistan – resulted in mass importation of *P. vivax* and *P. falciparum* malaria to receptive areas of Kurgan-Tyube. It was followed by large-scale malaria epidemics during 1993–1997 with an explosive rise in the number of officially reported *P. vivax* cases: 619 in 1993, 2410 in 1994, 6103 in 1995, and the peak of the epidemic with 29 794 cases in 1997 (Fig. 9). However, given the limitations of the surveillance system it was estimated that the real number at the time was potentially over 200 000 cases.

The first 35 locally acquired cases of *P. falciparum* appear to have been detected in 1994–1995 in 10 new active malaria foci in Darvaz district bordering Afghanistan. *P. falciparum* malaria also spread to 29 other districts and three cities (i.e. Dushanbe, Kulyab and Kurgan-Tyube), with a peak of 831 cases in 2000 and 826 cases in 2001 (Fig. 9). *P. falciparum* malaria foci were mostly detected in Bokhtar, Pyanj, Sarband and Vakhsh districts, where it constituted about 5% of total malaria cases. Tajikistan was the only country in the WHO European region that reported a resurgence of indigenous *P. falciparum* malaria.

The health system did not respond adequately to the increased risk of importation and of locally acquired malaria, and the malaria epidemic consequently affected almost all cities and districts of the country *(4–9,16,17,20,21,39–41).*

Fig. 9. Indigenous and imported malaria cases in Tajikistan (*P. vivax* and *P. falciparum*), 1980–2021



Source: RTDC.

In response to the worsening and complex situation, the National Programme for Control of Tropical Diseases (malaria) was developed with the technical assistance of WHO, and implemented in the country from 1997 to 2005 (*42*).

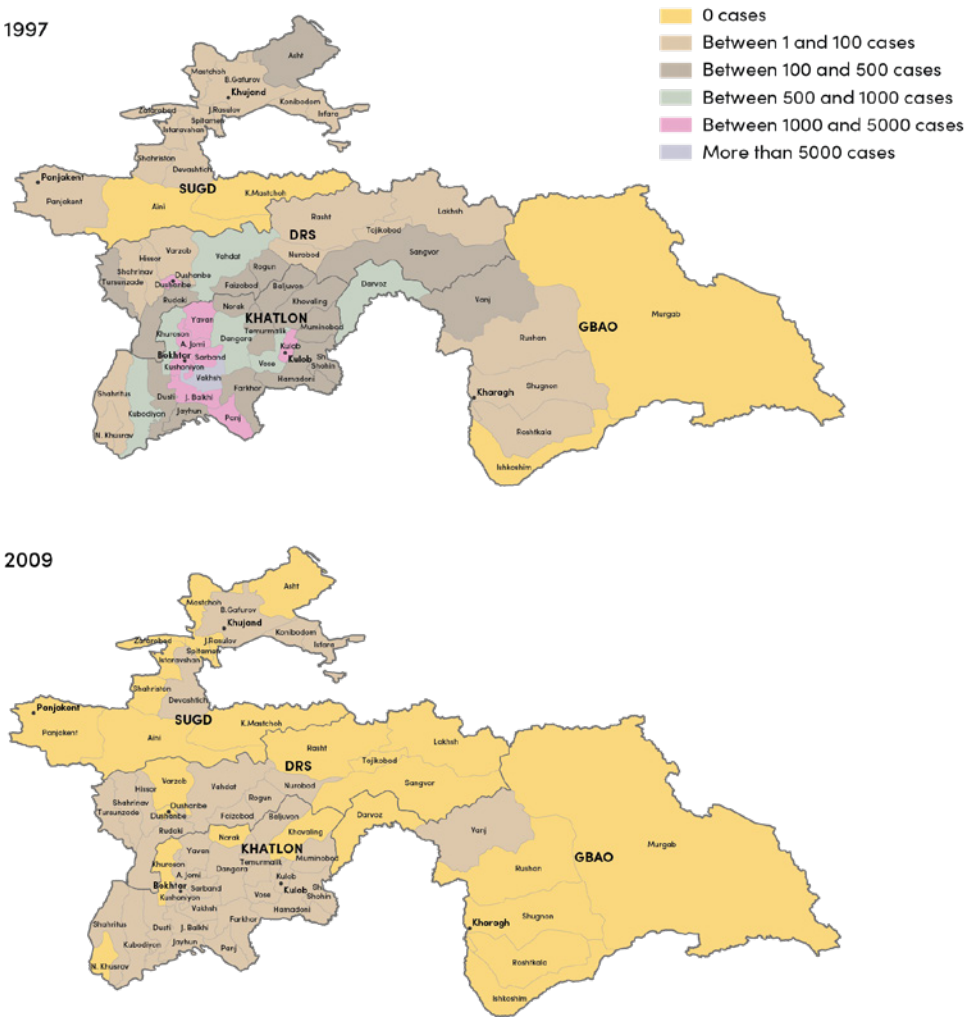
Vector control measures and surveillance interventions (i.e. active household visits and active case detection, improvement of laboratory diagnosis, registration and reporting, and epidemiological investigation of cases and foci) were accordingly scaled up nationwide. These combined efforts led to a reduction in the number of officially reported malaria cases by more than 50%, from 29 794 cases in 1997 to 13 493 cases in 1999.

However, the situation remained serious because of malaria spread throughout the country, including the re-emergence of local transmission of *P. falciparum* malaria. In 1998–2002, the number of falciparum cases increased from 187 to 826 cases. However, it should be noted that improved case detection – especially through active case finding and the quality of laboratory diagnosis – also contributed to the increase in the number of reported cases. In 2000, 19 064 cases of *P. vivax* and 831 cases of *P. falciparum* malaria were officially reported in the country (Fig. 9).

Further strengthening of antimalaria activities was guided by the National Programme for the Control of Tropical Disease (malaria) from 2006 to 2010 *(43)*.

Intensive nationwide antimalaria interventions resulted in stabilization of the epidemiological situation at the Afghanistan border and improvements in the rest of the country. The total number of reported malaria cases progressively dropped: from 2390 in 2005 to 1344 cases in 2006, and further 108 cases in 2010 (Fig. 9). In 2009, only 164 indigenous *P. vivax* cases were reported (malaria incidence rate 2.20 per 100 000 population). In 2010 this fell to 108 cases (1.42 per 100 000 population), much lower than the targeted 20 cases per 100 000 population. During the same period, *P. falciparum* cases decreased from 81 in 2005, to 28 in 2006 and 0 in 2009. Since 2009, no indigenous cases of *P. falciparum* malaria have been registered in the country, one year earlier than it was originally planned (Fig. 9) *(16,17,44)*. The map of indigenous malaria distribution in the country shrank rapidly through this period (Fig. 10).

Fig. 10. Distribution of indigenous malaria cases in the country, 1997 and 2009



Source: (21).

Malaria elimination, 2010–2015

Through the *Tashkent Declaration*, ten European countries – Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, the Russian Federation, Tajikistan, Türkiye, Turkmenistan and Uzbekistan – made a commitment in 2005 to eliminate malaria in the Region by 2015 *(10)*. The declaration led to the renewed *Regional strategy: from malaria control to elimination in the WHO European Region 2006–2015 (18)*, which guided these countries towards reducing the number of indigenous malaria cases to zero.

Sound results in malaria control inspired Tajikistan to develop a programme for malaria elimination aligned with the Tashkent Declaration *(10)*, the regional malaria strategy *(18)* and other WHO policy frameworks *(45,46)*. This led to the development and implementation of the *National programme for interruption of malaria transmission in Tajikistan* (2011–2015) *(47)* and the *National strategic plan for malaria elimination in Tajikistan (2015–2017) (48)*. A steady decrease of *P. vivax* cases was recorded, from 108 in 2010, to 56 in 2011 and 2 (the last locally acquired cases) in 2014 (see Fig. 9). One of these final two cases was registered in Kulyab district and defined as a relapsing case (infection was contracted in the previous year), and the second was the latest known case of local transmission, which occurred in the Shobika village of the Vose district. Since 2015, only imported malaria cases have been detected in the country *(21)*.

In 2017, Tajikistan signed the *Ashgabat Statement: Preventing the re-establishment of malaria transmission in the WHO European region (19), as well as* the *Strategic plan for the prevention of re-establishment of malaria transmission in the Republic of Tajikistan for 2019–2023*, which is currently being implemented *(49)*.

The absence of locally acquired cases in the following years encouraged the Government to apply for WHO recognition of the country's success. In 2023, Tajikistan was certified malaria-free by WHO *(15)*.

Factors contributing to malaria re-establishment

Despite the decision in 1960 to no longer consider malaria a public health concern in Tajikistan, its complete elimination has not been achieved, as reports of isolated cases at the border with Afghanistan persisted *(4,21)*.

Receptivity

Although mass vector control interventions were stopped after 1961, receptivity of former malaria-endemic areas remained due favourable climate conditions, and the continued presence of *Anopheles* sp. vectors and their breeding sites *(8)*.

Vector population densities increased due to changes in agricultural practices such as an increase in the cultivation of rice, combined with a marked decrease in the use of pesticides within cotton plantations, due to shortages of chemicals *(21)*.

Risk of importation

The malaria situation in Tajikistan has always been strongly influenced by the situation of the disease in neighbouring Afghanistan, and on the level of risk of importation of malaria to Tajikistan.

In the period of maintaining the achieved decline in malaria (i.e. 1961–1979), one factor that interfered with complete malaria elimination in the country was revealed: the capability of mosquitoes to fly malaria-endemic villages in Afghanistan, across the border rivers of Pyanj and Amu Darya, to the Tajik riverbanks. As mentioned, in 1963–1979, 25 settlements in seven out of eight districts bordering Afghanistan detected 135 cases of malaria. All new malaria foci were situated within 3 km of flood-lands of the border rivers of Pyanj and Amu Darya. The ability of mosquitoes to fly across the narrow border river was demonstrated by the studies in 1962, and confirmed by the absence of malaria cases in Kumsanghir district, the only unaffected district bordering Afghanistan, and situated more than 10 km from the nearest Afghan settlements *(4,8,21)*.

The risk of malaria importation to Tajikistan was also highly influenced by Soviet Union's military operations in Afghanistan from 1979 to 1989. Additionally, the migration of border populations to Afghanistan and back in the 1990s, driven by armed conflicts and social unrest in Tajikistan, contributed to drastic increases in imported cases in areas where malaria had been eliminated, resulting in the resumption of local malaria transmission, particularly in the Afghanistan border areas. The withdrawal of military troops from Afghanistan also caused a drastic increase in malaria importation and worsening of the epidemiological situation in Tajikistan.

A specific factor contributing to the next mass malaria importation of *P. vivax* and *P. falciparum* in 1993 to areas of Kurgan-Tyube was related to an influx of Tajik refugees (around 600 000) from malaria-endemic areas of Afghanistan, which was followed by large-scale malaria epidemics during 1993–1997 *(4,8,21)*.

During malaria control and elimination, the risk of malaria importation was increased by the intensive external migration to and from neighbouring Afghanistan, and also by the internal migration taking place in Tajikistan. Population movement to and from Afghanistan, and the increased level of contact between people from the two countries were facilitated by construction of several intercountry bridges over the Pyanj River, and by the establishment of trade zones between Tajikistan and Afghanistan in these districts on the Tajik side (e.g. Lower Pyanj – Sherkhan Bandar). Several border markets supported trade during weekends, attended by citizens of Tajikistan and Afghanistan, making malaria importation more likely.

Programmatic factors

During 1961–1979, the malaria programme activities in areas bordering Afghanistan contributed to containing emerging outbreaks and preventing malaria distribution. However, the termination of antimalaria interventions in the bordering areas of northern Afghanistan and insufficient case finding and insecticide spraying in Tajikistan led to a rise of malaria incidence in the latter 1980s. In addition, the insecticidal spraying of cotton plantations, which had created a restraining effect on malaria vector populations, was stopped all over the country.

Another crucial factor for malaria distribution and outbreaks in Tajikistan in the 1990s was the lack of adequate health system response to the increased risk of importation. In the years of civil war, for example, the hampered public health system and the interruption of antimalaria activities in the newly independent Tajikistan partly drove malaria distribution and epidemic.

Epidemiological features of malaria during control of epidemic and elimination

Malaria cases

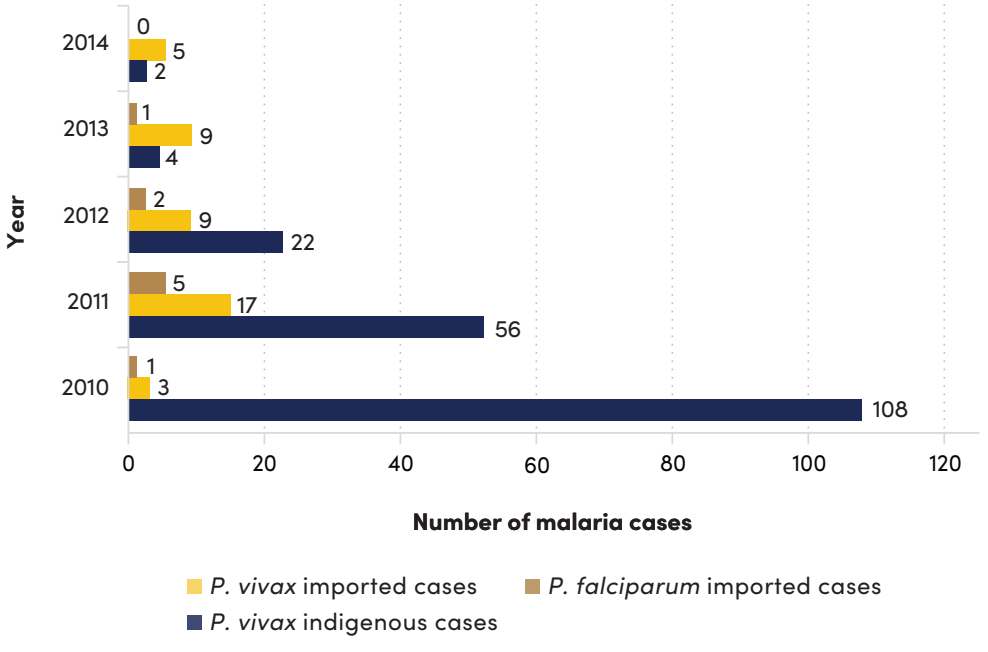
As mentioned, two malaria parasite species – *P. vivax* and *P. falciparum* – were reported in Tajikistan. Local transmission of *P. falciparum* was interrupted in 1956, followed by the interruption of local transmission of *P. vivax* in 1960, although some *P. vivax* cases were subsequently reported in areas bordering Afghanistan, possibly due to movement of infected mosquitoes across the border areas.

Initially, locally acquired cases and outbreaks during the 1980s and 1990s were caused by *P. vivax*. However, local transmission of *P. falciparum* was also re-established by 1994. Local transmission of *P. falciparum* was interrupted again in 2009, and since then no indigenous cases of malaria caused by *P. falciparum* have been officially reported. Transmission of *P. vivax* was interrupted by 2015 (see Fig. 9).

No other locally transmitted Plasmodia species have been reported.

During elimination (2010–2014), there was exclusive local transmission of *P. vivax* with a descending trend in the number of cases (Fig. 11). There were also few imported cases of *P. vivax* (between 3 and 22 annually) and of *P. falciparum* (from 1 to 5 cases annually), which were not followed by epidemiological consequences.

Fig. 11. Malaria cases in Tajikistan, 2010–2014



Source: CTDC.

In the period of malaria elimination, a total of 52 malaria cases were imported. The majority of patients *(43)* were infected with *P. vivax* and the remaining nine with *P. falciparum* (Fig. 11). Malaria was predominantly imported from Afghanistan (30 cases), followed by Pakistan (10 cases) and India (5 cases) (Table 5), and were found mainly in Tajik citizens (45 of 52 cases) (Table 6).

Table 5. Countries of malaria importation into Tajikistan, 2010–2014

Country of malaria importation	2010	2011	2012	2013	2014	Total
Afghanistan	3	9	4	9	5	30
Iran	-	1	-	-	-	1
Pakistan	1	4	5	-	-	10
India	-	3	-	2	-	5
Africa	-	5	1	-	-	5
Nigeria	-	-	1	-	-	1

Source: CTDC.

Table 6. Number of imported malaria cases by nationality, 2010–2014

Nationality	2010	2011	2012	2013	2014	Total
Tajikistan	4	18	11	8	4	45
Pakistan	-	1		-	-	1
India	-	3	-	2	-	5
Afghanistan	-	-		-	1	1
Total	**4**	**22**	**11**	**10**	**5**	**52**

Source: CTDC.

Malaria indices

Along with an increasing Tajikistan national population, the number of residents of higher malaria risk areas (mainly GBAO and Khatlon region) also increased from 4 388 577 (75%) in 1996 to 6 189 923 (80%) in 2014 (last year of local transmission) (Table 7).

Due to the intensive antimalaria interventions, the number of malaria-positive tests dramatically reduced from 1997 (29 794 malaria-positive tests in 1997; 165 in 2009; 7 in 2014; slide positivity rate (SPR) was– 11.742% in 1997; 0.088% in 2009; 0.003% in 2014).

During the pre-elimination period, the malaria prevalence also decreased drastically, from 501.73 per 100 000 population in 1997 to 2.26 per 100 000 population in 2009, followed by 0.085 per 100 000 population in 2014 (Table 7).

Table 7. Malaria indices, 1996–2014

Year	Total country population	Population at risk of malaria (i.e. Khatlon, GBAO)	Number of individuals tested for malaria under malaria surveillance[a]	Number of positive parasitological tests	Annual blood examination rate (%)[b]	Slide positivity rate (%)	Malaria prevalence (per 100 000)
1996	5 851 436	4 388 577	234 692	16 561	4.0	7.056	283.02
1997	5 938 275	4 453 706	253 729	29 794	4.3	11.742	501.73
1998	6 027 169	4 520 377	246 635	19 351	4.1	7.846	321.06
1999	6 120 769	4 590 577	264 842	13 493	4.3	5.095	220.45
2000	6 216 717	4 662 538	285 921	19 064	4.6	6.668	306.66
2001	6 319 943	4 739 957	262 202	11 387	4.1	4.343	180.18
2002	6 427 759	4 820 819	287 140	6 160	4.5	2.145	95.83
2003	6 542 492	4 906 869	241 160	5 428	3.7	2.251	82.97
2004	6 662 738	4 997 054	272 743	3 588	4.1	1.316	53.85
2005	6 789 695	5 092 271	216 197	2 309	3.2	1.068	34.01
2006	6 923 472	5 192 604	175 894	1 344	2.5	0.764	19.41
2007	7 063 627	5 297 720	160 822	635	2.3	0.395	8.99
2008	7 210 758	5 408 069	158 748	318	2.2	0.200	4.41
2009	7 303 651	5 477 738	186 700	165	2.6	0.088	2.26
2010	7 530 078	5 647 559	174 323	112	2.3	0.064	1.487
2011	7 745 688	5 809 266	173 367	78	2.2	0.045	1.007
2012	7 943 214	5 957 411	209 239	33	2.6	0.016	0.415
2013	8 124 481	6 093 361	213 916	14	2.6	0.007	0.172
2014	8 253 231	6 189 923	200 241	7[c]	2.4	0.003	0.085

Notes: a) Without double counting (i.e. counting the same patient twice). Research studies were not included.
b) Population at risk of malaria is used as denominator. c) In 2014, there were 2 indigenous and 5 imported cases detected.

Source: *(21)*.

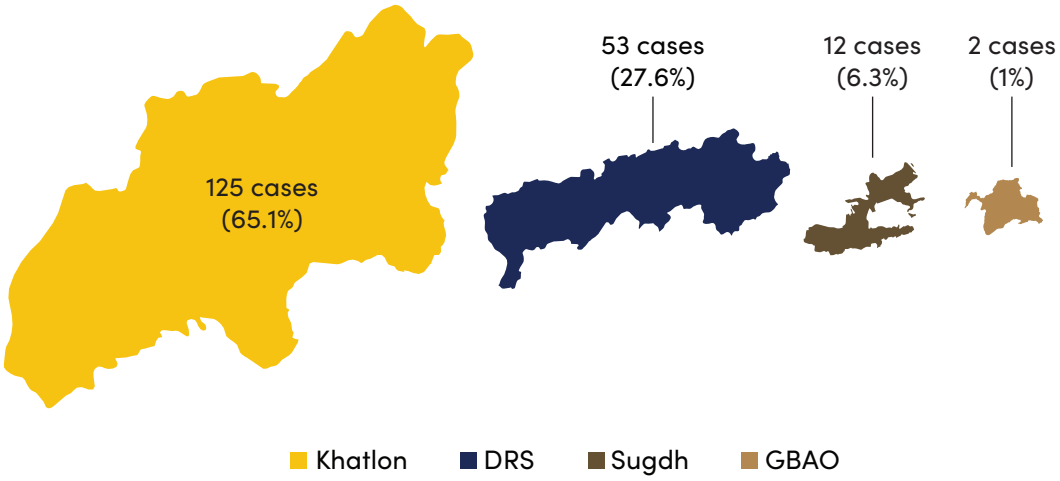
Distribution of malaria

Khatlon region borders Afghanistan and has always been the most affected by malaria. During the malaria elimination period from 2010 to 2014, 65.1% of 192 indigenous cases (all *P. vivax* cases) reported in the country were detected in Khatlon region (Fig. 12). The population of the southern districts of Khatlon region, which directly border Afghanistan, are categorized as being at higher risk of malaria infection. A large number of settlements in the bordering areas of Afghanistan are located within 3–5 km of Tajikistan settlements (some are at a distance of only 50–100 m (e.g. settlements in the Afghan provinces of Badakhshan and Takhar, the Pyanj riverbed is very narrow).

The population in these southern regions is not only attacked by mosquitoes flying from the territory of neighbouring Afghanistan, but also by mosquitoes from the Tajik side, where they breed in rice paddies and along the bank in the Pyanj River floodplain, as well as in backwaters and swamps resulting from floods, which lead to an increase in groundwater in summer.

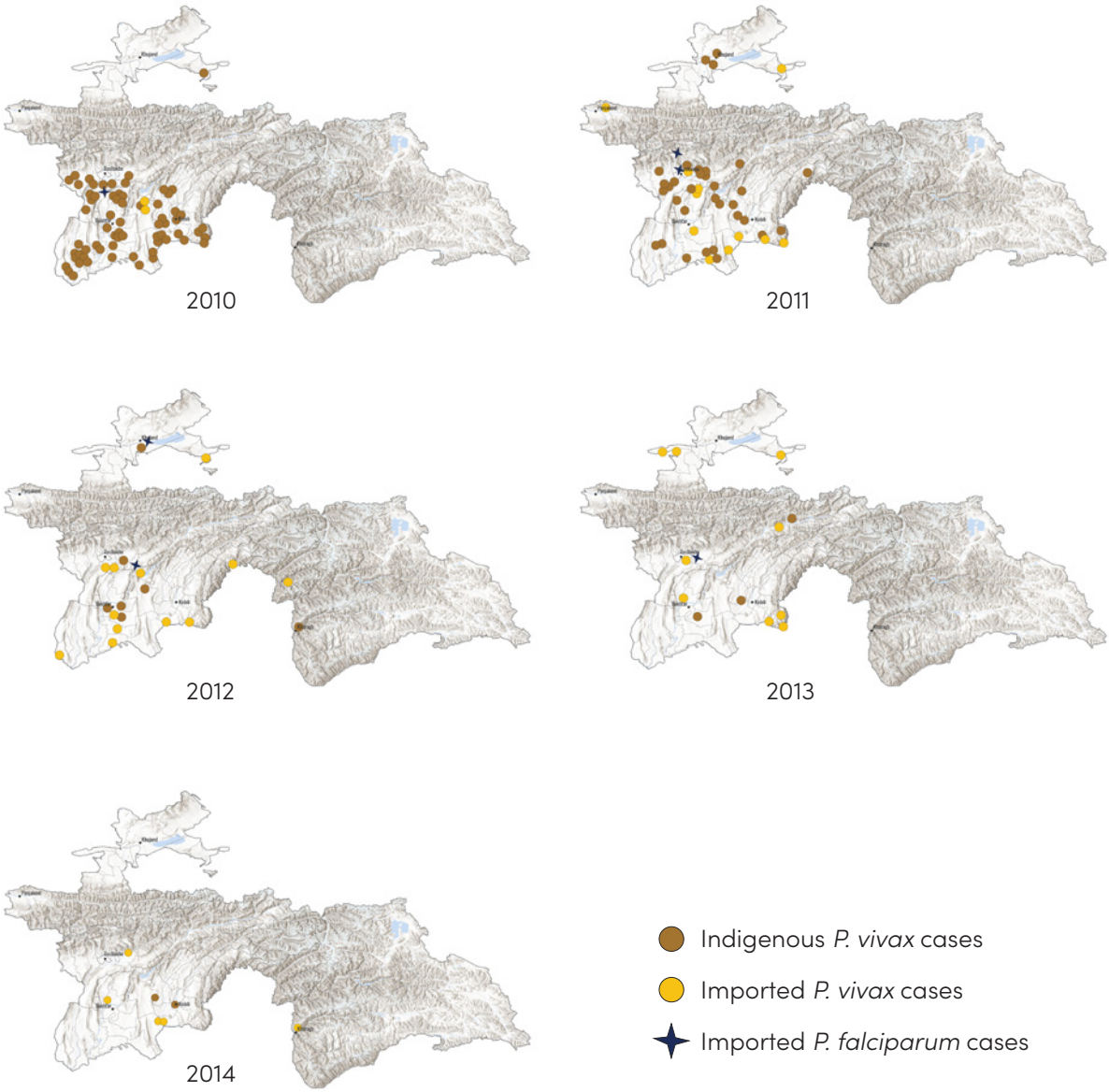
As local transmission was gradually re-established in other parts of the country over the period of malaria resumption, the next regions with a high proportion of reported cases were Districts under Republic Subordination (DRS) (27.6%), followed by Sugdh region (6.3%) and GBAO (1.0%). In 2010, 70 of 108 cases in the country were detected in Khatlon region. The last indigenous cases in Tajikistan were registered in 2014 in Kulyab district of the same region. Organized intensive complex malaria control and elimination measures in the country with a priority focus on Khatlon contributed to a drastic reduction in malaria cases and interruption of local transmission in this area (Fig. 13).

Fig. 12. Distribution of indigenous malaria cases by region, 2010–2014 (%, n=192)



Source: RTDC.

Fig. 13. Areas with indigenous and imported malaria cases in Tajikistan, 2010–2014



Source: RTDC.

Population most affected by malaria

During elimination, both males and females were affected by locally transmitted malaria with slight predominance of males (102 cases, or 53.1% from 2010 to 2014) (Fig. 14). The high proportion of women and children infected with malaria indicates an intensive transmission in households (Figs. 14 and 15). Their engagement with family agricultural work might have also contributed to contracting malaria. In the frontier zone, rice, cotton, cucurbits (melons and watermelons), and other crops are typically grown not just by farmers (Only 3.6% of total cases), but by their entire families. In summer, they come to work on their land plots from the early morning until after sunset, and are often attacked by mosquitoes. This partly explains the high proportion of school students (31.8%), housewives (23.4%) and unemployed people (19.8%) affected by malaria. Military personnel at border posts and in military units located on the border with Afghanistan (soldiers – 6.2% of cases) were also highly vulnerable (Fig. 16). There were cases of vivax

malaria with long incubation when the onset of the disease was detected in other areas of the country, after border guards' demobilization from service, thus creating an internal importation of malaria in the country.

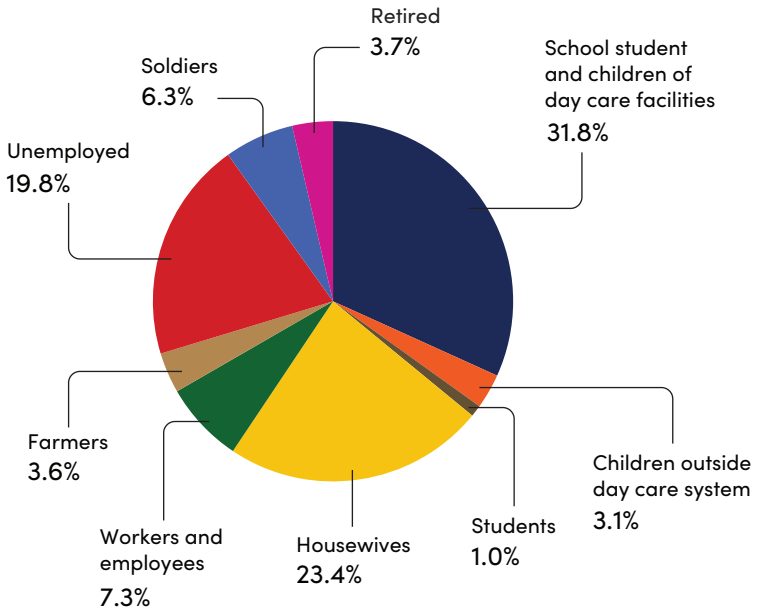
Fig. 14. Indigenous malaria cases by gender, 2010–2014 (n=192)

Source: RTDC.

Fig. 15. Indigenous malaria cases in adults and children, 2010–2014 (n=192)

Source: RTDC.

Fig. 16. Socio-professional composition of people with indigenous malaria, 2010–2014 (n=192)



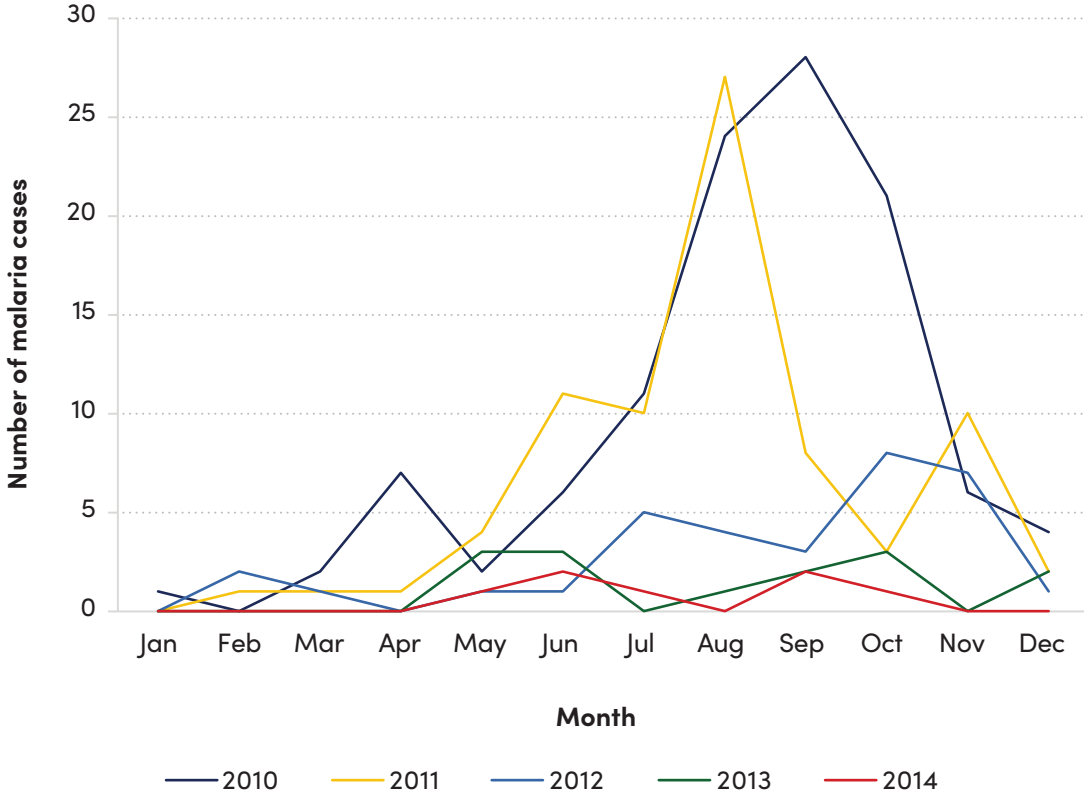
Source: RTDC.

Seasonality of malaria

The morbidity analysis shows that malaria cases were reported throughout the year, and the most intensive transmission occurred from June to October, which coincided with average daily temperature of 25 °C and higher and the resulting mass breeding of malaria mosquitoes. A significant increase in the number of malaria cases could begin as early as April, when the spring wave of *P. vivax* malaria infections occurred. At the same time, their level continued to increase, reaching a maximum in August to September, whereafter it decreased as the temperature dropped (Fig. 17).

Of all cases of malaria (244) reported in Tajikistan in 2010–2014, 208 (85.2%) cases occurred in the period from June to November. During this period, most cases were reported in August (56 or 22.9%), September (36 or 17.6%) and October (36 or 14.7%), with the lowest registration in winter months (one case in January and three cases in February.

Fig. 17. Seasonality of malaria, 2010–2014 (n=244)



Source: RTDC.

Key interventions to interrupt post-elimination epidemic and achieve malaria elimination

Improvements in the legislative framework

Malaria control and elimination interventions were guided by strategies and policies formulated in regulations approved by the MoHSPP and updated periodically in accordance with the epidemiological situation and planned targets. They regulated epidemiological surveillance, case management, vector control and entomological surveillance, and are cited and described in the respective chapters.

Targeting successful control of post-elimination malaria outbreaks, the National Programme for Control of Tropical Diseases (malaria) (1997–2005) was developed with the technical assistance of WHO and implemented in the country *(42)*.

Strategic lines to intensify malaria activities targeting the containment of the epidemic included:

- strengthened vector control and entomological surveillance;
- scaled-up epidemiological surveillance – active (household visits) and PCD, improvement of laboratory diagnosis, registration and reporting, prompt response and epidemiological investigation of cases and foci;
- deployment of antimalarial mobile teams in regions bordering Afghanistan;
- mass prophylactic treatment of the population in active malaria foci and prophylactic treatment of demobilized military personnel with primaquine, and their follow-up over three years;
- strengthening human resources, training and re-training of the staff; and
- health education of the population and social mobilization *(4–8,17–19,21,39–41)*.

Programme activities were backed up with technical and financial support by WHO, UNICEF, European Commission Humanitarian Aid Office, the Food and Agriculture Organization of the United Nations, the United States Agency for International Development, Merlin, and the Agency for Technical Cooperation and Development, as well as financially by the governments of Japan, Italy and Norway, which played an important role in the successful control of malaria epidemic.

A key document guiding antimalaria activities in the following years in the country was the *National programme for tropical disease (malaria) control in the Republic of Tajikistan for 2006–2010 (43)*.

The programme goals were:

- interruption of *P. falciparum* malaria transmission by 2010 and final clearing of malaria foci in the country;
- prevention of malaria outbreaks; and
- reducing overall malaria prevalence to less than 20 cases per 100 000 population.

A key role in the implementation of this programme was played by the considerable financial and technical support from various international organizations (mentioned above) and the Global Fund to Fight AIDS, Tuberculosis and Malaria *(16,17,20,21).* Priority was given to the interruption of *P. falciparum* malaria local transmission.

The complex activities were conducted in accordance with WHO recommendations *(50–52)* and local regulations *(43,53)* by the mobilized malaria network, and were further scaled up as follows: ACD (household visits every week during the malaria transmission season) and PCD carried out by general health services; comprehensive epidemiological investigations and classification of malaria cases and malaria foci, as well as reactive case detection (RCD), conducted by a group of specialists (i.e. epidemiologist, entomologist, and laboratory technician) at the district level or mobile teams; improved laboratory diagnosis and case management (i.e. radical treatment with chloroquine and primaquine of *P. vivax* cases; chloroquine or artesunate plus sulfadoxine–pyrimethamine, and single dose primaquine (0.25 mg of active substance/kg) as gametocytocidal drug of *P. falciparum* cases; registration and reporting of cases, entomological surveillance with monitoring of the breeding sites by district staff; vector control through indoor insecticide spraying with various pyrethroids applied as one of the main interventions in all malaria foci, long-lasting insecticide-treated nets (LLINs) (since 2006), with a priority for the populations living close to the border with Afghanistan; distribution of larvivorous fish *Gambusia affinis* into mosquito breeding sites; staff training; health education of the population and border activities with Afghanistan *(16,17,20,21,54–55).*

After the successful implementation of the NMCPs (1997–2005, 2006–2010) and elimination of the *P. falciparum* local transmission in 2009, the country's targets were directed to the interruption of local transmission of *P. vivax* and reaching elimination of malaria nationwide. The elimination strategies and policies were formulated in the *National programme for interruption of malaria transmission in the Republic of Tajikistan for 2011–2015 (47)* and in the *National strategic plan of malaria elimination in the Republic of Tajikistan for 2015–2017 (48*) in line with WHO recommendations *(9,18,45,46)* and approved by the Government of the Republic of Tajikistan. Strong political support played a key role in accomplishment of malaria elimination in the country.

Timely detection and tracing of each malaria case, and conducting adequate interventions and monitoring in the corresponding foci were of key importance for reducing the number of locally acquired cases, and of 'active' foci, to zero.

The main approaches and interventions that proved to be efficient in malaria elimination in Tajikistan are summarized in Box 2.

Box 2. Main approaches and interventions applied in the elimination programme

- Improvement of the legislative framework.
- Strengthening malaria surveillance and response throughout the country, including:
  - scaling up active and passive detection of malaria cases;
  - quality-assured malaria diagnosis through the network of laboratories;
  - timely radical treatment of patients and parasite carriers;
  - timely and comprehensive epidemiological investigation of cases and foci, and localized responses;
  - monitoring of malaria foci;
  - conducting seasonal and inter-seasonal preventive chemoprophylaxis in active foci;
  - timely notification of malaria cases and their registration;
  - maintaining a national malaria database;
  - meteorological monitoring, analysis and trends; formulation of the potential malaria season.
- Enhanced entomological surveillance and vector control.
- Mobile teams assigned to assist malaria activities in most affected areas.
- Special attention to and enhancement of surveillance and vector control activities in the areas with higher risk, especially at the border with Afghanistan.
- Intersectoral cooperation; implementation of border/regional/subregional cooperation.
- Cross-border cooperation.
- Raising public awareness of malaria prevention measures.
- Maintaining malaria expertise among health care personnel trough trainings and re-trainings.

Scaled-up surveillance and response

During the malaria elimination period, when the number of cases had already been drastically reduced and the transmission was localized to a few villages/districts, a key factor was strengthening the surveillance and response systems, and increasing their sensitivity and specificity. Clinical and epidemiological vigilance in malaria surveillance, quality and timeliness of preventive measures, and maintaining the preparedness to contain possible local outbreaks, were the key working components to strengthen the national systems. The malaria surveillance and response system functioned throughout the entire territory of the country, regardless of the malaria outbreak potential and epidemiological situation.

Case detection

The key objective of surveillance was to ensure early detection of malaria patients and parasite carriers, and their timely and adequate treatment. Both passive and

active (i.e. proactive and reactive) case detection were addressed, depending on the epidemiological situation and the level of receptivity and vulnerability of the territories:

- PCD was conducted mainly by peripheral general health services. All people presenting with fever, anaemia or other suspected malaria symptoms, or a history of travel to a malaria-endemic country or an endemic area of Tajikistan, were examined for malaria as soon as they contacted the health services.
- ACD detection through household visits by local health care providers was conducted in active foci (every week or every 2 weeks during the transmission season) by local general health service, with blood sampling and examination of all people with fever and people suspected to have malaria.
- RCD was performed during epidemiological investigations of cases in settlements and workplaces, through interviews and screening for malaria by microscopy among the respective 'contact' people.

More than 200 000 malaria tests were conducted annually during 2010–2018 (Table 8). Blood sampling was conducted by state health care facilities.

Table 8. Annual number and types of malaria tests performed and proportions of positive results, 2010–2018

	Year									
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
Case detection approach	**No. of parasitology tests and proportion (%) of positive test results**									
Passive case detection	95 878 0.05%	90 151 0.06%	108 127 0.12%	115 515 0.01%	106 128 0.006%	125 061 0.004%	109 388 0.001%	125 551 0.001%	117 505 0.001%	993 304 0.03%
Proactive case detection	78 445 0.07%	83 216 0.02%	92 065 0.02%	98 401 0.004%	94 113 0%	101 178 0%	100 973 0%	106 951 0.001%	92 325 0%	847 667 0.013%
Reactive case detection	–	–	9047 0.01%	–	–	4158 0%	–	–	–	13 205 0.005%
Total	**174 323**	**173 367**	**209 239**	**213 916**	**200 241**	**230 397**	**210 361**	**232 502**	**209 830**	**1 854 176**

Source: RTDC.

Quality assured diagnosis and case management

A good laboratory network for malaria diagnosis existed in Tajikistan throughout the elimination phase. A national reference laboratory (NRL) was operational; provincial centres for tropical diseases control (PCTDCs) and centres of sanitary epidemiological surveillance (CSES) included five reference laboratories of second level; and at the city/district/rural level there were 285 diagnostic laboratories (Annex 2). The laboratories of the Ministry of Internal Affairs and the Ministry of Defence performed only blood sampling, and samples were sent to the laboratories of the state Institutions for microscopy testing (i.e. RTDC, PCTDC and CSES).

Examination of Romanovsky–Giemsa-stained blood slides was the main method applied. Rapid diagnostic tests (RDTs) were used as a supportive screening method. Malaria examinations were free of charge to patients.

The national external quality assurance/control (EQA/EQC) programme was regulated by a 2010 manual on laboratory diagnosis of malaria *(56)*. It was coordinated by the NRL and included a system of cross-checking of slides, supervision of the controlled laboratories at various levels, as well as staff training. Confirmation of all positive slides and monthly cross-checking of at least 10% of all negative slides was conducted at two levels (i.e. reference laboratories at the secondary level and then at NRL), and included regular feedback to controlled laboratories. Each year, the NRL developed summarized information on quality control and shared it with all participating laboratories, and to the MoHSPP. Accordingly, the NRL and provincial laboratories planned and held trainings for controlled laboratory staff.

All cases of malaria were confirmed at parasitological laboratories of the CTDC and CSSES at all levels, and re-confirmed by the NRL.

Treatment of malaria patients was well regulated, organized and conducted. Malaria treatment was free of charge and was carried out in a timely manner at public health facilities. According to the malaria treatment protocol, which aligns with WHO recommendations, the radical treatment of *P. vivax* malaria was conducted with chloroquine phosphate 25 mg (base)/kg for three days, and with primaquine phosphate 0.25 mg (base)/kg for 14 days.

For cases of *P. falciparum* malaria, different antimalarial drug combinations were recommended for treatment, depending on availability: arthemeter–lumefantrine (coartem); artesunate plus amodiaquine; artesunate plus mefloquine; artesunate plus sulfadoxine–pyrimethamine; artesunate plus tetracyline or doxycycline or clindamycin; and quinine plus tetracycline or doxycycline or clindamycin. All patients (except pregnant women and children aged under one year) were administered a single dose (0.25 mg of active substance/kg) of primaquine as gametocytocidal drug on the first day of the treatment with artesunate combination therapy (ACT). Treatment was monitored and patients were followed up.

Medicines were procured centrally by the MoHSPP of Tajikistan and procurement was also supported by WHO and the Global Fund. A supply of antimalarial drugs was stored at the RTDC before distribution to CTDCs and health facilities *(21)*.

Epidemiological investigation of malaria cases and foci

Since the first elimination efforts in the 1960s, confirmed malaria cases (whether imported or locally acquired), have been subject to epidemiological investigation and classification immediately after receiving a case notification, combined with epidemiological investigation of the focus, including entomological investigation. The purpose of an epidemiological investigation of a malaria focus was to identify the source of infection and the conditions enabling the emergence and spread of malaria. The results of the investigation informed the classification of the case and the corresponding

focus, and decisions on the rational antimalaria measures to be performed by CTDC, SES and/or local health care workers. A case definition and focus categorization were completed according to WHO definitions *(45,46,51,52).* In the first instance, foci were classified as: 'new active', 'residual active', 'residual non-active', 'potential' and 'cleared'; and subsequently as 'active', 'residual inactive' and 'cleared'. It is worth mentioning that during the elimination period and since, the programme continued to use the additional category of 'potential focus'. Cases were epidemiologically classified as indigenous, imported, introduced, induced or relapsing. Case and focus epidemiological investigation forms were filled and reports sent to the higher authorities.

All information about malaria cases and foci is stored in the national malaria registers in paper-based and computer-based formats.

The programme benefited much from timely and comprehensive epidemiological investigations. As a rule, the investigations were carried out within the first 24 hours of receiving a case notification *(21).*

Monitoring of malaria foci

As malaria focus was the main unit of interventions during elimination, the malaria foci were monitored during the malaria season by local parasitologists and entomologists of the territorial health facilities. Supervision and interventions on clearing foci (i.e. household visits, follow up of malaria-treated people – for three years in the case of *P. vivax* malaria and for one year of *P. falciparum* malaria – entomological surveillance, health education, etc.) were also carried out over the course of three years. The information on the focus was entered into a focus recording form (or focus passport) with mapping of every focus kept up to date and maintained by CTDC/CSSES. The focus registering form was updated annually with a review of the focus classification. In 2014, there were only two active foci and 653 cleared up foci since the beginning of malaria resurgence, which number was 667 in 2018 *(21).*

Accelerated efforts towards conducting epidemiological investigations of cases and foci, and interventions in the foci and their clearing, contributed substantially to malaria elimination in the country. In comparison with the first elimination efforts, the country obtained complete interruption of malaria transmission on the whole territory as a result of this acceleration: timely, comprehensive and well-targeted activities by experienced staff as part of a well-organized malaria network. The special attention paid to the areas bordering Afghanistan, where single cases and outbreaks were registered after the first malaria elimination, resulted in stable malaria elimination there.

Information system

Malaria is a notifiable disease in Tajikistan. Notification of all cases, whether imported or local, was required within 24 hours of their detection at public health facilities (i.e. information goes from health care facility to the district SES centre or CTDC, then further to the provincial CTDC, which reports to the RTDC and MoHSPP).

A legal basis to regulate weekly, monthly and annual reporting was in place. During elimination, an electronic communication network with provincial structures was put in place, enabling continuous monitoring of the epidemiological situation and supporting emergency measures to contain outbreaks in the risk zone. The flow of information was simple and efficient.

A number of officially approved unified reporting and registration forms were used: register of communicable diseases; register of laboratory blood tests for malaria; medical records and outpatient cards; monthly and annual reports of health care facilities, SES and CTDC facilities; malaria case and focus investigation forms; focus passport; report on entomological surveillance and vector control, and others *(21).*

Vector control and entomological surveillance

Malaria vector control

Vector control activities were guided by a number of WHO *(57–60)* and national documents and guidelines *(47,61)*.

Indoor residual spraying (IRS)

Well legislated and performed, IRS was conducted by a treatment of indoor spaces (both residential and non-residential buildings, as well as livestock rooms) with insecticides. Based on WHO recommendation, the insecticides used were of the pyrethroid group (e.g. alphacypermethrin, cyfluthrin, lambdacyhalothrin) of various formulations with prolonged residual effect.

IRS was carried out by the district CTDC and SES staff in priority districts depending on the analysis of the epidemiological situation and data of entomological surveillance, mostly in the target districts bordering Afghanistan. In the areas with high intensity of transmission, there were two rounds of surveillance per year (in June and August–September); and one round (in July) in the areas with low intensity of transmission. IRS coverage in 2010–2018 is presented in Table 9. The proportion of totally targeted and actually treated households in the country varied from 96% to 105%. Over the years, most of the interventions conducted were in Khatlon province bordering Afghanistan.

Table 9. Households covered by indoor residual spraying, by province/district, 2010–2018

Administrative unit Province/district	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Dushanbe	1631	–	–	–	–	–	–	–	–	1631
	1631									1631
	100%									100%
DRS: Rudaki[a], Vahdat[a], Tursunzade, Nurabad, Gissar, Shakhrinav	19333	6773	6585	3583	5866	2469	–	–	–	44 609
	19169	5282	6684	3824	5866	2244				43 069
	99%	78%	102%	106%	100%	91%				96%
	–	–	–	6263[a]	6767[a]	1761[a]	–	–	–	14 791[a]
				6805	6767	1718				15 290
				108%	100%	97%				103%
GBAO: Darvaz, Vanj	1060	1331	1459	2098	2098	1435	1436	1802	1488	14 207
	1069	1263	1463	2252	2098	1458	1436	1778	1665	14 482
	101%	95%	100%	107%	100%	101%	100%	98%	111%	101%
Khatlon: Shaartuz[a], A. Jami[a], Vakhsh[a], Panj[a], Kabodiyan[a], Dangara[a], Farkhor[a], Khamadoni[a], Sh. Shokhin[a],	92 601	24 849	20 683	23 757	15 069	4531	26 903	9219	7873	225 485
	91 394	24 463	19 533	24 776	15 069	4543	26 903	9156	8236	224 073
	98.6%	98%	94%	104%	100%	100%	100%	99%	104%	99%
Bokhtar, Sarband, Dusti, Jaykhun, J. Balkhi, Kushoniyon, Yavan, Khuroson, N. Khisrav, Vose, Kulyab, Baljuvan, Temurmalik, Muminabad, Khovaling		64 380[a]	43 682[a]	23 794[a]	27 650[a]	16 942[a]	–	–	–	176 448[a]
		63 421	43 166	24 362	27 650	16 894				175 493
		98%	99%	102%	100%	99%				99%
Sugdh: B. Gafurov, Isfara	2795	1814	2566	4456	5952	3648	–	–	–	21 231
	2795	1341	2404	4569	5952	3602				20 663
	100%	73%	94%	102%	100%	98%				95%
Total	**117 420**	**99 147**	**74 975**	**63 951**	**63 402**	**30 786**	**28 339**	**11 021**	**9361**	**498 402**
	116 058	**95 770**	**73 250**	**66 588**	**63 402**	**30 459**	**28 339**	**10 934**	**9901**	**494 701**
	99%	**96%**	**98%**	**104%**	**100%**	**99%**	**100%**	**99%**	**105%**	**99%**

[a] Districts with highly intensive transmission of infection, where two-round IRS was conducted.

Source: (21).

Larval control

Larvicidal insecticides were not used against pre-imago stages (i.e. larvae, nymph) of mosquitoes to avoid causing harm to nature. However, the larvivorous *Gambusia affinis* fish, widely used in water bodies and especially in rice plantations, proved to be highly effective causing drastic reduction of the *Anopheles* mosquitoes. In 2006–2013, supported by the grant from the Global Fund, *Gambusia* fish were distributed in the districts with prevailing exophilic and semi-exophilic vector species (e.g. Bokhtar, Vakhsh, Dusti, A. Jami, J. Balkhi, Shaartuz, Kabodiyan, Jaykhun, Pyanj, M.S.A. Khamadoni, Farkhor, Vahdat and Tursunzade). In 2010–2013, 527 to 732 hectares of mosquito breeding habitats (water reservoirs and rice fields) countrywide were stocked with *Gambusia affinis (21)*.

Long-lasting insecticide-treated nets (LLINs)

Implementation of LLINs aims to protect vulnerable populations in malaria-affected areas from mosquito bites and prevent malaria infection and local transmission. In 2006–2015, particular attention was given to LLINs distribution in the districts bordering Afghanistan. In 2013–2016, almost half (48%) of LLINs were used in the districts bordering Afghanistan. They were distributed free and provided by a project of the Global Fund (Table 10) *(21)*.

Table 10. Long-lasting insecticide-treated nets distributed in malaria-affected areas, 2010–2015

Year	No. of households	Population	Total number of distributed LLINs
2010	12 130	84 667	34 747
2011	36 945	226 879	117 041
2012	34 661	201 134	100 000
2013	30 735	245 634	100 000
2014	16 232	127 717	50 000
2015	9702	80 945	31 100
2016	1084	8240	3695

Source: (21).

Environmental management

Environmental management (i.e. draining and filling of agriculturally unnecessary water reservoirs, maintenance and cleaning of water collection and drainage networks, development and cleaning of water reservoirs, fountains, irrigation networks, etc.) was an important part of the complex vector control activities directed towards receptivity through reducing areas of mosquito breeding sites. According to the RTDC, the area managed annually in 2010–2013 was above 100 000 m^2 *(21)*.

Entomological surveillance

Entomological surveillance was conducted countrywide but receptive areas – such as the south of the country in areas bordering Afghanistan, the districts of central Tajikistan, and northern districts of Sugdh province as well as a number of districts in GBAO – were especially addressed.

Surveillance was conducted by identification, registration and regular monitoring of vector breeding sites of *Anopheles spp.* (i.e. surveillance of 92–98 sentinel water reservoirs (annually in 2010–2019 nationwide) (Table 11) during the entire period of vector activity and of *Anopheles* imago population at sentinel sites, every 10 days during the malaria

season by district entomologists; maintaining and annually updating registers (passports) of breeding sites at the district level; studying and collection of information on *Anopheles* spp. and their density, vector bionomics, as well as on meteorological data. Special attention was paid to monitoring the mosquito populations in rice fields. Monitoring of the *Anopheles* imago population was also done once a decade in the pre-identified sentinel premises, in their daytime rest sites and at the moment of their blood meal – attacking the human or animal. Based on the findings, seasonal curves of population sizes of exophilic and endophilic *Anopheles* mosquitoes were drawn.

The entomological monitoring information was a basis for defining the parameters of the potential malaria season, for planning adequate vector control interventions, as well as for the evaluation of receptivity and stratification of the country according to the risk of re-establishment of malaria transmission. This approach is still adopted at present *(1).*

Table 11. Number of routine/sentinel entomological surveys, by administrative units, 2010–2019

Administrative unit	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Districts of Republican Subordination (DRS)										
Shakhrinav	6	6	6	6	6	6	6	6	6	6
Vahdat	5	5	5	5	5	5	5	5	5	5
Rasht	4	4	4	4	4	4	4	4	4	
Districts of Khatlon province										
A. Jami	3	3	3	3	3	3	3	3	3	3
Kushoniyon (former Bokhtar)	5	5	5	5	5	5	5	5	5	5
Vakhsh	5	5	5	5	5	5	5	5	5	5
Shaartuz	6	6	6	6	6	6	6	6	6	6
Kabodiyan	4	4	4	4	4	4	4	4	4	4
Pyanj	5	5	5	5	5	5	5	5	5	5
Farkhor	4	4	4	4	4	4	4	4	4	4
Khamadoni	6	6	6	6	6	6	6	6	6	6
S. Shakhin (former Shuroabad)	4	4	4	4	4	4	4	4	4	4
Kulyab	5	5	5	5	5	5	4	4	4	4
Dangara	5	5	5	5	5	5	5	5	5	4
Districts of Gorno-Badakhshan autonomous province										
Darvaz	5	5	5	5	5	5	5	5	5	5
Vanj	5	5	5	5	5	5	5	5	5	5
Rushan	4	4	4	4	4	4	4	4	4	4
Khorog	4	4	4	4	4	4	4	4	4	4
Districts of Sugdh province										
Penjikent	4	4	4	4	4	4	4	4	4	4
Khujand	5	5	5	5	5	5	5	5	5	5
Isfara	4	4	4	4	4	4	4	4	4	4
Country total number of observational sites	92	98	98	98	98	98	97	97	97	92

Source: (21).

Entomological investigation of foci was also conducted to confirm/exclude local transmission in a given area, as well as to correctly plan the relevant vector control activities or, conversely, prove that they were not needed. Water reservoirs within 3 km distance were identified and pre-imago stage vector population was determined and recorded.

The sensitivity (resistance) testing of the main malaria vectors (*An. superpictus* and *An. pulcherrimus)* in Tajikistan – carried out by the staff of the entomology department of the Republic CTDC in 2011, 2012 and 2019 in different districts of the country – showed that the mosquitoes remained susceptible to pyrethroids (i.e. alphacypermethrin, cyfluthrin, lambdacyhalothrin and deltamethrin) and organophosphorus compounds (i.e. malathion), and there was no progressive decrease in vector sensitivity to the listed insecticides.

Tajikistan benefited substantially from the well-educated entomological staff, whose expertise was maintained by participation in numerous national and international trainings (Fig. 18).

Fig. 18. WHO training course on vector-borne diseases, environmentally sound methods of controlling them and the basics of integrated vector control (Dushanbe, 04 March 2013)

(Photo courtesy of Dilshod Sattor Qadamzoda.)

Community education and engagement

Extensive work has been carried out to raise awareness about malaria, to train local activists among schoolchildren, teachers etc. to perform advocacy for improved health education about malaria prevention and control. The range of activities included: television and radio broadcasts; publications in central and local newspapers and magazines; conducting of round tables, seminars, talks and lectures; and publication of leaflets and posters on malaria prevention. Along with specialists from CTDCs, healthy lifestyle promotion centres and local health care workers, these activities involved staff of social organizations, students, schoolchildren, teachers and religious leaders *(21).*

Intersectoral collaboration

The malaria programme was implemented in close and well-balanced collaboration with all relevant ministries and departments, such as ministries of agriculture, defence, education and science, internal affairs, melioration and water resources, the border troops directorate of the national security committee, railways and airlines and local administrative authorities that played a key role in the success of the programme.

These activities were backed up by the National Coordination Committee under the Tajikistan Government.

Cross-border coordination and cooperation

Realizing the key significance of cross-border cooperation with neighbouring countries where malaria was endemic or has come back – and especially with malaria-endemic Afghanistan – Tajikistan took part in cross-border cooperation meetings organized by the WHO Regional Office for Europe (e.g. 2010 meeting in Bishkek among Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan on the elimination of malaria) *(21)*. To strengthen cross-border cooperation and interaction between the countries, a joint statement on cross-border cooperation on malaria elimination among Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan was signed in 2011.

International cooperation

Malaria control and elimination programmes were implemented in cooperation with various international agencies and organizations: WHO, the Global Fund, MERLIN (international organization for health care in crisis), United Nations World Food Programme, the Agency for Technical Cooperation and Development of France (ACTED), United States Agency for International Development, UNICEF and UNDP.

Tajikistan has benefited from close cooperation with WHO. The WHO Regional Office for Europe has provided great assistance to the country in developing strategies, programmes and plans of action, methods, and training of health staff, etc. Many WHO experts and consultants have provided technical assistance in assessment of laboratory services, identifying and mapping of malaria mosquito breeding sites and the existing *Gambusia* stock ponds, updating cartograms of malaria foci, and monitoring and evaluation of preventive and elimination interventions working with local specialists for many years after the re-establishment of malaria. The WHO field office in Kurgan-Tyube with international staff in 2001 essentially assisted the NMCP in clarification of the epidemiological and entomological situation, in strengthening surveillance, control and prevention interventions, improving the microscopical diagnosis and training of personnel.

The Global Fund has provided a major financial support to Tajikistan, which played a key role in achieving the goals and tasks of the NMCP.

Three projects of the Global Fund were implemented in the country:

- Global Fund Round 5: TAJ-506-G04-M. Malaria control in Tajikistan (2006–2011) funded at US$ 2 772 001.
- Global Fund Round 8: TAJ-809-G08-M. Malaria elimination project in Tajikistan (2009–2013) funded at € 8 172 044.
- Global Fund project (Transit mechanism of funding): TAJ-809-G08-M. Malaria elimination project in Tajikistan (2013–2015), funded at US$ 474 158.

Prevention of re-establishment of malaria transmission

Countries that have eliminated malaria should continue to carry out malaria prevention activities to maintain malaria-free status in the face of existing receptivity and continued importation of malaria *(62–65)*.

After attainment of malaria-free status, preventing a resurgence of the disease is of key importance. Even before the complete interruption of malaria transmission has been achieved in the whole country, activities should be directed at preventing any re-establishment of malaria transmission in the territories that have already achieved zero indigenous cases. In the former endemic areas where the vector – *Anopheles* mosquitoes – remains and conditions for transmission are favourable, there is a risk of malaria resurgence due to malaria importation from endemic countries.

Importation of malaria to malaria-free countries or areas can cause the following types of consequences:

- clinical (uncomplicated to severe disease or even death of the person who imported malaria);
- epidemiological (reintroduction and re-establishment of malaria related to appearance of locally acquired cases, resumption of malaria transmission from imported cases); and
- economic (workdays lost to the disease and expenses on malaria response activities (*51*).

In Tajikistan, maintaining a high level of surveillance and response system countrywide is key to prevent the re-establishment of malaria. The surveillance strategies and policies are well developed in the comprehensive strategic plan for prevention of re-establishment of malaria transmission in the Republic of Tajikistan for 2019–2023 *(49)* and implemented accordingly. The plan is based on the stratification of subnational units in accordance with the risk of re-establishment of malaria transmission, and on the experience gained during the elimination phase.

The transition from elimination to prevention of malaria re-establishment are accomplished by conducting continuous adequate and effective surveillance and maintaining high vigilance in the country. In line with the strategic plan, efforts aim at conducting continuous adequate and effective surveillance, maintaining knowledge and skills of staff of malaria surveillance, strengthening vigilance, early detection and timely notification, treatment and investigation of imported cases, as well as early detection of possible malaria outbreaks and adequate response with the focus on high-risk areas. Particular emphasis is given to malaria importation and prevention of its clinical and epidemiological consequences.

Subnational (province and district) operational plans have been developed on the basis of the national strategic plan.

Prevention of re-establishment of malaria transmission in the Republic of Tajikistan is backed by sustainable political and financial support, endorsed and implemented by the Government.

Risk of re-establishment of malaria transmission

The risk of re-establishment of malaria into the malaria-liberated territory depends on many conditions: environmental, climatic, social, demographic, epidemiological, entomological, and on the level of performance of health systems and the quality of implementation of preventive measures.

The combined effect of receptivity and risk of importation (i.e. vulnerability), determining the malariogenic potential, determines the risk of re-emergence of local malaria transmission.

Receptivity

Following malaria elimination, the risk of re-establishment of malaria transmission in Tajikistan remains since most of the country's territory is receptive and vulnerable to malaria. Receptivity of Tajikistan's areas remains high due to the landscape, presence of effective malaria vectors (see Figs. 6 and 7) and numerous water bodies favourable for mass mosquito breeding, as well as enabling climatic factors for malaria transmission. Entomological surveillance and analysis showed that the primary vectors *An. superpictus* and *An. pulcherrimus* are widely distributed in the south, south-west and north-west of the country. The same is also true for *An. claviger, An. hyrcanus* and *An. artemievi*.

The area along the border with Afghanistan is considered by local malariologists as highly receptive. In total, 15 southern districts of the country are located opposite the adjacent malaria-endemic territories of the Afghan provinces of Badakhshan, Takhar, Kunduz and Balkh, and only the Pyanj River and the Amu Darya River separate them from Tajikistan. These are the Tajik districts located in the south of Khatlon oblast (i.e. N. Khisrav, Shaartuz, Kabadiyan, Dusti, Jaykhun, Pyanj, Farkhor, Khamadoni, Sh. Shokhin), and in the south-west of GBAO (i.e. Darvaz, Vanj, Rushan, Shugnan, Ishkashim, Murghab). The territory of these districts, with the exception of the high-altitude Shugnan, Ishkashim and Murghab, is considered receptive because of its landscape and malariogenic characteristics based on the presence of the main malaria vectors *An. superpictus* and *An. pulcherrimus*, the episodic vector *An. claviger,* and the secondary vector *An. hyrcanus*. Moreover, some of these settlements (34 villages in Darvaz district; 9 villages in Vanj district; 10 villages in Rushan district and 20 villages in Shugnan district) are located in the 3-km zone bordering Afghanistan.

In these southern regions, mosquitoes massively breed in rice fields and along the bank of the Pyanj River floodplain, as well as in backwaters and swamps resulting from floods, which lead to an increase in groundwater in summer. Most of the residents of these areas are agricultural workers who cultivate land and are engaged in growing of rice, cotton, cucurbits (melons and watermelons) and other crops in the frontier zone. In summer, they come to work on their land plots in early morning hours and leave very late after sunset; and are thus vulnerable to malaria mosquito bites.

After malaria elimination, vector control activities – especially IRS – have been reduced. However, using of *Gambusia affinis* larvivorous fish in mosquito breeding habitats continues, as well as some IRS activities, mainly in districts adjacent to Afghanistan, aiming at a reduction of the receptivity *(21)*.

Risk of importation

Risk of importation of a territory is defined by WHO as the probability of influx of infected individuals and/or infective anopheline mosquitoes *(52)*.

As mentioned, risk of malaria importation in Tajikistan was previously much higher, especially in the highly vulnerable areas at the border with Afghanistan (see Table 5). Today the border crossing is strongly controlled and the trade zones between Tajikistan and Afghanistan on the Tajik side have been closed. At bridges over the Pyanj River, sanitary control points (SCPs) are functioning on the Tajik side, where in case of those crossing the bridge, blood samples for malaria testing are collected from Afghan migrants and other categories of Afghan citizens and RDTs are used. Thus, malaria importation from Afghanistan has decreased. At conferences held in 2016 and 2019 – within the framework of the agreements between Tajikistan and Afghanistan – joint decisions were made regarding information sharing, notifying about malaria outbreaks at the border and coordinating the actions in the frontier zone *(21)*.

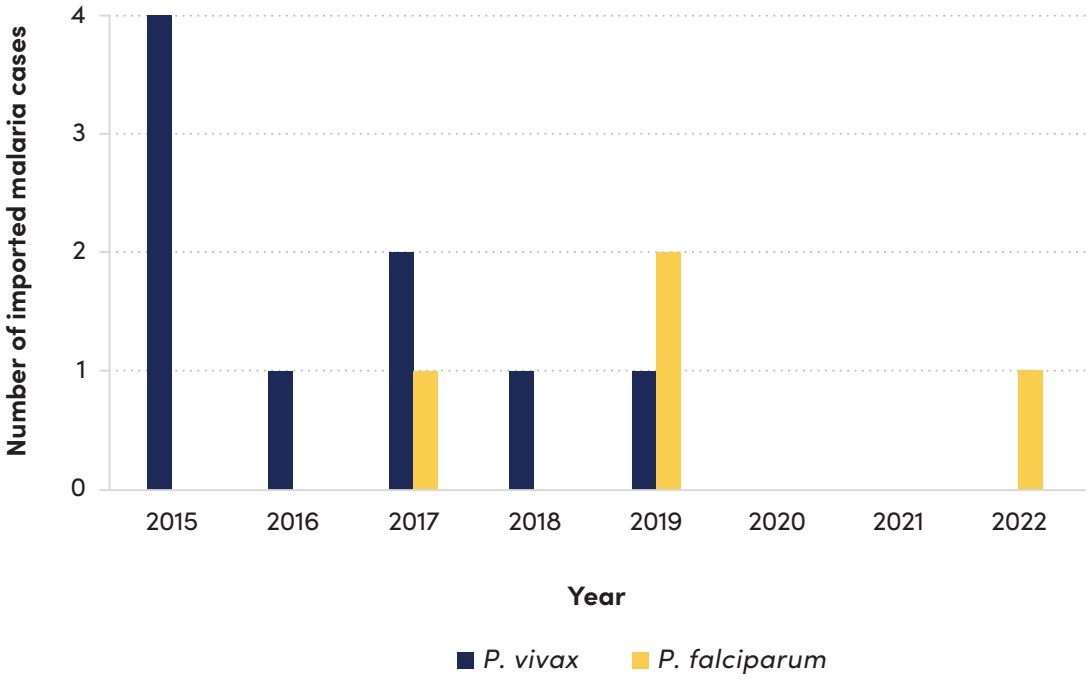
A passive importation of malaria vectors by vehicles, more often by aircraft are described in some countries. There is some information that an active flight of mosquitoes across the border of a malaria-endemic country to a neighbouring country is possible *(4,8*). Uzbek investigators conducted studies and provided data on crossing the malaria vector *An. pulcherrimus* from Afghanistan across the Amu Darya River to the district of Termez in Uzbekistan *(66–68)*. Tajik malariologists also assume that there is a possibility of active flight of infected mosquitoes from the adjacent Afghan territory to Tajik settlements located in the 3-km frontier zone. Some of the southern districts of Khatlon oblast bordering Afghanistan and the districts of GBAO are at a distance of only 50–100 m from Afghan settlements *(21)*.

After interruption of local transmission in 2014, malaria importation was lower. Since 2015, single imported *P. vivax* and *P. falciparum* cases have been officially reported in Tajikistan (see Figs. 9 and 19). Other *Plasmodium* species have not been detected. In 2015–2022, importation accounted for only 13 cases (*P. vivax* – 9 cases, *P. falciparum* – 4 cases*)*. Moreover, in 2020 and 2021, there was zero importation, but it is likely that it may have also been related to the decreased population movement due to the COVID pandemic. In 2015–2022, the number of foreign visitors from malaria-endemic countries is rather low.

Malaria was imported predominantly by Tajik citizens (11 of totally 13 imported cases) (Table 12), which is an indicator that the programme activities on informing local travellers on malaria prevention should be strengthened. *P. vivax* was imported predominantly from Afghanistan, but also from Pakistan and Sudan, *P. falciparum* – from Africa (Table 13) *(21)*. However, the number of imported cases from Afghanistan has dropped: 7 cases in 2015–2022 in comparison to 30 cases in 2010–2014. This might be explained by the stronger preventive activities conducted at the border.

An important favourable fact for Tajikistan is that the neighbouring countries – Kyrgyzstan and Uzbekistan – that also faced malaria resumption, had been certified by WHO as malaria-free *(13,14)*.

Fig. 19. Imported malaria cases, 2015–2022



Source: (21).

Table 12. Citizenship of people importing malaria

Citizen of	2015	2016	2017	2018	2019	2020	2021	2022
Pakistan	–	–	–	1	–	–	–	–
Tajikistan	4	1	3	–	2	–	–	1
Italy	–	–	–	–	1	–	–	–

Source: RTDC.

Table 13. Places of contracting malaria

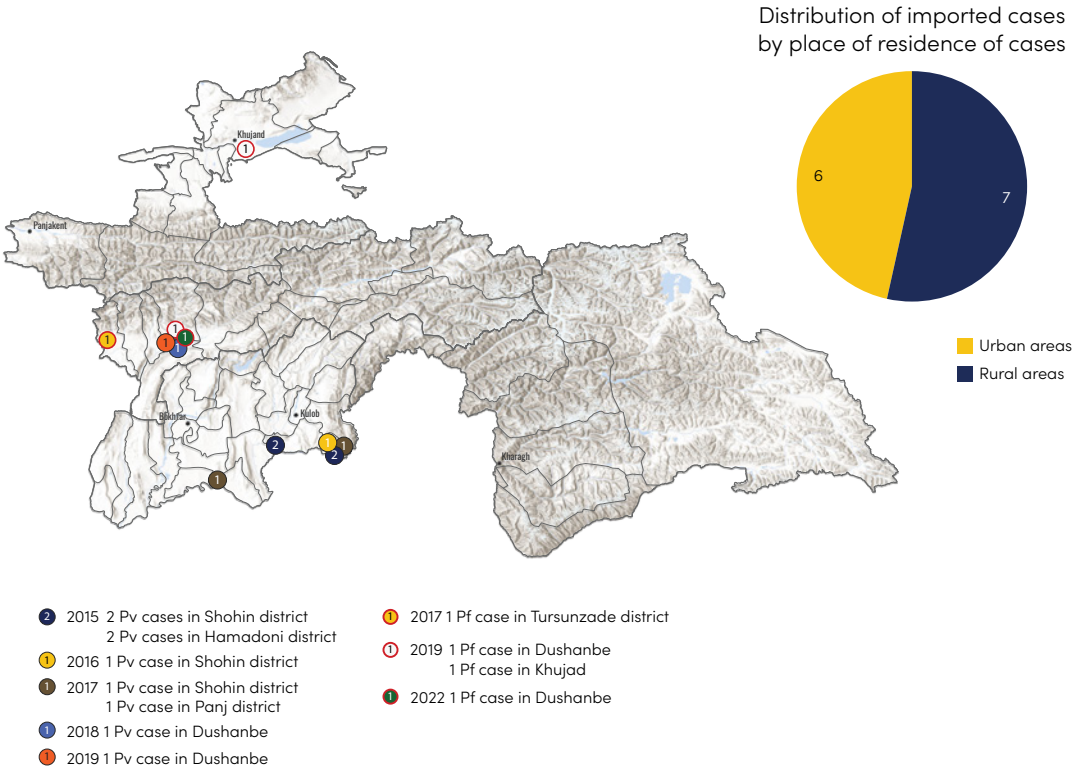
Year	Number of imported cases	Place of contracting malaria
2015	4	Afghanistan (4 *P. vivax*)
2016	1	Afghanistan (1 *P. vivax*)
2017	3	Afghanistan (2 *P. vivax*) Gabon (1 *P. falciparum*)
2018	1	Pakistan (1 *P. vivax*)
2019	3	Sudan (1 *P. vivax*, 1 *P. falciparum*) Nigeria (1 *P. falciparum*)
2022	1	Côte d'Ivoire (1 *P. falciparum*)

Source: RTDC.

According to some malariologists, imported *P. vivax* is more adaptive to local vectors than *P. falciparum*. Afrotropic variety of *P. falciparum* has many specific features, in particular, it is not able to infect mosquitoes from the Palearctic Region *(4,51)*. The resumption of local transmission of *P. falciparum* In Tajikistan is most probably due to importation of the parasite from Afghanistan, as both countries share the same malaria vectors *(21,51)*. In general, in central Asia, the resurgence of indigenous *P. vivax* transmission as a consequence of importation is more probable.

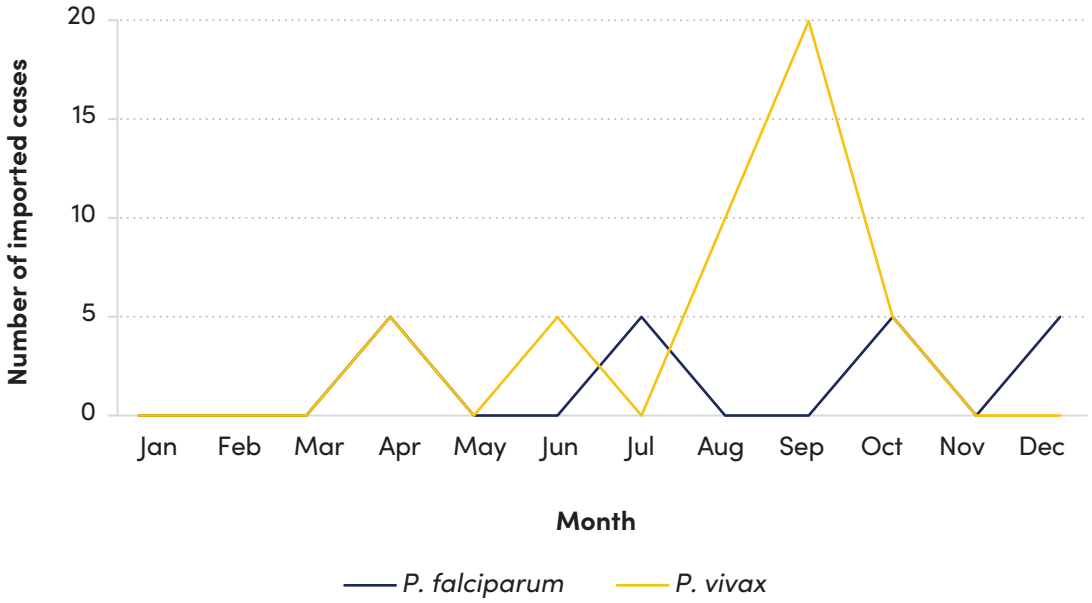
In 2015–2022, six malaria cases were imported to settlements in rural areas and seven to urban areas. It is worrisome that the imported cases were reported from highly receptive areas: seven in the south of Khatlon province at the border with Afghanistan, five in the western part of the DRS and one in the northern part of Sugdh (Fig. 20).

Fig. 20. Spatial distribution of imported malaria cases in areas of Tajikistan



Imported cases of malaria were detected throughout the year in the country; however, during the transmission season, attention should be given to *P. vivax* importation (Fig. 21). Most intensive transmission during malaria control occurred from June to October.

Fig. 21. Seasonality of malaria importation, 2015–2022



Source: RTDC.

It is likely that the vulnerability of the territory of Tajikistan is currently lower; however, the southern border districts of Tajikistan adjacent to Afghanistan, remain of particular concern. Local transmission in Afghanistan can contribute to importation of malaria to Tajikistan by migrants and other categories of Afghan citizens. The possibility should be considered of inflight of infected mosquitoes from the adjacent Afghan territory to Tajik settlements located in the 3-km frontier zone. Expanding international relations in the fields of economics, trade, tourism and culture should also be taken into account, as they might change the situation in the future.

The profile of high-risk populations has been identified, which included:

- The population of border areas with Afghanistan (i.e. Shahritus, Dusti, Jayhun, Pyanj, Farkhor, Hamadoni, Sh. Shokhin, Darwaz, Vanj and Rushan districts) is at higher risk of malaria infection, as the location of settlements is in the 3-km border zone with Afghanistan, which is an area of high receptivity and risk of importation. Most of the residents of these areas are agricultural workers (dehkans) who cultivate land.
- Also vulnerable are military personnel at border outposts and in military units deployed on the border with Afghanistan. There have been cases of internal importation of malaria by border guards after their demobilization from service to other parts of Tajikistan.
- Citizens of Tajikistan and foreigners (i.e. tourists, businessmen, international students – currently from India, Pakistan, Afghanistan and other countries) are also from malaria-endemic countries.
- Refugees from Afghanistan.

Stratification

The determination of the risk of re-establishment of malaria transmission should be based on a detailed analysis of all risk factors, the malaria potential of the area (i.e. combination of the risk of importation and receptivity). The receptivity and risk of importation of the territory do not always correlate. For example, provided the risk of importation is high in

a nonreceptive territory, the malariogenic potential (i.e. the risk of re-establishment), can be zero. The risk of malaria resumption varies in different areas, so strata of territories with similar characteristics are allocated aiming at optimizing the prevention of malaria re-establishment in the country, as recommended by WHO *(9,63).*

Table 14 shows how the risk of malaria re-establishment is assessed.

Table 14. Assessment of the risk of malaria transmission re-establishment

	Risk assessment factors		
Scenario	**Receptivity**	**Risk of importation (vulnerability)**	**Risk of malaria transmission re- establishment**
1	+	+	From high to low, depending on the severity of risk factors
2	+	–	None (can rise with increasing degree of vulnerability)
3	–	+	
4	–	–	None

Source: (63).

To conduct timely and adequate interventions, a stratification of the districts of Tajikistan according to the risk of malaria re-establishment was developed in 2013, based on the analysis of receptivity and risk of importation indicators and taking into account the former malaria endemicity (Fig. 22). It was based on the following parameters:

- Former malaria endemicity and data on current malaria situation in the country.
- Species composition, population density and distribution of malaria vectors.
- Area of breeding sites of malaria vectors.
- Estimation of the potential malaria season, including the number of days in a year with an average daily temperature above 16 °C.
- Vulnerability, the presence and/or absence of a border with malaria-endemic countries (with emphasis on Afghanistan).

Based on a scoring system using the above parameters, four groups of districts were classified according to the level of risk of malaria re-establishment: high, medium, low and no risk of malaria re-establishment *(21).*

Territories of high risk of malaria re-establishment

Subgroup 1

- Territory of districts bordering Afghanistan and making a complete belt from the border with Uzbekistan[2] in the west to Sh. Shokhin district in the east (i.e. Khamadoni, Vose, Farkhor, Pyanj, Jaykhun, Dusti, Kabadiyan, Shaartuz). The districts have a long (more than six months) malaria transmission season, a rich vector fauna, extensive breeding habitats, including large areas of rice plantations, and are constantly at risk of infected mosquitoes flying from the territory of Afghanistan. The trade zones between Tajikistan and Afghanistan in these districts can facilitate malaria importation from Afghanistan into the territory of Tajikistan. This group also includes several districts that do not directly border Afghanistan (i.e. the districts of A. Jami, Bokhtar, Vakhsh, J. Balkhi, Kulyab), but have all the characteristics of this group. If there is an epidemic in the districts at the Afghanistan border, it can quickly spread to the territory of neighbouring settlements, which was the case during the post-elimination epidemic in Tajikistan in the 1990s.

[2] In 2013, Uzbekistan was not certified by WHO as malaria-free.

Subgroup 2

- Four districts of Republican Subordination (i.e. Rudaki, Gissar, Tursunzade, Shakhrinav) bordering Surkhan-Darya region of Uzbekistan affected by *P. vivax* re-emergence. These districts are characterized by the presence of rice fields, a rich vector fauna and a long season of malaria transmission. It should be noted that this group merges with the districts of the first group in the south, which can also contribute to the spread of the malaria epidemic, and this spread can be in two directions – both from the border with Afghanistan to the border with Uzbekistan, and the other way round.

Subgroup 3

- Districts located in the low-mountainous and hilly parts of Sugdh region (i.e. Zafarabad, Spitamen, B. Gafurov, J. Rasulov, Matcha, Kanibadam and Isfara districts), having long borders with Uzbekistan and Kyrgyzstan and located in the south-western edge of Ferghana intermountain basin. They border Syr Darya, Tashkent, Namangan and Ferghana regions of Uzbekistan and Batken region (affected by the re-establishment of *P. vivax* local transmission) of Kyrgyzstan.[3] Therefore, in the event of a malaria epidemic in Syr Darya and Tashkent regions, and Ferghana or the Kyrgyz sub-Ferghan region, there is a potential risk of rapid malaria spread to the Tajik areas of Sugdh province that is also characterized by a rich vector fauna, extensive rice production and a long history of malaria transmission (although somewhat shorter than that in the districts of the first two groups).

Territories of medium risk of malaria re-establishment

- In Tajikistan, there is a significant number of districts (i.e. Vahdat, Shurabad, Yavan, Khuroson, Sarband, Dangara, Temurmalik, Penjikent, Istaravshan, Darvaz and Vanj) with a medium risk of malaria re-establishment due to a shorter transmission season, the presence of fewer vectors in the fauna and smaller or no land under rice plantation. In addition, the larger part of the territories of the districts of Sh. Shokhin, Darvaz and Vanj (i.e also bordering Afghanistan) are located at an altitude of more than 2000 m above sea level, making malaria transmission impossible. However, the situation is complicated by the presence of a significant number of adjacent settlements and breeding sites in the frontier zones of Afghanistan, so these districts should not be left out of the focus of preventive services.
- The districts of Dangara and Yavan have a smaller area of anophelogenic reservoirs and a smaller diversity/number of vector species; however, they have had a fairly significant number of active malaria foci (Dangara – 52 foci, Yavan – 42 foci in 2008–2012).

Territories of low risk of malaria re-establishment

Remaining districts of Tajikistan fall under the group of low risk of malaria return (apart from the no-risk group below).

Regularly conducted entomological and epidemiological surveillance provide data enabling updating of risk stratification. The malaria situation of neighbouring regions also plays an important role. As mentioned above, Kyrgyzstan and Uzbekistan are now free of malaria and, based on epidemiological and entomological surveillance information, the RTDC is in the process of updating the risk stratification in accordance with the malariogenic potential.

[3] In 2013, Kyrgyzstan was not certified by WHO as malaria-free.

Territories of no risk of malaria re-establishment

A separate no-risk group was formed by three high-altitude areas having no breeding sites and malaria vectors: Gornaya Matcha, Ishkashim and Murghab.

In accordance with the latest territorial risk stratification, the strategic lines of malaria preventive strategies and approaches have been developed (Box 3).

Prevention of re-establishment strategy

The goal of the Strategic plan for the prevention of re-establishment of malaria transmission in the Republic of Tajikistan for 2019–2023 *(39)* is to ensure a stable epidemiological status, to prevent the re-establishment of local malaria transmission in the malaria-free territory – despite the risk of continued importation and movement of infected mosquitoes over borders from Afghanistan and high receptivity of many areas in Tajikistan.

The objectives contributing to the goal are:

- early detection, registration, classification and reporting of all cases of malaria, their timely diagnosis and radical treatment;
- prediction and identification of possible causes of re-establishment of local malaria transmission;
- preparedness for immediate implementation of preventive and epidemic control measures, including case management and vector control, in the event of re-established malaria transmission;
- monitoring the risk of importation (vulnerability) and receptivity of the territory.

To achieve these objectives, the following key approaches and activities are implemented:

- strengthening of the malaria surveillance system;
- mitigating malaria importation (and prevention of its consequences);
- ensuring adequate malaria case management;
- ensuring sustainable entomological surveillance and monitoring of malaria vectors;
- implementing information and communication activities;
- maintaining human resource capacity;
- conducting applied scientific research;
- strengthening intersectoral cooperation;
- strengthening cross-border cooperation;
- strengthening international cooperation.

All key approaches and measures are described in depth and in detail in the guidelines under the Strategic plan for the prevention of re-establishment of malaria transmission in Tajikistan for 2019–2023 *(49)*.

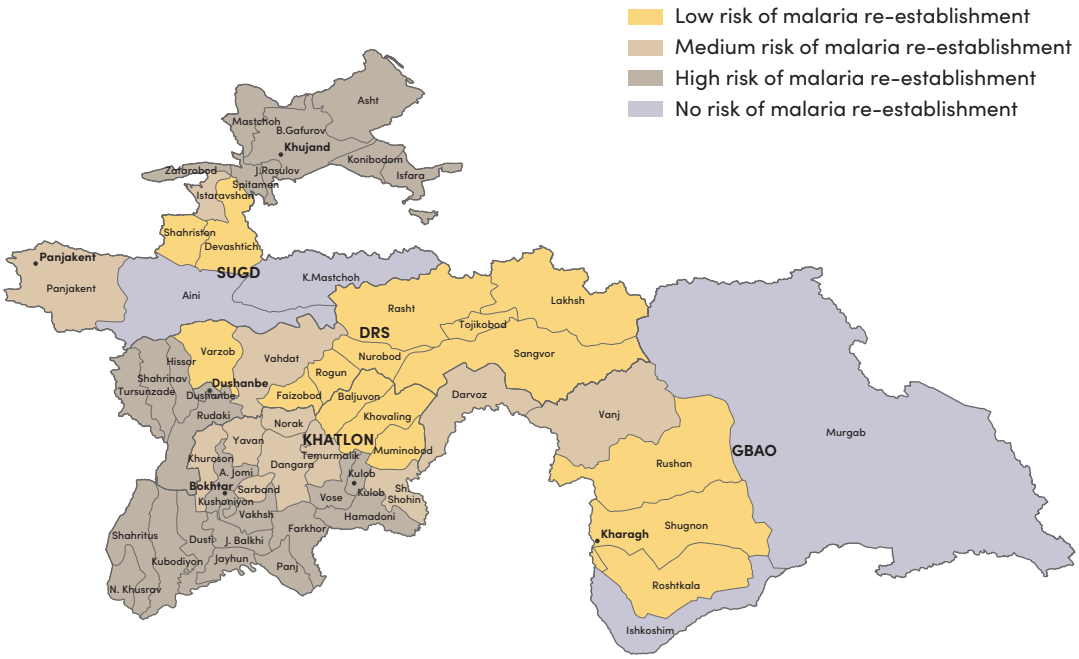
In areas with no risk of malaria transmission (non-receptive), the key objectives are to prevent serious clinical complications of imported malaria infection (including fatal *P. falciparum* cases) through early detection and treatment of infected persons. In strata with a risk of re-establishment of transmission (receptive areas), activities are directed to prevent both clinical and epidemiological (resumption of transmission) complications (see Box 3).

The responsibility for implementation of the Strategic plan for the prevention of re-establishment of malaria transmission in Tajikistan, 2019–2023 lies with the MoHSPP and the RTDC, including the province and district CTDCs and SSES, in close collaboration

with general health facilities and ministries and agencies whose activities are important for its implementation. In line with the approved indicators, the RTDC annually evaluates its implementation. An external or independent evaluation of the strategic plan is carried out by independent WHO experts.

Implementation of all main components of the strategic plan is subject to monitoring. Information is collected and analysed from databases: standard health information systems (i.e. epidemiological and entomological surveillance, reports from the centres, laboratories, clinics, etc.); health care facility surveys; household surveys; operational studies; oversight of health services, etc.).

Fig. 22. Stratification of the territory of Tajikistan according to the risk of re-establishment of malaria, 2013



Source: (1).

Box 3. Strategic directions of the National Programme for Prevention of Re-establishment of Malaria in accordance with the territory stratification

Strata	Malaria surveillance and response					Entomological surveillance and vector control					
	Passive case detection	Active case detection	Radical treatment of detected cases	Epidemiological investigation of all cases and foci	Health education community outreach	Entomological vector surveillance	IRS	*Gambusia* fish distribution in *Anopheles* habitats	Environmental management	Protective measures against mosquito bites	Meteorological monitoring and determination of the elements of the potential malaria season
Areas at high risk of resurgence of malaria (Subgroup 1)	+	+	+	+	+	+	+	+	+	+	+
Areas at high risk of resurgence of malaria (Subgroups 2 and 3)	+	+	+	+	+	+	–	–	+	+	+
Areas at medium risk of resurgence of malaria	+	+	+	+	+	+	–[a]	–	+	–	+
Areas at low risk of resurgence of malaria	+	+	+	+	+	+	–	–	–	–	+
Areas where malaria transmission is not possible	+	–	+	+	+	–	–	–	–	–	–

[a] IRS is conducted in areas with medium risk of resurgence of malaria (Shohin, Darwaz and Wanch).

Source: RTDC

Key interventions to sustain the prevention of re-establishment

Maintaining a strong surveillance system

Measures directed towards the prevention of the re-establishment of local transmission have been carried out in subnational areas where malaria was eliminated prior to complete elimination (all over the country). The surveillance approaches used in the phase of prevention of re-establishment of malaria transmission are similar to those during elimination; although, they are directed in areas where imported cases have been reported, and specified in accordance with the strata of risk of re-establishment of malaria transmission (see Box 2).

Case detection

Reinforced case detection among risk populations. Detection of malaria cases is carried out among the population throughout the country by health care staff in all health facilities. It is reinforced among at-risk populations and implemented through PCD and/or ACD, depending on the epidemiological situation and level of the malariogenic potential – receptivity and risk of territories (see Box 3).

Passive case detection (PCD) is the main approach adopted in all strata. It is conducted mainly by public health care providers: a network of primary health care facilities (i.e. district polyclinics, health centres in rural areas, including hospitals and rural first medical aid centres) using microscopy and rapid diagnostic tests (RDTs). Indications for malaria testing include (at least one of) the following:

- fever with unspecified diagnosis or with such diagnoses as "fever of unclear aetiology";
- intermittent fever with chills;
- history of visiting tropical or subtropical malaria-endemic countries;
- on registration of travellers who arrived from malaria-endemic countries, as well as on clinical (in any illness with fever) and epidemiological indications during the follow-up;
- hepatosplenomegaly, jaundice and/or anaemia of unclear aetiology; and
- foreign citizens are subject to laboratory examination according to the clinical and epidemiological indications.

Proactive case detection is done as a PCD-supporting activity in the potential malaria transmission season, and is carried out by public health workers during house-to-house visits. Proactive case finding is reinforced if epidemiologically indicated, by selective screening in high-risk groups (i.e. migrants, workers and students from malaria-endemic countries, demobilized military personnel from the areas bordering Afghanistan, etc.). It is also reinforced if an increase in the malariogenic potential is detected, in the situation of mass importation of malaria by migrants, for example.

In 2021, in the framework of cooperation with the local executive authorities, 143 refugees from Afghanistan were screened in Bokhtar and 735 refugees in Vahdat district. In 2022, the number of examined refugees from Afghanistan was 300. Demobilized military personnel from the border areas with Afghanistan are screened for malaria at their place of permanent residence.

In the high-risk border areas (i.e. trade zones, bridges over the border river Pyanj), there are sanitary control points. Citizens are examined upon their entry into the country and, if necessary, RDTs are used and blood samples are collected for malaria microscopy.

Reactive case detection (RCD) is done as a response to the epidemiological investigations of imported cases at places of residence and work during the season of malaria transmission in receptive areas. All contacts of a confirmed case are tested.

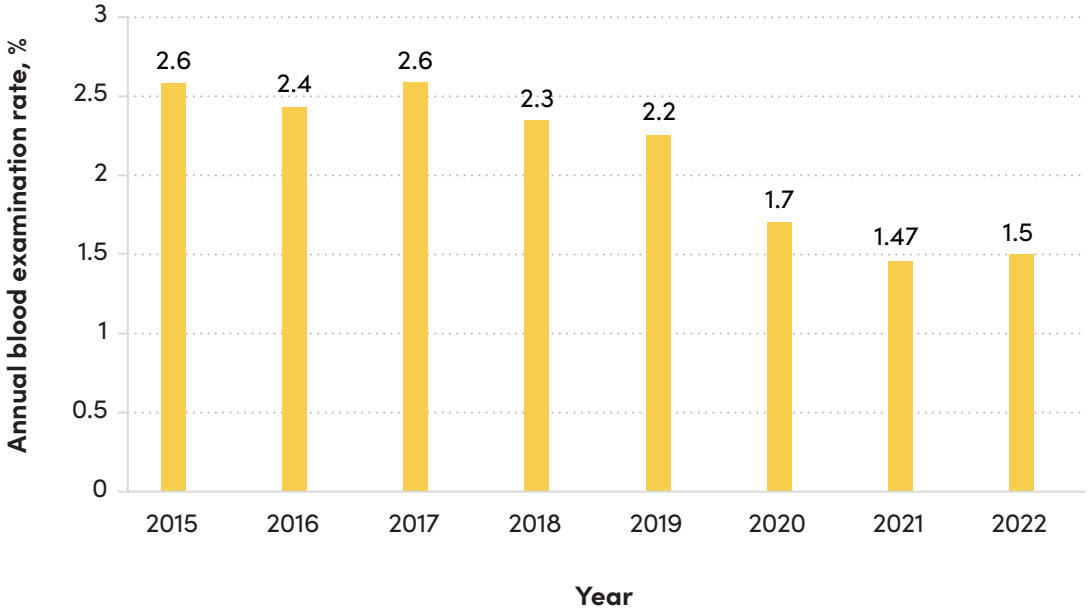
The annual number of examinations for both PCD and ACD in this period is above 100 000. The positive rate of examinations conducted is quite low (e.g. in 2018 it accounted for 0.001% of 117 504 samples sanitary control point through PCD, and in 2017 it was 0.001% of 106 950 examined samples *(1)*; but considering the high receptivity in many areas, it was important for the NMCP not to miss even a single case.

In the post-elimination period 2015–2020, the annual number of individuals tested for malaria in the country varied from 161 467 (2020) to 207 821 (2018) (Table 15). According to the local authorities, the population at risk of malaria (i.e. Khatlon and GBAO) was about 7 million people *(21)*.

The annual blood examination rate (ABER) varied from 1.7% (2020) to 2.6% (2015) (Fig. 23). The data indicate that after the interruption of local transmission, the country maintains vigilance regarding malaria at a good level.

The case detection approaches adopted in Tajikistan in the post-elimination period seem to be efficient, as neither clinical (malaria death) nor epidemiological (introduced and indigenous cases) consequences have been reported since 2015.

Fig. 23. Annual blood examination rate (ABER), 2015–2020



Source: RTDC.

Epidemiological investigation of malaria cases and foci, and responses

The well-established practice of timely and comprehensive investigation of each case continues during prevention of resumption of malaria.

Immediately after receiving an emergency notification of an imported malaria case, the parasitologist/epidemiologist and entomologist of the district CTDC or CSSES carry out an epidemiological investigation of the case, completing a standard form for epidemiological investigation of case and focus, a copy of which is sent to the provincial CTDC/CSSES and then to the RTDC. A case is defined according to the WHO definitions *(51,62,65)*.

Since 2017, the NMCP has been using the new WHO foci classification – active, residual active and cleared focus *(62)*; however, staff have found that using the category of potential focus from the previous WHO classification is also helpful.

Table 15. Number of microscopy tests, by administrative units, 2010–2020

Administrative unit	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
GBAO	7 628	8 133	2 674	290	3 299	5 814	6 235	8 783	10 475	11 482	12 864	77 677
DRS	16 099	16 067	12 979	11 718	11 741	13 778	10 593	10 396	11 548	11 138	8 372	134 429
Dushanbe	21 896	18 551	41 777	37 695	40 742	49 187	55 758	52 178	55 292	56 496	41 867	471 439
Khatlon oblast	87 909	82 423	63 825	51 608	63 910	68 516	51 740	70 033	77 205	71 991	61 344	750 504
Sugdh oblast	40 791	48 193	17 997	52 528	44 652	51 046	51 465	49 894	53 301	53 253	37 020	500 140
Country total	**174 323**	**173 367**	**139 252**	**153 839**	**164 344**	**188 341**	**175 791**	**191 284**	**207 821**	**204 360**	**161 467**	**1 934 189**

Source: RTDC.

A focus investigation aims at characterization of the location – demographic data including the populations at greatest risk, mosquito breeding sites, the distribution of malaria vectors and the underlying conditions that may support transmission, health facilities available, etc. Prompt entomological investigation (during the potential transmission season), identifying adult vector anopheline mosquitos, their identification and density, as well as detecting vector breeding habitats and the presence of larvae are important for the planning of responses. The response includes RCD and meteorological monitoring.

The information on the focus is recorded in focus investigation/recording forms (passport), with mapping of every focus. The district public health facility responsible for malaria prevention keeps the focus investigation form, the passport and a register of foci. The focus investigation form is provided to the upper administrative level.

All information is reflected in the provincial and national registers of malaria cases and foci.

All information on the case and measures carried out are sent to upper administrative structures and are reflected in the national register of malaria cases and the laboratory register.

In 2015–2022, all detected cases (100%) are reported to the national TDC and MoHSPP within 24 hours, and all epidemiological investigations of the detected imported malaria cases and foci are conducted within 24 hours after notification.

After the interruption of local malaria transmission in 2014, there were only a few (5–9) residual inactive foci that were cleared by 2018 (see Fig. 6). As there was no local transmission, there were no other foci categories apart from potential foci during the malaria season where malaria transmission was prevented by response activities.

Maintaining quality-assured diagnosis and case management

Programme activities are directed towards timely diagnosis in laboratories supervised by the National System of Malaria Diagnosis External Quality Assurance/Control (EQA/C), and prompt radical treatment of malaria cases. All categories of the population are provided with easy access to health care services. Diagnosis and treatment of malaria cases are free of charge.

The effective laboratory network for malaria diagnosis in Tajikistan established during malaria control and elimination has been maintained in the post-elimination period. As part of the implementation of the strategic plan for malaria prevention, special attention is given to laboratory services and for maintaining the knowledge on microscopy of blood samples for malaria testing. Microscopic diagnosis of malaria is available at health care facilities in the public sector. The national EQA system for malaria diagnosis conducted by the reference laboratories – the NRL and five reference laboratories of second level at PCTDC during elimination – continues to work throughout the country. All malaria cases are confirmed at the NRL.

The main diagnostic method is microscopic examination of Giemsa-stained blood slides. The microscopists are guided by the *Educational and methodological manual on laboratory diagnosis of malaria* (2010) *(56)* and the newly developed *Guidelines for the laboratory diagnosis of malaria* (2022) *(69)* in Tajik language.

The strategic plan for prevention of malaria re-establishment mandates provision of WHO-prequalified RDTs targeting better access to immediate malaria diagnosis in remote mountain areas and at border posts located in the frontier area at Afghanistan border, and to train community health workers in use of RDTs. This will assist screening by both microscopy and RDTs of individuals with suspected malaria on the Tajik–Afghan border (six bridges serve as border crossing points) and in remote areas. In 2022, 2500 RDTs were delivered to the country with WHO support. They were distributed to health facilities in areas of high risk of malaria resurgence and to border outposts and military units stationed at the border with Afghanistan.

Analysis of the timelines of laboratory diagnosis (from seeking medical assistance to diagnosis) (2017–2022) shows a variation from one to six days (and in one case even nine days), indicating some delay in making a diagnosis of some cases (Table 16). To overcome delays in malaria diagnosis, activities on strengthening the health education of the population on malaria prevention through door-to-door rounds are conducted by primary health workers, as well as training and re-training sessions with primary health workers and other clinicians.

Table 16. Timelines of laboratory diagnosis (from seeking medical assistance to diagnosis)

Year	Median period (days)	Minimal period (days)	Maximal period (days)
2017	3	2	4
2018	-	-	4
2019	3.5	1	6
2020	-	-	-
2021	-	-	-
2022	-	-	9[a]

[a] The patient was in Côte d'Ivoire for 2 months, fell ill there, then flew to Russia, was treated for 2 weeks, and then arrived in Tajikistan without major symptoms but with anaemia. He was tested for malaria and *P. falciparum* was detected.

Source: RTDC.

Treatment of patients with malaria is administered in accordance with the national treatment protocol *(70)*, which is periodically updated based on malarial parasite resistance data, in line with the latest WHO recommendations *(65)*. Patients are typically treated within 24 hours after the confirmation of the diagnosis, and only at public health facilities.

Funding of procurement of antimalarials is part of the Strategic plan of prevention of malaria re-establishment in Tajikistan for 2019–2023 and it is planned in the budget of health care facilities in the public sector dealing with malaria treatment. The medicines are stocked at the RTDC and antimalarials are distributed to the provinces on request.

Mitigating malaria importation into the country and preventing the consequences of malaria importation

Considering the risk of epidemiological (resumption of local malaria transmission related to an index imported case) and clinical (development of severe disease and death) consequences of malaria importation, a number of measures were introduced before the complete interruption of malaria transmission and remain in place. To mitigate the risk of malaria importation, programme efforts are directed to reduce the risk of importation of parasite carriers, minimize the time during which the imported case may act as a source of infection, and reduce the risk of importation of infected vectors.

All categories of travellers may become sources of infection on their arrival in Tajikistan. The programme staff realizes that the delay of diagnosis and treatment due to a delay in seeking medical aid, neglecting the travel history by health officers and not conducting timely blood examination will contribute to clinical and epidemiological consequences.

The main measures are: prevention of contracting the infection in a malaria-endemic area; early detection and radical treatment of imported malaria cases; timely and detailed epidemiological investigation of malaria cases; and prompt responses.

The groups considered at higher risk have been identified (see section on Risk of importation).

To prevent contracting malaria by travellers, people leaving for malaria-endemic countries are advised how to protect themselves of contracting malaria. For this purpose, in 2017, the RTDC of the MoHSPP issued a special guide for travellers to tropical countries, which was disseminated to all CTDC and SSES structures, general health facilities, tourist agencies and companies whose staff visits or works in malaria-endemic countries.

Medical consultation for local citizens leaving for or coming back from malaria-endemic countries is conducted in the RTDC and in provincial and district CTDCs. In accordance with the guide, the consulting staff provides information to travellers on: protection from mosquito bites; geographical distribution of malaria caused by different *Plasmodium* species in the country and specific areas to be visited according to the latest information of WHO (*WHO International Travel and Health*) *(71*); current medicines recommended by WHO for chemoprophylaxis and stand-by therapy to be administered and description of malaria symptoms. Travellers are advised to equip themselves with the proper medicine for chemoprophylaxis and have a first-aid kit.

Tajikistan citizens returning from countries with endemic malaria are subject to follow up for three years and should be examined for malaria in case of clinical indications (e.g. fever, chills, anaemia and/or hepatosplenomegaly).

At points of entry (i.e Tajikistan's airports and land points of entry for rail and road transport), foreign citizens are provided with information on malaria, including guidance on where and when to seek care in case of suspected malaria. They receive leaflets, booklets and other information and educational materials. They can undergo laboratory tests according to clinical–epidemiological indications in health facilities according to company agreement (for workers), at student clinics (for foreign students) or at public health facilities in the place of residence.

Every year, according to prior agreement with the universities of the country and supported by the order of the Ministry of Education and Science, all students from tropical and malaria-endemic countries are tested for malaria at the RTDC upon their arrival in Tajikistan. A total of 257 individuals were tested in 2018, 5493 in 2019, and 1423 in 2020, comprising foreign students from India, Pakistan, Afghanistan and other countries.

Border troops are provided with medicines, laboratory consumables, insecticides and insecticide-treated bednets to protect them from mosquitoes.

The system of outbreak detection and rapid response; outbreak preparedness

Comprehensive case investigation and results of the response interventions (i.e. population screening, entomological investigations) inform the health authorities about the presence/absence of any malaria outbreak(s).

Each year, the MoHSPP SES develops an action plan of emergency response that includes measures to respond to outbreaks of communicable diseases, including malaria. In case of a malaria outbreak in any region, the plan states that an emergency team should be established by the order of the MoHSPP to prevent the spread of infection to other regions. The team is to be led by the Minister of Health and Social Protection of the Population and includes the Deputy Minister in charge of sanitary and epidemiological security, the head of the Department of Sanitary and Epidemiological Security, the head of the Emergency Department of the MoHSPP, leading consultant specialists, the director of the RTDC and other specialists. The team decides how the necessary human and medical resources are to be deployed. The team coordinates the activities of all state institutions on control and prevention of the spread of communicable diseases among the population.

A stock of consumables/medicines for immediate response in case of malaria is available at the RTDC. The Department of Pharmacy and Medical Devices of the MoHSPP is responsible for the rapid deployment of supplies in case of outbreaks of infectious diseases.

Information system and data analysis

The malaria information system is maintained at a good level and the mechanisms and flow of information applied during the elimination are presently in place. Malaria is on the list of diseases that require compulsory notification and registration. At the district, provincial and national levels, the structures of CTDCs and CSSES are responsible for data collection and analysis. Progressive and annual analytical reports on malaria situation and activities are sent by the lower levels to the upper levels of CTDCs and CSSES as well as relevant feedback.

Entomological surveillance and vector control measures

In the post-elimination period, entomological surveillance has been continued, aiming at monitoring any changes in the malaria receptivity of the territories. The aim is to monitor local mosquito populations and their habitats, analyse and assess data, and plan vector control measures accordingly, targeting potential resumption of local transmission in malaria-free areas and, in the case of any outbreak, to control and interrupt it.

The more receptive territories in the south of the country in areas bordering Afghanistan, areas of central Tajikistan and northern areas of Sughd province, as well as some areas of GBAO, are a particularly focus of these activities. There are malaria vector sentinel points in 21 districts of the country for entomological monitoring of the *Anopheles spp.* population every 10 days during the malaria season by district, as well as provincial entomologists of CTDC and CSSES. After malaria elimination, there was a minimal decrease in the number of monitored sites (2015 – 98 sites nationwide; 2019 – 92 sites) (see Table 11). *Anopheles* breeding sites are also monitored, and registers of breeding sites are updated. The collected information includes: vector species identification; mosquito (pre-imaginal phases and adult mosquitoes); density dynamics; the timing of the mass emergence of the first generation of vectors; bionomics and behaviour characteristics *(61).*

On the basis of meteorological monitoring – average daily air temperature and precipitation levels – the periods of the potential malaria season (i.e. the beginning of the effective mosquito infection period and the beginning of the period of malaria transmission to humans, and others) are defined. These data are used for prediction, planning and timing of mosquito control interventions, depending on malaria potential, as well as for the stratification of the territory of the country regarding the risk of the re-establishment of malaria transmission.

Monitoring the rice cropping technology in the valley and river zones in floodplain landscapes is particularly important. It is known that the population of the main vectors of malaria increases strongly in the second half of the summer as a result of intensive breeding of mosquitoes in rice fields, and their numbers remain high until late autumn, thus the duration of the potential malaria transmission season is steadily maintained.

Projects of irrigation facilities and drainage systems undergo additional epidemiological monitoring by CTDC and CSESS staff, to help minimize the possible risks of increasing the receptivity to malaria of the territory.

Depending on the epidemic situation and entomological indications, malaria vector control is carried out through IRS, *Gambusia affinis* distribution to control *Anopheles* larvae (especially in rice-growing areas), distribution of LLINs to vulnerable communities to protect them from mosquito bites, environmental management, cleaning of irrigation canals and elimination of economically unnecessary vector reservoirs *(56,58,61,73).*

Discontinuing vector control activities soon after malaria elimination increases the risk of malaria resurgence in vulnerable areas, as receptivity often increases. Therefore, Tajikistan has followed the WHO recommendation that any reduction in vector control should only be done after evaluation of the present status of receptivity, vulnerability and surveillance and response system *(62).*

After malaria elimination, IRS activities are still carried out, primarily in districts adjacent to Afghanistan as a barrier treatment, since all the territories bordering Afghanistan are vulnerable and receptive. The coverage with IRS applying alphacypermethrin 5% s.p. and fastac q.e. 10% during 2015–2022 is presented in Table 17.

Table 17. Indoor residual spraying, 2015–2022

Year	Number of farms treated	Surface area treated, m²
2015	18 612	5 211 360
2016	28 339	7 541 504
2017	10 934	3 061 520
2018	9 901	3 306 529
2019	16 163	4 468 800
2020	17 746	4 993 295
2021	26 394	7 390 320
2022	22 578	6 322 340

Source: RTDC.

Distribution of *Gambusia affinis* larvivorous fish in water reservoirs where breeding of *Anopheles* takes place and environmental management are also widely used (e.g. draining swamps, building a collector–discharge network, backfilling economically unnecessary reservoirs, repairing drains and cleaning the irrigation network, lakes, ponds and other reservoirs) *(60).*

At Tajikistan's airports and land points of entry for the rail and road transport, vehicles are treated with insecticides, as necessary, in coordination with the respective services at state borders (e.g. sanitary control and quarantine points, border and custom services).

Resistance vectors to insecticides are also studied (usually once every three years). According to a study conducted by the staff of the entomology department of the RTDC in 2019, the main malaria vectors (*An. superpictus* and *An. pulcherrimus)* in Tajikistan remained susceptible to pyrethroides (alphacypermethrin, cyfluthrin, lambdacyhalothrin, deltamethrin) and organophosphorus compounds (malathion), and there was no progressive decrease in vector sensitivity to the listed compounds.

Monitoring and evaluation

The objectives of monitoring and evaluation (M&E) of the surveillance system are clearly defined by the national malaria programmes. M&E is conducted in accordance with a plan developed by the RTDC, which reflects the main objectives of prevention of re-establishment activities, key indicators, expected results, sources and deadlines for data collection and periodic analysis of indicators, as well as responsible health system structures.

Indicators include timelines and quality of malaria case detection, laboratory diagnosis and treatment of malaria patients, notification, registration, reporting of malaria cases, epidemiological investigation, of data collection and analysis, information flow, as well as the training/re-training of the personnel, etc.

M&E is carried out by the CTDCs and CSSES staff at all administrative levels.

Maintaining malaria expertise

Maintaining malaria expertise of various specialists engaged in the prevention of re-establishment of malaria transmission is of key importance.

Training in malaria is integrated into the system of graduate and postgraduate education, and continuous postgraduate education of specialists is conducted at the Tajik State Medical University Abuali ibn Sino and the Institute of Postgraduate Education in Healthcare of the Republic of Tajikistan.

Maintaining expertise in malaria and updating knowledge of the staff and newly appointed specialists – including epidemiologists, parasitologists, physicians (general practitioners, paediatricians, infectious disease specialists), laboratory technicians and entomologists considering the low number of imported malaria cases – is a primary challenge. Therefore, regular trainings and re-trainings are conducted, organized by the RTDC and its branches and general health facilities. Special training modules and guidelines for different specialists have been developed and/or updating of existing ones *(69,70,72)*. These are used along with available WHO guidelines and materials.

Special attention is paid to the training of laboratory service workers on malaria microscopy (e.g. within clinical and diagnostic laboratories of medical institutions and parasitological laboratories of the Central Clinical Hospital and the Central State Sanitary and Epidemiological Service), as this is the main diagnostic method applied in the country.

Improving the knowledge and skills of general health workers and private practitioners in the diagnosis, treatment, prevention of malaria and surveillance is also addressed.

To maintain the necessary level of vigilance over malaria among the population, primary health care workers carry out education among the population on preventive measures (seeking early medical help when symptoms of malaria appear, protection against insect bites etc.).

Special attention is given to the training of medical workers for the Ministry of Defence and the State Border Protection Committee of the Republic of Tajikistan.

Role of multisectoral collaboration in prevention of re-establishment

Maintaining the country free of malaria requires multisectoral cooperation involving the participation of a wide range of non-health parties, coordinated by the MoHSPP.

The National Coordinating Committee coordinates programmes on AIDS, tuberculosis and malaria. It consists of representatives of government agencies, such as the sectors of health, tourism, youth and sports, migration, economy and finance, education and science, foreign affairs, agriculture, defence, internal affairs, land reclamation and water resources, the Committee of television and radio broadcasting, the Committee on environmental protection, the Committee on the defence of the state border of Tajikistan, the Committee on women's affairs, and religious organizations.

Under the coordination of the RTDC, and within the framework of the Strategic plan for the prevention of re-establishment of malaria transmission in the Republic of Tajikistan for 2019–2023 *(49)*, national coordination meetings are held on issues concerning malaria with specialists of the health services of other ministries and agencies (e.g. Defence and of Internal Affairs, the Border Guard Directorate under the National Security Committee, railways, airlines and other ministries and agencies).

Joint work is carried out with the medical services of other agencies (e.g. the Border Guard Directorate) on malaria vector control, malaria screening of personnel and conducting workshops on malaria prevention. At each border outpost, there is a health worker or

paramedic who has a close contact with the district CTDCs. They are provided RDTs and laboratory consumables for malaria slide preparation.

In cooperation with the Ministry of Agriculture and the Ministry of Education and Science, joint activities are organized in the regions to prevent the re-establishment of malaria. And together with the branches of the Ministry of Land Reclamation and Water Resources, inspections are carried out in the districts to identify and eliminate unnecessary vector reservoirs, reducing the number of breeding sites of malaria mosquitoes.

In areas with high malariogenic potential, malaria prevention-related health education activities for communities are organized together with the local administration.

Cross-border collaboration

Close cooperation is required with countries bordering Tajikistan and particularly with malaria-endemic Afghanistan. During the period of malaria elimination, an agreement was signed with the Ministry of Health of Afghanistan on holding inter-governmental conferences and cooperation in the field of malaria control and prevention, especially in frontier areas. This included provision for exchange of information, notification of outbreaks and coordination of measures of both countries. Within the framework of this agreement, two inter-country conferences were held, and situational information was exchanged via email.

In accordance with the strategic plan for the prevention of re-establishment of malaria transmission, coordination meetings with other neighbouring countries (i.e. Uzbekistan, Kyrgyzstan) were held on prevention of re-establishment of malaria transmission.

Financing

The Strategic plan for the prevention of re-establishment of malaria transmission in Tajikistan, 2019–2023, is ensured with sustainable funding within the allocated state budget of the health sector. The annual allocations for various malaria preventive activities account for about US$ 1 000 000 *(21).*

Lessons learned

Control of post-elimination epidemic and elimination of malaria

After the interruption of malaria transmission in Tajikistan by 1960, only isolated cases and small outbreaks were reported at the border with Afghanistan, which were successfully controlled in the following years. However, in the 1990s when the political situation deteriorated and antimalaria activities had almost ceased, the health system could not respond adequately to the increased receptivity and vulnerability resulting in an explosive malaria epidemic. Recognizing the magnitude of the problem, the government mobilized the specialized and general health services and scaled up surveillance and control activities to contain the epidemics and interrupt malaria transmission in the country.

The main strategies and approaches that proved to be efficient are listed below:

- Legislation supporting complex activities directed to the source of infection (i.e. case detection and radical treatment), vector control and protection of the population, and ensuring adequate coverage. Good performance by general health services and specialized services were critical.
- Recognizing the key role of human resources, specialized services and laboratories were upgraded and capacity-building conducted, such as staffing and training/re-training, which were crucial for reaching related goals. The leading role of the RTDC and its branches in the country supported by SES and general health services should be highlighted.
- The malaria surveillance and response system was upgraded; it functioned throughout the entire territory of the country, regardless of the level of the malariogenic potential and epidemiological situation.
- Case detection was one of the core surveillance functions. Efforts were made to detect malaria cases by ACD and PCD as early as possible and to treat them promptly and adequately. The effectiveness of proactive case detection through household visits (e.g. every week or every two weeks during the transmission season) by primary health care facilities and mobile teams in active foci, with blood sampling and examination of all people with fever and people suspected to have malaria should also be highlighted. RCD performed as a response to epidemiological investigations of cases and foci in settlements and workplaces with interviews and screening for malaria by microscopy of the respective contact people also contributed to timely identification of cases.
- Laboratory support was crucial for reaching elimination. Microscopy testing in quality-assured laboratories was important for the confirmation of every malaria case. Timely and adequate treatment in accordance with national policies and guidelines contributed to a drastic reduction in sources of infection and preventing further distribution of the disease in the country.
- Cases and foci investigation and foci management, the core surveillance functions in malaria elimination, merited special attention. On the basis of resulting information, stratification of the territory, as well as selection, planning and application of appropriate interventions targeting clearing up of foci were conducted.

- Timely recording and reporting of confirmed malaria cases to the NMP played an important role in undertaking prompt actions. The network of electronic communication with provincial structures – that has been put in place during elimination – enabled continuous monitoring of the epidemiological situation and planning of emergency measures to contain the outbreaks, particularly in risk-associated zones.
- The NMP also benefited from good entomological surveillance and vector control that were extremely important in the control of malaria resumption and in elimination. Without these capabilities, the malaria situation might have worsened dramatically. Entomological activities were conducted by the CTDC staff countrywide, especially in receptive areas such as the south of the country in the areas bordering Afghanistan, the districts of central Tajikistan, northern districts of Sugdh province and some areas of GBAO. The CTDC staff conducted identification, registration and mapping of all vector breeding sites of *Anopheles*, entomological monitoring in representative sentinel sites, with maintaining and regular updating of breeding site records (or 'passports'). Entomological investigations were carried out during the identification of malaria foci and of any new confirmed cases. The information collected was used for stratification of the national landscape by levels of receptivity and for planning vector control activities.
- Vector control was well planned and performed by the district CTDC and SES staff. IRS was conducted in targeted districts in accordance with the epidemiological situation and data of entomological surveillance, mostly in the districts bordering Afghanistan. Wide use of *Gambusia affinis* fish in water bodies and rice fields proved to be very efficient in the larval control of *Anopheles*. Insecticide-treated bednets were used as a supplementary tool to protect the population from mosquitoes in malaria-affected areas, especially at the border with Afghanistan. Environmental management contributed to reducing areas of mosquito breeding sites.
- Tajikistan worked extensively to strengthen intersectoral and international collaboration in the field of malaria, as well as to raise awareness about malaria, improving health education of the population and strengthening community mobilization. Cross-border cooperation with neighbouring countries where malaria was endemic, or has returned, especially with malaria-endemic Afghanistan, was of key significance.
- Strong political support played a key role in the accomplishment of malaria elimination in the country.
- The success of malaria control and elimination programmes was greatly related to the technical, operational and financial support of many international agencies and organizations: WHO, the Global Fund, MERLIN, United Nations World Food Programme, the Agency for Technical Cooperation and Development of France, the United States Agency for International Development, UNICEF and UNDP. The WHO Regional Office for Europe provided consultancy support in developing strategies, plans and guidelines, in operating a field office in Khatlon province, conducting, monitoring and evaluation of interventions, training health staff, etc. The Global Fund has provided major financial support to Tajikistan in 2006–2015, which played a key role in achieving the goals.

Prevention of re-establishment of malaria transmission

For almost a decade since the interruption of local malaria transmission in 2014, Tajikistan has been free of the disease, although the risk of its re-establishment persists since most of the country's territory is receptive and vulnerable to malaria. The area along the border with Afghanistan is considered by local malariologists to be at higher risk. At present, malaria importation is low but Tajik specialists acknowledge the possibility of

active flight of infected mosquitoes from the adjacent Afghan malaria-endemic territory to Tajik settlements located in the 3-km frontier zone. The programme for the prevention of re-establishment of local malaria transmission is functioning well. Although the period of maintaining a malaria-free status is not long, the main strategies and approaches that sustain a malaria-free status should be highlighted:

- To conduct timely and adequate interventions, a stratification of the territory of Tajikistan according to the risk of malaria re-establishment was developed based on the analysis of receptivity and risk of importation indicators and taking into account the former malaria endemicity. It is the basis for planning and conducting malaria prevention activities.
- It is crucial that the epidemiological surveillance and response of malaria are maintained at a satisfactory level to ensure prompt detection and treatment of imported cases, as well as for a timely response to any emergency.
- The profile of high-risk populations has been identified and respective populations are being especially addressed.
- High vigilance, PCD supported by proactive case detection (i.e. household visits in the potential malaria transmission season and selective screening in high-risk groups if epidemiologically indicated) and RCD as a response to the epidemiological investigation of imported cases lead to timely detection of imported cases.
- Timely quality-assured malaria diagnosis and good case management are maintained.
- A number of activities (medical consultation and recommendations for local citizens leaving for or coming back from malaria-endemic countries, examination of foreign students from malaria-endemic countries, etc.) mitigate malaria importation into the country and prevent the consequences of malaria importation.
- Special attention is given to preventive activities at border areas with malaria-endemic Afghanistan, which is politically unstable and poses a major risk for malaria re-establishment in neighbouring countries, including Tajikistan. To ensure well-being in this territory, the activities include maintaining the case-based surveillance at a high level, provision of border troops with medicines, laboratory consumables, insecticides and LLINs to protect them from mosquito bites, etc.
- Entomological surveillance has been continued, which provides valuable information for monitoring the changes of receptivity of the territories.
- To reduce receptivity, the use of *Gambusia affinis* larvivorous fish in mosquito breeding habitats continues, as well as some IRS activities, primarily in districts adjacent to Afghanistan, as a barrier treatment.
- A system of outbreak detection and rapid response and outbreak preparedness are in place.
- Maintaining expertise in malaria and updating knowledge of the staff is especially addressed.
- Multisectoral and cross-border collaboration, particularly with malaria-endemic Afghanistan, contribute to prevention of re-establishment of malaria transmission.
- The high level of political commitment and ensuring sustainable funding for the strategic plan for the prevention of re-establishment of malaria transmission in Tajikistan are of key importance.

Conclusions

In Tajikistan, malaria elimination has been achieved following a resurgence, thanks to the collaborative efforts of the health system, other sectors, and the entire population. This success was made possible through well-planned and effectively organized interventions, supported by sustained financial investments over an extended period. This highlights the need for continued and sustained malaria prevention activities in the post-elimination period to prevent future re-establishment of local transmission.

Although malaria importation into the country is not frequent, and the neighbouring Uzbekistan, Kyrgyzstan and China have been certified as free of malaria, the malaria situation in Afghanistan presents an essential threat considering the remaining receptivity of the territory of Tajikistan.

After reaching malaria elimination, a well-organized surveillance system and preventive activities were maintained at effective levels, as these are crucial for preventing another return of the disease. These activities are guided by the NMP and national strategic plan for the prevention of re-establishment of malaria aiming at prompt and timely response, maintaining high vigilance, timely detection of any malaria case and undertaking the necessary response actions. Continued entomological surveillance, particularly in high-risk areas, helps in monitoring the changes in receptivity. Monitoring the risk of importation contributes to mitigating the consequences of malaria importation. Any weakness of the system will prevent the prompt and timely response to the changes in receptivity and risk of importation in the country, which may lead to the resumption of local transmission and possible epidemic outbreaks.

Maintaining the status of a malaria-free country is an important condition for the development of economic and social programmes in the country. Re-establishment of malaria will create a threat to planning and implementing of major projects of international integration. Development of the tourist industry depends on the favourable situation of infectious and parasitic diseases in the country.

Now, when Tajikistan is free of malaria, the set of activities including maintaining of expertise regarding malaria and financial allocations to malaria should not be withdrawn. The activities regulated in the in the Republic of Tajikistan for 2019–2023 *(49)* should be continued efficiently.

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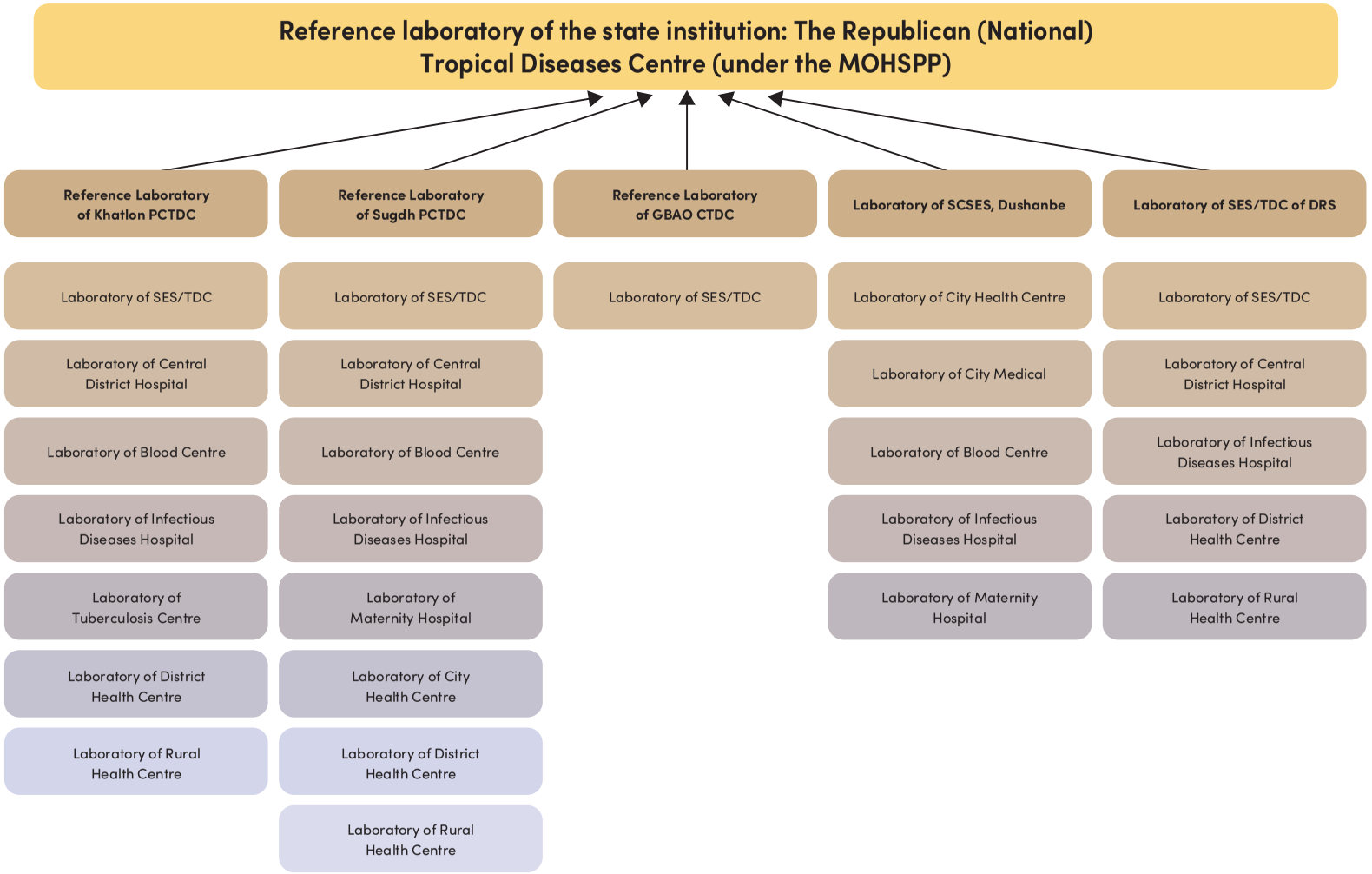
Annex 1. Data sources and analysis

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/Republic Centre for Tropical Diseases Control documentation – reports, registers of cases and foci, maps and guidelines;
  - National Report on the Elimination of Malaria in Tajikistan.
- 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 Tajikistan up to 2024;
  - 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 Tajikistan 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: annual number of cases (locally acquired and imported); 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 characteristic of parasites and vectors.

Annex 2. Laboratory network in Tajikistan



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