National Malaria Elimination Report: Bhutan

Submitted to the World Health Organization on: 15 June 2026
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List of abbreviations

ABER	Annual Blood Examination Rate
ACD	Active Case Detection
ACT	Artemisinin-based Combination Therapy
AIDS	Acquired Immunodeficiency Syndrome
API	Annual Parasite Incidence
APLMA	Asia Pacific Leaders Malaria Alliance
AUFI	Acute Undifferentiated Febrile Illness
BCG	Bacillus Calmette–Guérin
BCTA	Bhutan Construction and Transport Authority
BHTF	Bhutan Health Trust Fund
BHU	Basic Health Unit
BoQ	Bill of Quantities
BQPCA	Bhutan Qualifications and Professionals Certification Authority
CAGs	Community Action Groups
CDC	Centers for Disease Control and Prevention
CDD	Community Development Division
CFR	Case Fatality Rate
CME	Continuing Medical Education
CMO	Chief Medical Officer
CNVR	Catch-Neuter-Vaccinate-Release
COVID-19	Coronavirus Disease 2019
CPD	Continuing Professional Development
CVD	Cardiovascular Disease
DBS	Dried Blood Spot
DDT	Dichloro-Diphenyl-Trichloroethane
DHA	Dihydroartemisinin
DHIS2	District Health Information Software 2
DMS	District Malaria Supervisor
DNA	Deoxyribonucleic Acid
DOTs	Directly Observed Treatment, Short-course
DPHO	District Public Health Officer
eBMSIS	Electronic Bhutan Medical Supply Inventory System
EBS	Event-Based Surveillance
ECAMM	External Competency Assessment for Malaria Microscopy
ELISA	Enzyme-Linked Immunosorbent Assay
EmONC	Emergency Obstetric and Newborn Care
ePIS	electronic Patient Information System
EQA	External Quality Assessment

FAO	Food and Agriculture Organization
FYP	Five Year Plan
G6PD	Glucose-6-Phosphate Dehydrogenase
GDMO	General Duty Medical Officer
GDP	Gross Domestic Product
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GIS	Geographic Information System
GMC	Gelephu Mindfulness City
GNH	Gross National Happiness
GOI	Government of India
GPS	Global Positioning System
HA	Health Assistant
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
HTA	Health Technology Assessment
ICD-11	International Classification of Diseases, 11th Revision
iDES	integrated Drug Efficacy Surveillance
IEC	Information, Education and Communication
IHR	International Health Regulations
IM	Intramuscular
IMF	International Monetary Fund
IMTART	Indian Military Training Team
IQC	Internal Quality Control
IRS	Indoor Residual Spraying
ITNs	Insecticide-Treated Nets
IV	Intravenous
IVM	Integrated Vector Management
JDWNRH	Jigme Dorji Wangchuck National Referral Hospital
JICA	Japan International Cooperation Agency
KGUMSB	Khesar Gyalpo University of Medical Sciences of Bhutan
KPI	Key Performance Indicator
LDC	Least Developed Country
LIS	Laboratory Information System
LLIN	Long-Lasting Insecticidal Net
M&E	Monitoring and Evaluation
MBBS	Bachelor of Medicine, Bachelor of Surgery
MHPC	Medical and Health Professionals Council
MLT	Medical Laboratory Technologist
mNEQAS	Malaria National External Quality Assessment Scheme
MO	Medical Officer
MOIT	Ministry of Infrastructure and Transport

MS	Mass Supervisor
MT	Malaria Technician
NAAT	Nucleic Acid Amplification Test
NACP	National AIDS Control Programme
NCD	Non-Communicable Disease
NDSS	National Disease Surveillance System
NEQAS	National External Quality Assessment Scheme
NEWARS	National Early Warning, Alert and Response Surveillance
NHS	National Health Survey
NKRA	National Key Result Area
NMCP	National Malaria Control Programme
NMRL	National Malaria Reference Laboratory
NSP	National Strategic Plan
NTBCP	National Tuberculosis Control Programme
OG	Operational Group
OOP	Out-of-Pocket
OPV	Oral Polio Vaccine
ORC	Outreach Clinic
P&M	Professional and Management
PACD	Passive Case Detection
PBO	Piperonyl Butoxide
PCD	Passive Case Detection
PCR	Polymerase Chain Reaction
PDC	Private Diagnostic Centre
PEN	Package of Essential Noncommunicable Disease Interventions
PEN HEARTS	WHO PEN and HEARTS Technical Package
PF	Plasmodium falciparum
PHC	Primary Health Centre
pLDH	Parasite Lactate Dehydrogenase
POR	Prevention of Re-establishment
PPQ	Piperaquine
QA	Quality Assurance
QC	Quality Control
RACD	Reactive Active Case Detection
RBA	Royal Bhutan Army
RCDC	Royal Centers for Disease Control
RCSC	Royal Civil Service Commission
RDT	Rapid Diagnostic Test
RWSS	Rural Water Supply and Sanitation
RGoB	Royal Government of Bhutan
SDG	Sustainable Development Goal

SOP	Standard Operating Procedure
SPR	Slide Positivity Rate
SS	Support and Supervision
TAGME	Technical Advisory Group for Malaria Elimination
TAGPoR	Technical Advisory Group for Prevention of Re-establishment
THC	*Thromde* Health Centre
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
VCT	Voluntary Counselling and Testing
VDCP	Vector-borne Disease Control Programme
VHW	Village Health Worker
WHO	World Health Organization

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This report documents Bhutan's long and remarkable journey from a malaria-endemic country to one that has successfully interrupted indigenous malaria transmission and sustained zero indigenous cases. Such an achievement would not have been possible without the collective efforts of generations of health professionals, policymakers, local authorities, communities, and development partners. We gratefully acknowledge the sustained commitment of the Royal Government of Bhutan, successive health leaders whose tireless efforts made malaria elimination a reality.

We express our deep appreciation to the WHO Country Office in Bhutan, the WHO South-East Asia Regional Office (SEARO), and the WHO Global Malaria Programme (GMP), and all our development partners including the Government of India for their continued technical guidance and support throughout Bhutan's malaria elimination journey. We also acknowledge the Global Fund and other partners for their longstanding financial support, which has significantly strengthened malaria control, elimination, and prevention of re-establishment activities in the country.

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Finally, we acknowledge the communities of Bhutan and all partners whose collective efforts, vigilance, and collaboration transformed the vision of a malaria-free Bhutan into a reality. This National Malaria Elimination Report is an evidence of Bhutan's successful malaria elimination journey and its continued commitment to preventing the re-establishment of malaria transmission for future generations.

Executive summary

Bhutan has made major strides in controlling malaria since the launch of its National Malaria Eradication Programme (later renamed National Malaria Control Programme) in 1964 which has led to elimination of indigenous transmission of malaria since 2022. With implementation of active surveillance and indoor residual spraying (IRS) using dichlorodiphenyltrichloroethane (DDT), reported cases declined to 114 by 1966. In subsequent years, however, the number of reported cases rose. Surveillance was considered inadequate, leading to delays in identification of cases. Health system decentralization in the late 1970s was another major factor: while it expanded the primary health care system through increases in basic health units, it also created inefficiencies, with *dzongkhags* (districts) being unable to swiftly implement indoor residual spraying. Insecticide stockouts, early chloroquine resistance, and population movement and instability in the southern portion of the country exacerbated the problem. By 1994, the reported malaria cases had increased to almost 40 000, the highest on record. In the 1990s, Bhutan shifted further responsibility for the implementation and oversight of health services and malaria control to the *dzongkhag* and *gewog* (subdistrict) levels.

The National Malaria Control Programme was renamed the Vector-borne Disease Control Programme (VDCP) in 2003 and its mandate was extended to include other vector-borne diseases. Nevertheless, the primary workforce of the malaria programme, malaria technicians and health workers, posted in hospitals and basic health units, maintained a focus on malaria diagnosis, surveillance, reporting, coordination of vector control and entomological surveillance, and awareness-raising activities. Malaria cases declined from 1996 to 2005. Over the period 2006 − 2013, a phased malaria elimination strategy was adopted, aiming to eliminate the disease first in the nine epidemic-prone *dzongkhags* while continuing enhanced control strategies in the seven endemic *dzongkhags* in the south of the country.

Bhutan received a major Round 4 grant from the Global Fund to Fight AIDS, Tuberculosis and Malaria in 2006 and a Round 7 grant in 2008. These grants supported the scale-up and integration of new malaria interventions, notably the procurement and distribution of long-lasting insecticidal nets (LLINs) and the introduction of artemisinin-based combination therapy (ACT) for treatment of Plasmodium falciparum infections. Cases declined during this period until 2009, when an increase resulted from earlier than usual monsoon rains, delays in focal IRS application, fishery project development, and reduced effectiveness of the LLINs that had been distributed in 2006. Remedial action was taken and, in 2013, there were 14 indigenous and 34 imported cases reported in the country.

Bhutan is most receptive to malaria transmission from April to September, or during the warm monsoon period, while an increasing numbers have been reported between October and November in 2024 and 2025. A north-east monsoon occurs in winter, from November to March, with snowfall at higher elevations. Malaria in Bhutan has been seasonal, following a two-peak pattern: the first peak occurs before the start of the monsoon season and the second at the end of the monsoon season. In April, the rivers are shallow and temperatures sufficiently warm for vector breeding. During the monsoon, frequent heavy showers wash away the mosquito larvae but, as the rainy season subsides in August, conditions become once again conducive to vector breeding. The timing of IRS attempts to address the peak in malaria incidence.

Pre-control malaria has long affected Bhutan, especially residents along the country's southern border with India who have historically been at the highest risk for the disease. Nonetheless, historical records on malaria incidence and corresponding indicators (e.g. slide positivity rate, API, annual blood examination rate) have been kept only since 1965, one year after Bhutan formally established its malaria programme. The country's first malaria survey was conducted in November 1962, led by India's National Malaria Eradication Programme. Results indicated that Bhutan did have local malaria transmission, at varying intensities depending on altitude and climate. Parasite rates in children ranged from 10.7 to 55.5%, with higher prevalence of parasites in children living in Bhutan's foothill regions (altitude 150 − 300 metres). The 1962 survey also showed that *P. vivax* accounted for 47% of all malaria infections in Bhutan, whereas *P. falciparum* and *P. malariae* were responsible for 42% and 11% of total cases, respectively.

Since the early 2000s, Bhutan has been able to control malaria keeping indigenous malaria cases reported at a very low level over a sustained period of time; Bhutan interrupted indigenous malaria transmission in 2021 and has not reported a single case of indigenous malaria since 2022 despite having relatively free border crossings with Assam and West Bengal states in India where malaria is prevalent. Even during a massive epidemic of malaria in Assam state, India in 2024, the number of indigenous cases was kept at zero; this trend was also maintained during the transmission season the following year demonstrating the resilience of the country's health system in preventing re-establishment of malaria. Bhutan strives to achieve malaria-free certification by WHO in 2026, the national vision of 'a nation being with the best health'.

Bhutan has demonstrated zero indigenous cases of malaria over three consecutive years, a major criterion for consideration for malaria-free certification by WHO. In addition, Bhutan has demonstrated the resilience of its health system and its success in preventing re-establishment of malaria in the country even during an outbreak of malaria in neighbouring Assam state of India which shares a porous land border in 2024. The integrated health system of Bhutan has incorporated all major recommendations of WHO in achieving malaria elimination and preventing re-establishment of malaria.

Broadening the focus of the national malaria control programme to a vector-borne disease control programme has optimized control of vector-borne diseases by incorporating an integrated approach that is more cost effective. The lessons learned in malaria elimination and prevention of re-establishment of malaria are also applied to the control and elimination of other diseases while retaining the technical expertise required for prevention of re-establishment of malaria. The VDCP plays a stewardship role and focuses on multi- and intersectoral collaboration in all its activities.
Surveillance has been the cornerstone of Bhutan's malaria elimination and prevention of re-establishment of malaria programme. While emphasis is placed on passive case detection with provision of microscopy or RDTs ate primary care level, active case detection in terms of proactive and reactive case detection is conducted as and when required as per national guidelines that have been developed based on WHO recommendations.

Together with early detection, quality assured antimalaria treatment for uncomplicated malaria is provided at all positive cases detected by microscopy or RDT as per national treatment guidelines. Second line antimalarials and IV artesunate is available at referral hospitals.

A major threat to prevention of re-establishment of malaria is waning skills of malaria workers in diagnosis and doctors/clinicians ability to suspect malaria as the disease is now a rare occurrence. The VDCP assesses competencies of malaria workers and conducts regular training programmes for all categories of staff at regular intervals. In addition, material for quick reference has been developed; these materials are accessible to staff.

A major thrust of malaria control in the past and in the prevention of re-establishment of malaria in southern districts bordering India has been use of IRS; ITNs and LLINs are also used to complement IRS. The choice of insecticide used for IRS and LLINs are guided by insecticide resistance tests carried out in different ecological zones of the country and recommendations of WHO to alternate insecticides to prevent development of resistance.

Entomological surveillance is routinely carried out at different locations in the country. Detailed vector incrimination studies in Bhutan are scanty but there is a wealth of information from adjoining Assam state of India. There is a dearth of expertise in entomology in the country as well as a lack of adequate amounts of equipment and supplies for entomological surveillance in the country; this needs to be strengthened in the future.

The malaria control programme and subsequent malaria elimination and prevention of re-establishment programmes have been implemented focusing on providing quality assured services and products. All antimalarial commodities procured including RDTs, antimalarial drugs, insecticides and other antimalarial supplies are WHO-prequalified products which are tested prior to their shipment to the country. Human skills needed for malaria work such as microscopy, surveillance and response are assessed on a regular basis and routine training programmes are held to update their knowledge and skills.

Maintaining a high level of vigilance and awareness on malaria among the general public has been a major challenge in the face of dwindling numbers of malaria cases reported. The VDCP has initiated a series of health education programmes targeting mainly the vulnerable communities residing along the southern border with India to ensure prevention of re-establishment of malaria in the country. This outreach programme is facilitated by community action groups at village level; these community action groups raise awareness on malaria, the importance of Bhutan remaining malaria-free, when to suspect malaria, the need to consult a health professional, the importance of complying with treatment for radical cure and assist with mobilising communities for community participation for prevention re-establishment of malaria activities.

Bhutan has developed a digital inventory system which is accessible at all levels. Redistribution of supplies and requests for procurement of antimalarial commodities are guided by real time data generated by the system.

With malaria-free certification Bhutan will lose some funding opportunities for malaria; this is to be expected given the fact that there is no longer malaria transmission in the country. The Royal Government of Bhutan is committed to obtaining malaria-free certification in achieving the national vision of ‘a nation with the best health’. The Royal Government of Bhutan has demonstrated its commitment to this goal by providing additional funding through other funding mechanisms when donor funding was abruptly withdrawn in 2025; the activities that were affected

by withdrawal if funding was refinanced by the Royal Government of Bhutan without any impact on the technical aspects and implementation of the prevention of re-establishment of malaria.

As malaria across the Indian border is the looming threat for prevention of re-establishment of malaria in Bhutan, cross-border collaboration has been initiated with Indian counterparts with the facilitation of WHO and other donor agencies. However, though a system exists, the functioning of the system is not optimal and can be improved. In 2025, the extent of collaboration improved significantly with malaria officers from Bhutan visiting the Indian side for direct observations. It is proposed that such activities are increased in the future and more networking and joint plans and activities across both sides of the border to achieve the common goal of eliminating malaria from the area.

Bhutan is ready and has demonstrated its intent to embark on a new phase of prevention of re-establishment of malaria post-malaria-free certification. The national strategic plan for prevention of re-establishment malaria 2026 – 2030 has documented an impressive plan to overcome these. The greatest challenge for Bhutan will be maintaining high vigilance along the Indian border as long as malaria is prevalent on the Indian side of the border.

1. General Information

Bhutan is at the cusp of achieving another landmark goal in public health. The country has already interrupted indigenous malaria transmission since 2022 and is now eligible to be certified as malaria-free by the World Health Organisation (WHO) which is proposed to be achieved in 2026. With malaria-free certification, the whole country transits to the Prevention of Re-establishment (POR) phase of malaria (2026 to 2030) and beyond. This is a significant milestone achieved in line with the national vision of 'A Nation with the Best Health'.

No indigenous malaria cases have been reported in Bhutan since 2022. Even during the large number of cases reported in 2024, primarily originating from neighbouring country India, detailed epidemiological analysis revealed that there were only 9 introduced cases, the rest being imported cases. Some cases required detailed review including repeat field visits because of complex cross-border movement of population across the border villages with close socio-economic interactions. The ability of the health system of Bhutan to control the outbreak and prevent onward transmission and re-establishment is a testament of the system being capable of Preventing Re-establishment of malaria. The Royal Government of Bhutan (RGoB) has already earmarked additional funds required to sustain POR activities despite the dwindling external funding landscape. Preventing Re-establishment of malaria 2026-2030 program outlines the activities required for WHO malaria-free certification and prevention of re-establishment of malaria cases from 2026 to 2030 and beyond.

Sustaining elimination and prevention of re-establishment of malaria cases in Bhutan are implemented within the broader framework of vector-borne disease control. The programme operates as an integrated Vector-borne Disease Control Programme (VDCP), which also encompasses dengue and leishmaniasis control.

The National Malaria Elimination Report outlines the progress made in malaria elimination and the preparedness of the health system to prevent re-establishment of malaria in Bhutan post-certification. This report is a part of documentation submitted for the WHO malaria-free certification of the Kingdom of Bhutan. Following certification, Bhutan will implement the National Strategic Plan for Prevention of Re-establishment of Malaria 2026-2030.

1.1 Geography

Bhutan is a landlocked sovereign country of 38,394 square kilometres in the eastern Himalayas, bordered by China to the north (approximately 470 kilometres), including a border with China's Tibet Autonomous Region, and India to the south, east, and west (approximately 605 kilometres) (National Statistics Bureau, 2025). Its geography is defined by a mountainous terrain that ranges from subtropical foothills in the south to the high, snow-capped peaks of the Himalayas in the north, with fertile river valleys in the central region (Figure 1). The country's landscape is dramatic, with an area of 38,394 square kilometres and a diverse climate.

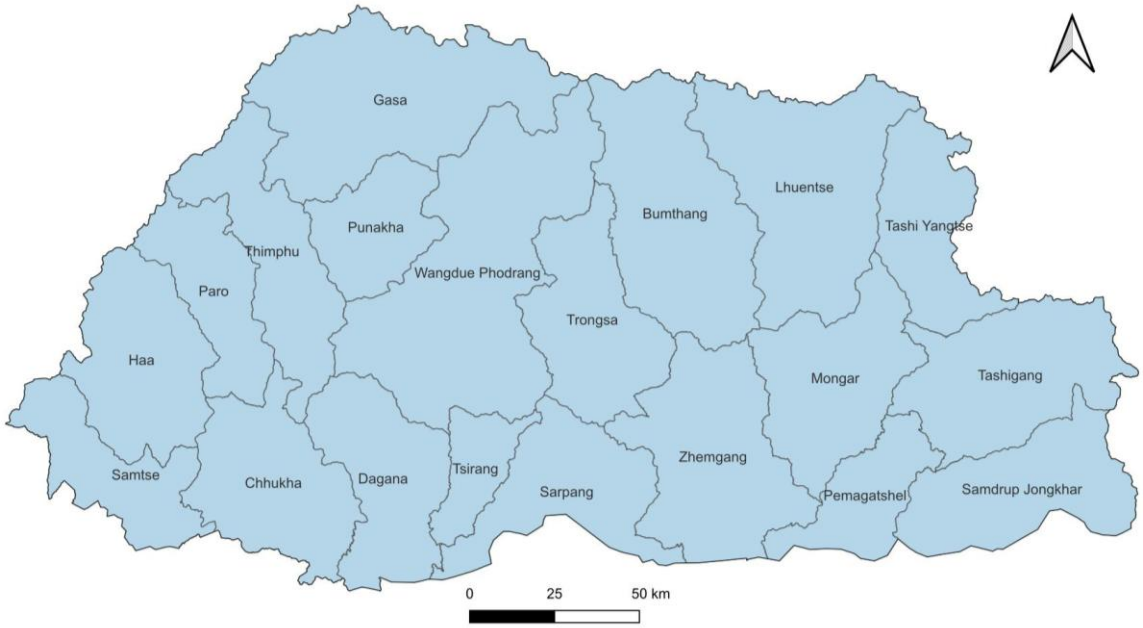


Figure 1. Map of Bhutan with its 20 administrative *dzongkhags* (districts)

The entire country is mountainous, with elevations ranging from approximately 160 metres in the south to 7,500 metres at its highest point in the Himalayas. About 70 percent of the Kingdom is covered with forests; 7 percent with year-round snow and glaciers; nearly 3 percent is cultivated or agriculture areas; and 4 percent as meadows and pastures, while the rest of the land is either barren, rocky or scrubland. Bhutan's geography can be divided into three main physical regions as:

- Southern Foothills: The subtropical southern region with dense forests and fertile land. The southern region experiences a warm, humid subtropical climate with abundant rainfall and temperatures that can exceed 35 °C during summer
- Inner Himalayas: A central zone with fertile river valleys, where most of the population lives and agriculture is prominent. The central valleys enjoy a cool temperate climate with moderate rainfall and distinct seasons
- Northern Himalayas: The high, northern part of the country characterized by high peaks, glaciers, and permanent snowfields.

Bhutan is one of the most forested countries in the world, with forests covering an estimated 69.71 percent of the country's total land area, equivalent to approximately 2.68 million hectares in 2022 (Department of Forests and Park Services, 2023). The remaining 30.29 percent of the land area comprises non-forest land uses, including snow and glaciers, settlements, agricultural land, water bodies, and other non-vegetated areas. Broadleaved forests constitute the largest share of forest cover, accounting for approximately 68 percent of Bhutan's forests, while coniferous forests account for about 32 percent as shown in Figure 2.

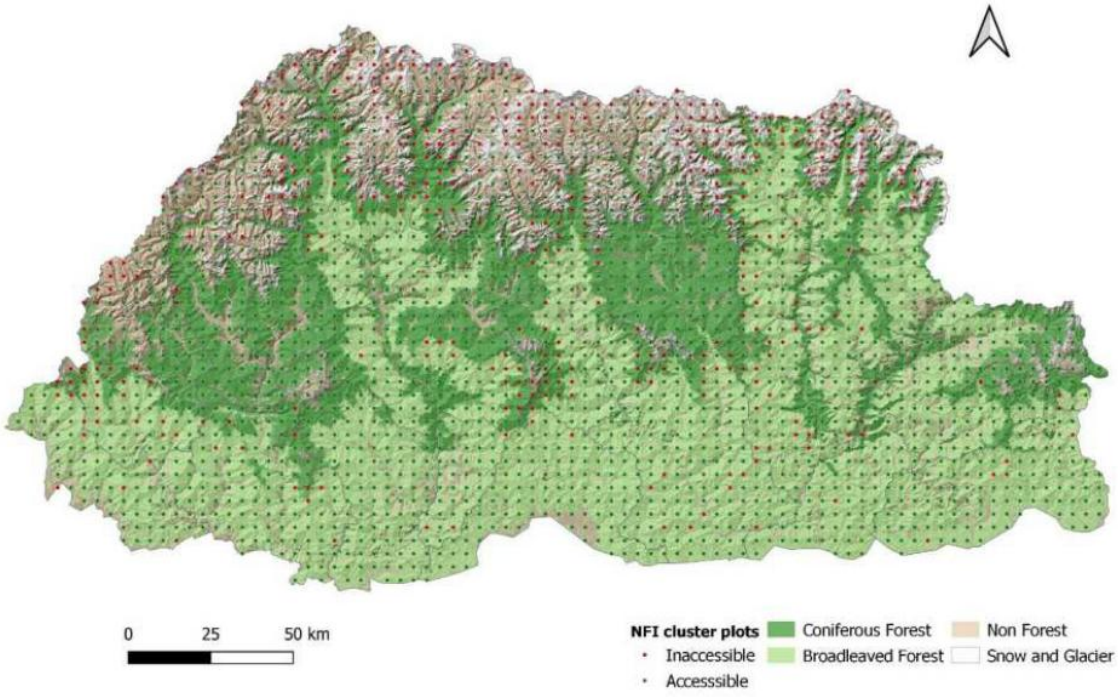


Figure 2. Types of forest cover based on the National Forest Inventory 2022

Article 5 of the Constitution of Bhutan emphasizes the protection, conservation, and improvement of the natural environment. It mandates that a minimum of 60 percent of the country's total land area shall remain under forest cover for all time and requires the State to conserve biodiversity, protect natural resources, and prevent ecological degradation (Royal Government of Bhutan, 2008).

1.2 Ecological regions

Bhutan's ecological zones are primarily determined by dramatic altitude changes, ranging from 100 metres above sea level in the south to over 7,500 metres in the north. The three main ecological zones are described shown in Figure 3 (Department of Forests and Park Services, 2021):

- Subtropical Zone (approx. 150 – 2,000 metres): Located in the southern foothills, this region is hot and humid with high rainfall, featuring dense tropical forests. It includes wet, humid, and dry subtropical sub-zones which are ideal for vector breeding.
- Temperate Zone (approx. 2,000 – 3,500 metres): Covering central Bhutan, this zone has a moderate climate with warm summers and cool, dry winters. It is characterized by mixed conifer and broadleaf forests.
- Alpine Zone (above 3,600 – >4,000 metres): Located in the northernmost regions, this area features high Himalayan peaks, very short summers, and extreme cold with substantial snowfall.

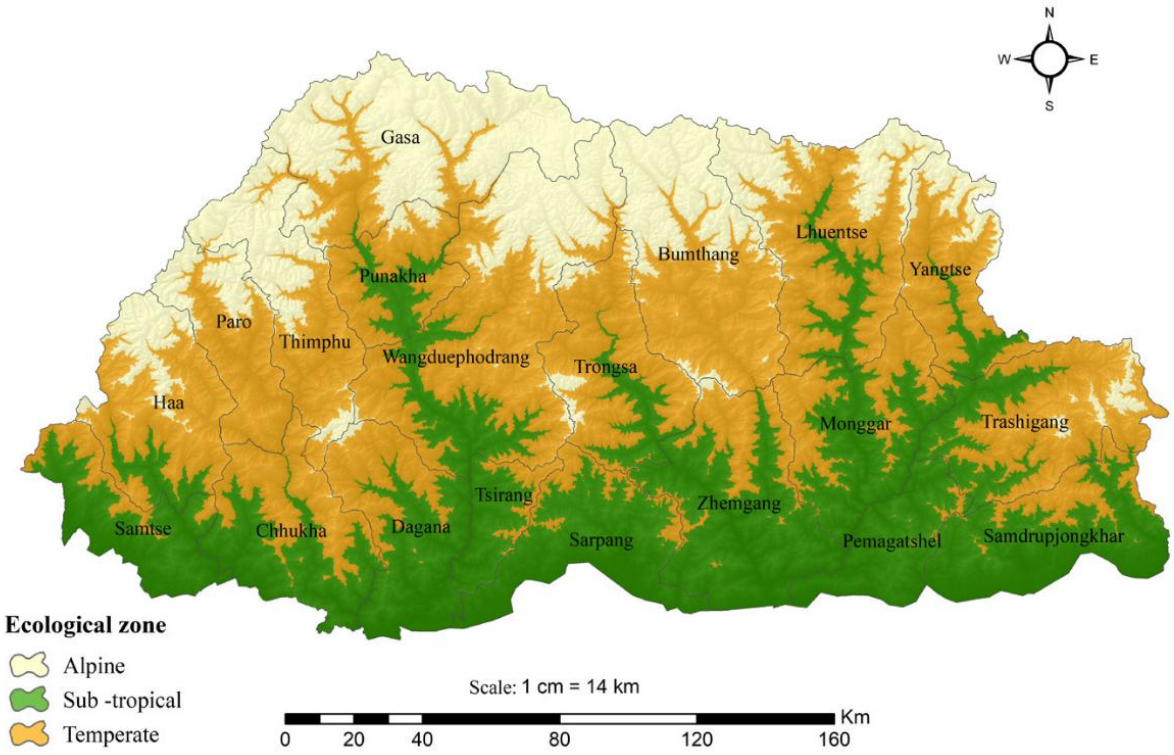


Figure 3. Map showing major ecological zones in Bhutan

1.3 Climate

The country experiences four distinct seasons. Spring (March to April) is generally dry and mild, characterized by blooming vegetation and rising temperatures. Summer (May to September) coincides with the monsoon season and receives the highest rainfall. Autumn (October to November) is marked by clear skies, pleasant temperatures, and excellent visibility. Winter (December to February) brings cold conditions, frost in many regions, and snowfall at elevations above 3,000 metres.

Bhutan's weather is strongly influenced by the South Asian monsoon system. The summer monsoon, extending from late June to September, brings heavy rainfall, high humidity, and occasional floods and landslides, particularly in southern and eastern regions. The rainfall within these three regions varies with annual precipitation of 2000 – 5000 millimetres in the south, 600 – 800 millimetres in the central region to about 75 – 200 millimetres in the north. The differences in these geo-climatic features are experienced even within a short distance due to steep mountains and deep valleys. This harsh geo-climatic factor has not only resulted in unique socio-cultural diversities but also given rise to different health conditions which is unique to the locality.

The southern foothills abound with tropical diseases such as malaria and increasingly dengue whereas respiratory diseases are more prevalent in the cold northern region. Malaria transmission primarily used to take place during the summer months peaking towards the end of the year; imported cases which are dependent on human migration patterns are reported throughout the year. In the historical past, the southern region was dreaded for the deathly disease (*tshed-pai naed*), malaria. Further, Bhutan's fragile ecosystem makes it very vulnerable to the impacts of global

warming and climate change, and susceptible to natural disasters such as floods and earthquakes. It is also located in region identified as one of the global hotspots for emerging and re-emerging infectious diseases (World Health Organization Regional Office for South-East Asia, 2014).

1.4 Political and administrative system

The government of Bhutan is a democratic constitutional monarchy since 18 July 2008 with the King of Bhutan as the Head of State. The hereditary monarchy was established in 1907 with the coronation of Ugyen Wangchuck as the First Druk Gyalpo. The country underwent significant political reforms under the Fourth Druk Gyalpo, Jigme Singye Wangchuck, culminating in the adoption of Bhutan's first Constitution in 2008 and the transition to a democratic constitutional monarchy. The Fifth Druk Gyalpo, Jigme Khesar Namgyel Wangchuck is the reigning monarch since 09 December 2006.

Under the Constitution of the Kingdom of Bhutan 2008, the Druk Gyalpo serves as the Head of State, while executive authority is exercised by an elected government headed by the Prime Minister (Royal Government of Bhutan, 2008). The Parliament consists of two houses: the National Assembly and the National Council. The National Assembly comprises 47 elected members representing constituencies across 20 *dzongkhags* (districts). The National Council, consisting of 20 elected members and five eminent members nominated by the Druk Gyalpo. The National Council is constitutionally designated as a 'continuous House' that is never dissolved, ensuring uninterrupted legislative and review functions.

Bhutan has a multi-party electoral system, with political parties registered with the Election Commission of Bhutan (ECB) before they participate in National Assembly elections. Under the Constitution 2008, all registered political parties compete in a primary round, after which the two parties receiving the highest number of votes advance to the general election forming the Ruling and the Opposition Parties in the National Assembly. Following the General Elections held in January 2024, the People's Democratic Party (PDP) is the ruling government while Bhutan Tendrel Party (BTP) is the opposition in the National Assembly. The Health Minister is a member of the Cabinet, appointed amongst an elected member of the ruling party in the National Assembly.

The Judiciary of Bhutan consists of the Royal Courts of Justice: *Dzongkhag* and *Dungkhag* Courts, High Court and the Supreme Court, which is the highest appellate authority. The Constitution mandates separation of functions of the Executive, Legislature and the Judiciary.

On the National Day celebration on 17 December 2023, His Majesty Jigme Khesar Namgyel Wangchuck announced the Gelephu Mindfulness City (GMC) as a Special Administrative Region. The GMC is guided by Bhutan's philosophy of Gross National Happiness and mindfulness living.

1.4.1 Executive Government

Under the Constitution of Bhutan, executive power is vested in the *Lhengye Zhungtshog* (Council of Ministers), which is headed by the Prime Minister. The Prime Minister is the leader of the political party that secures the majority of seats in the National Assembly. The appointment of the Prime Ministers and members of the *Lhengye Zhungtshog* is one of the prerogatives of His Majesty

the King under the Constitution 2008. The executive government is guided by the principles of state policy that requires the State to provide free basic education and access to healthcare, promote economic self-reliance, ensure justice and equality, protect the environment, foster international peace and cooperation, safeguard the country's cultural and spiritual traditions and be guided by the principle of Gross National Happiness (GNH).

1.4.2 Local Government

Bhutan has 20 administrative districts. As per the Local Government Act of Bhutan 2009, the local government comprises of *Dzongkhag Tshogdu*, *Thromde Tshogde* and *Gewog Tshogde*. All members of the local governments are elected and are not members of any political party.

The *Dzongkhag Tshogdu* is the highest decision-making body within the *Dzongkhag*. The *Dzongkhag Tshogdu* comprises elected *Gups* from the *Gewogs*, elected representatives from the *Dzongkhag Thromdes*, and Members of Parliament from the *Dzongkhag* as ex-officio members. The *Dzongkhag Tshogdu* is headed by the *Dzongkhag Thrizin*. The *Dzongkhag* Administration is headed by the *Dzongdag*. The *Dzongkhag* administration has administrative power over the civil servants including primary health workers in the district.

There are three *Thromde Tshogde* in three urban municipalities in Thimphu, Phuentsholing and Samdrup Jongkhar as of 2026. The *Thromde Tshogde* is chaired by the *Thrompon*, and the *tshogde* comprises of elected representatives, known as *Thromde Thuemis*, who represent local constituencies. In 2026, the charges of the *Thromde Tshogde* in Gelephu has been handed over to the Governor of the Gelephu Mindfulness City.

There are 205 *Gewogs* in the country. Each *Gewog Tshogde* comprises of the *Gup*, *Mangmi* and *Tshogpas* representing *gewogs* (blocks) and *chiwogs* (villages). The *Gup* is the chairperson of the *Gewog Tshogde*.

1.4.3 Gelephu Mindfulness City

GMC is a Special Administrative Region announced by His Majesty Jigme Khesar Namgyel Wangchuck on 17 December 2023. As a Special Administrative Region, GMC is granted greater autonomy to pilot innovative governance systems, business-friendly policies, and sustainable development approaches while preserving Bhutan's cultural values and environmental commitments. His Majesty The King heads the GMC as the chairperson of the GMC Authority. Its administrative structure includes the Chief Executive Officer, GMC Board of Directors, Governor and an independent court of justice.

At the core of GMC is the Diamond Strategy, a transformative vision of His Majesty The King that promotes balanced national transformation through interconnected areas of development. Guided by the "One Country, Two Systems" approach, GMC serves as a testing ground for progressive policies, technologies, and governance models that can be adapted and scaled across the country. Its key thrust areas include sustainable economic growth, environmental conservation, regional connectivity, education and innovation, healthcare and wellness, cultural preservation, and good governance.

1.5 Population and its movement

The mid-year population of Bhutan in 2025 was projected to be 784,043 with a median age of 30.2 years (National Statistics Bureau of Bhutan, 2019). In 2025, life expectancy at birth was reported as 73.5 years for both sexes (75.6 years for females and 71.8 years for males). The rural population makes up 62.2% of the total population of Bhutan. Thimphu Dzongkhag has the largest population (138,736), constituting 19.1% of the total population of the country, while the least populated is Gasa Dzongkhag (0.5%) with 3,952 persons. The population density in Bhutan in 2025 was 21 persons per km^2; Thimphu was the largest city with a population of 98,676 (Ministry of Health, 2025).

Bhutan has been witnessing a decline in fertility with drop in crude birth rate and total fertility rate. The total fertility rate as 1.9 in 2017 and is expected to decline to 1.7 by 2032 and plateau. The life expectancy is expected to increase to 76.8 years (78.5 for females and 75.2 for males by 2047) (National Statistics Bureau of Bhutan, 2019).

In 2025, approximately 20.4% of the population was aged 0 – 14 years (162,214 people), 73.0% were of working age (15 – 64 years) (581,672 people), and 6.6% were aged 65 years and above (52,803 people) as shown in Figure 4.

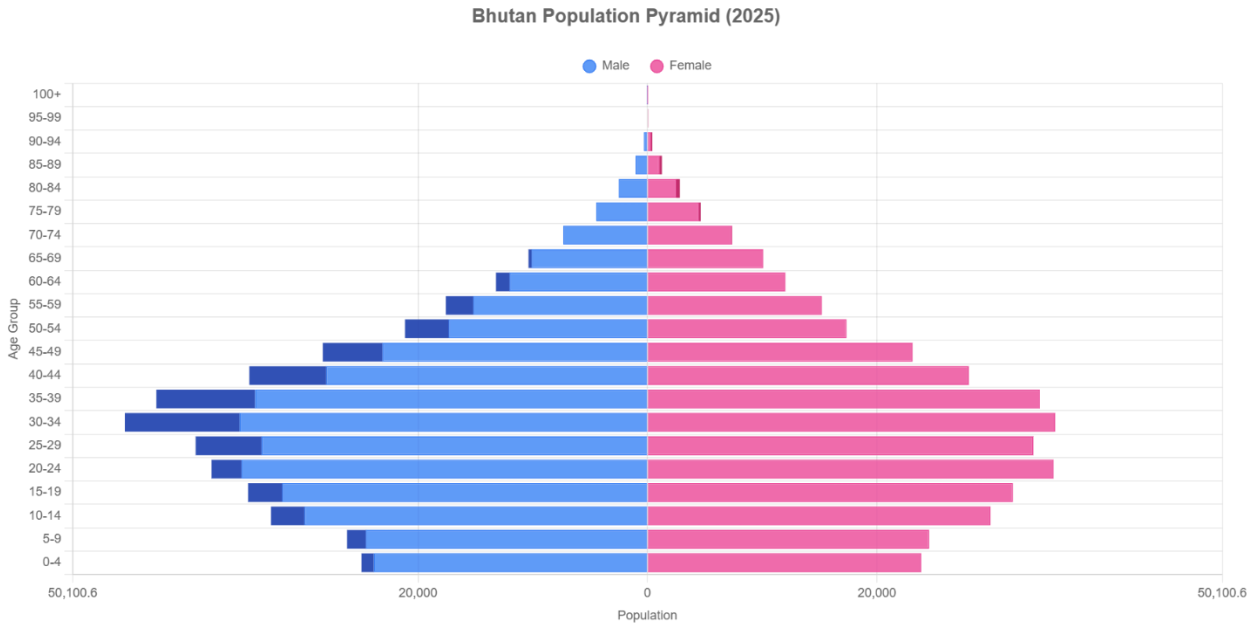


Figure 4. Population pyramid for 2025 (Projections based on Population and Housing Census 2017)

1.5.1 Age and sex distribution of the population

The population has a sex ratio of roughly 114.6 males per 100 females (Figure 4). In 2025, the projected male population was approximately 425,498 (53.4%) and the projected female population was 371,191 (46.6%).

The population is ageing, with the 60+ demographic growing. While still having a relatively young population, the proportion of adults aged 60 and older is increasing, rising from 7% in 2005 to 8.8% in 2017 during the Population and Housing Census (National Statistics Bureau, 2017c). The population is maturing, with the average age increasing from 29.94 years in 2024 to 30.47 in 2025. The proportion of people aged 65 and older is projected to reach 13.7% by 2030 and 20.3% by 2050 (T. Dorji, Dorji, et al., 2024).

1.5.3 Special populations

The majority of malaria cases reported in Bhutan during the past 5 years has been in farmers engaged in farming activities along the Indian border. Some migrants from India have also contributed to imported cases. Students, mostly studying in India, also comprise an important source of importation. Deploying army personnel for United Nations (UN) peace-keeping missions in Africa is another source of malaria importation.

The majority of malaria cases have been reported among adult males. However, during the malaria outbreak in 2024, there were a few cases reported among children under 5 years and among those 5 – 14 years indicating the risk among children who travel with family or reside across the border.

Border malaria along the Indo-Bhutan land border is a major threat to malaria elimination and prevention of re-establishment of malaria in Bhutan. The risk of cross-border malaria importation arises through human migration and the potential movement of infected vectors across border areas. Although migration across the border is restricted to a limited number of border check posts (gates), this by itself is sufficient to result in imported infections and limited introduced cases, as observed during the 2024 outbreak in neighbouring India.

1.6 Gross National Happiness

Gross National Happiness (GNH), propounded in 1972 by His Majesty Jigme Singye Wangchuck, is the guiding development philosophy enshrined in the Constitution of Bhutan (Royal Government of Bhutan, 2008). It mandates the State to promote conditions that enable the pursuit of holistic wellbeing. GNH is operationalized on daily government functioning to ensure that national policies and development strategies remain aligned with the broader goal of collective happiness and sustainable development.

GNH is a holistic multidimensional concept (Ura et al., 2023). It recognizes the spiritual, physical, social, and material needs of individuals and emphasizes equal importance across all these domains of wellbeing. The GNH framework is structured around four pillars: (1) sustainable and equitable socio-economic development, (2) environmental conservation, (3) preservation and promotion of culture, and (4) good governance. These pillars are further described under nine domains that collectively measure population wellbeing (Figure 5). Together, these nine domains are assessed through 33 clustered indicators and 124 variables, providing a comprehensive framework for evaluating and monitoring holistic wellbeing in Bhutan. Malaria elimination efforts can be seen through these domains with the overall aim of ensuring that the right conditions are established for happiness of every citizen.

Figure 5. Nine domains of Gross National Happiness (GNH). Malaria elimination efforts can be seen through these domains with the overall aim of ensuring that the right conditions are established for happiness of every citizen (Source: Centre for Bhutan and GNH Studies)

Among these domains, the health domain plays a central role in assessing population wellbeing. It encompasses both physical and mental health status, access to healthcare services, health-related behaviours, and overall health outcomes. The domain reflects the importance of not only the absence of disease but also the presence of conditions that support a healthy and productive life. Within the GNH framework, health is closely linked with other domains such as environmental quality, living standards, and psychological wellbeing, highlighting its interdependent nature in determining overall happiness and quality of life.

1.7 Economy

The nominal (current) Gross Domestic Product (GDP) of Bhutan is United States (US) $3.41 billion as of 2025, according to the International Monetary Fund (IMF). The GDP growth rate in 2025 is 6.8%. The GDP per capita in Bhutan according to the World Bank data was US$ 3,831.3 (2023). Bhutan successfully graduated from the United Nations Least Developed Country (LDC) category on 13 December 2023, marking a significant milestone in its socio-economic development journey. The graduation reflects sustained progress in improving national income, human assets, and economic resilience through investments in health, education, infrastructure, and good governance.

Guided by Bhutan's national development philosophy of GNH, Bhutan follows a Five-Year Plan (FYP) development framework. The current FYP is the 13th in series (2024-2029) and has 17

National Key Result Areas (NKRAs). The implementation of the activities are done by signing the Annual Performance Agreement between the Prime Minister and Ministers, Ministers and Secretaries and Secretaries and departments and Divisions which are all linked to the individual performances and to financial and programmatic performance systems.

The current 13th FYP focuses on transitioning to a high-income economy by 2034 through transforming the agrifood sector, boosting economic growth (7 – 8% target), digital innovation, green development (like solar energy, sustainable transport), job creation, and public sector reform, while maintaining environmental sustainability (carbon neutrality with 60% forest cover). This plan integrates a 10-year strategic vision, a four-cluster approach for implementation, and key performance indicators (KPIs) like reducing youth unemployment and trade deficit, supported by partners like the World Bank and UN.

For expenditures, budget proposals within the plans are prepared by government agencies and consolidated by the Ministry of Finance. The annual budget is submitted to Parliament for review and approval, ensuring legislative oversight of public expenditure. Budget implementation is monitored through established financial management systems, while accountability is strengthened through parliamentary scrutiny and independent audits conducted by the Royal Audit Authority.

1.8 Health profile

The country has achieved remarkable successes in public health sectors such as maternal and child health, vaccine-preventable diseases in children and women, control of communicable diseases such as leprosy, improvement in access to safe drinking water and sanitation, reduction in diarrhoeal diseases in children under 5 years from 5331 cases of dysentery in 2004 to 344 cases in 2025, 12260 cases of watery diarrhoea in 2004 to 5838 in 2025, and an overall increase in life-expectancy (Ministry of Health, 2025a). The health infrastructure covers more than 96.8% of the population within 2 hours of travel distance, 99.7% of the population have access to improved drinking water services and 95.2% have access to improved sanitation facilities (Ministry of Health, 2025a). Bhutan was awarded the Open Defecation Free award by the United Nations Children's Fund (UNICEF) in 2022. There are no overt health inequities or disparities in terms of conventional comparisons such as the percentage coverage of the health network, staffing and health financing and primary healthcare indicators. The overall summary of the health indicators as given in Table 1.

Table 1. Basic health indicators of the Kingdom of Bhutan

Health indicators	Current status	Source
Maternal Mortality Ratio (Per 100,000)	53	NHS 2023
Deliveries attended by skilled health worker (%)	98.50%	NHS 2023
Institutional delivery (%)	98	NHS 2023
Under 5 mortality rate (Per 1000)	19.5	NHS 2023
Neonatal Mortality Rate (Per 1000)	6.9	NHS 2023
Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations	85	NACP 2024
Total new cases of HIV among young adults (15 – 24 years)	9	NACP 2024
Total TB cases detected	920	NTBCP 2024
Malaria incidence (indigenous) per 1,000 risk population	0	VDCP
Suicide mortality rate per 100,000 population	2.3	NHS 2023
The road crash fatality rate (per 10,000 vehicles)	11.05	BCTA, MOIT
Contraceptive prevalence rate (aged 15 – 49 years)	74.2	NHS 2023
Unmet need for family planning	8.5	NHS 2023
Percentage of population within 2 hours to the nearest health facility	96.8	NHS 2023
Percentage of death due to illness	78.1	NHS 2023
Number of death due to unintentional poisoning	0.5	NHS 2023
The prevalence of current use of any tobacco product among 15 – 69 years population	31.4	NHS 2023
Population aged 15 – 69 years who are current smoker	14.2%	NHS 2023
Incidence of low birth weight among newborns	11.70%	UNICEF/WHO (2022)
Anaemia prevalence in children	44.70%	
Anaemia prevalence in women of reproductive age	33.80%	World Bank
Proportion of the target population covered by all vaccines included in the national immunization programme	>98%	WHO
Hospital beds per 1000 persons	2.2	World Bank
Timeliness of death registration coverage	98.60%	Vital Statistics Report, Bhutan 2021
International Health Regulations (IHR) core capacity score	64	WHO 2025

1.8.1 Vaccine-preventable diseases

Bhutan achieved major milestones in vaccine-preventable diseases with poliomyelitis free status in 2014 (T. Dorji et al., 2019), measles eliminated in 2017 and rubella eliminated in 2023. During the COVID-19 pandemic, Bhutan exhibited an exemplary effort in securing COVID-19 vaccines, managed the logistics of transportation and distribution, and delivered it to every corner of the country, including delivering vaccines at people's homes (T. Dorji & Tamang, 2021; Phuntsho et al., 2022; S. T. Tamang & Dorji, 2022). This had a major impact in preventing severe forms of COVID-19 and reducing COVID-19 related deaths in the country. These achievements reflect the

system readiness for solving public health problems and sustaining the efforts to maintain elimination status. The vaccination coverage under the Expanded Programme on Immunization is as shown in Table 2.

Table 2. Coverage of childhood vaccination in Bhutan, 2023

Vaccines	Coverage (%)	Source
Crude childhood immunization coverage	99.4	NHS 2023
Proportion of 1 year-old children immunized against measles (MR1)	99.4	NHS 2023
BCG	100	NHS 2023
Penta/DTP-HipB1	100	NHS 2023
Penta/DTP-HipB2	100	NHS 2023
Penta/DTP-HipB3	100	NHS 2023
OPV0	97.8	NHS 2023
OPV1	100	NHS 2023
OPV2	100	NHS 2023
OPV3	100	NHS 2023

1.8.2 Communicable diseases

Bhutan has a triple burden of diseases with communicable diseases still comprising of major burden, and increasing burden of non-communicable diseases (NCDs) and the increasing threat of emerging and re-emerging diseases. In communicable diseases, the burden of childhood diarrhoea has seen a significant reduction in the country while acute respiratory infections remain as a major proportion of morbidity among children. Among adults, respiratory infection remains a major cause of hospital admissions. Scrub typhus is a common cause of fever among those residing in the temperate and the foothills region (Tsheten et al., 2022). While the number of HIV detected has risen to 1020 by 2024, the coverage of anti-retroviral therapy is 98% with a robust surveillance system. The burden of pulmonary tuberculosis has declined from 1026 in 2004 to 920 cases in 2024, with an increasing proportion of multi-drug resistant tuberculosis detected. The national tuberculosis programme has a robust system of detection, case management and follow up. Dengue is considered as one of the emerging threats in Bhutan with a large outbreak in 2019 (Tsheten et al., 2021). However, the number of cases detected remains low in the following years with fever surveillance conducted through the reporting of Acute Undifferentiated Febrile Illness by the Royal Centers for Diseases Control (RCDC).

1.8.3 Non-communicable diseases

With improving socio-economic conditions and income level of the population, there has been an increase in the burden of non-communicable diseases (M. Tamang et al., 2022). Alcoholic liver disease is a major NCD. According to the National Health Survey (NHS) 2023, diabetes cases have increased substantially with a rise in the prevalence from 2.1% in 2019 to 5.6% in 2023 (Ministry of Health, 2024a). Hypertension prevalence rose from 28% in 2019 to 30.1% in 2023. Ischemic heart disease cases increased to 508 from 439 in 2022, while rheumatic heart disease cases decreased slightly to 584 from 686 in the previous year. The NHS 2023 report also revealed

an increase in cardiovascular disease (CVD) risk from 3.7% in 2019 to 5.1% in 2023, supporting the observed rise in NCD cases.

Cancer is another non-communicable disease of increasing burden. The common cancers among adults were cancers of stomach, cervical and breast. Given the high prevalence of *H pylori*, a flagship national screening program for *H pylori* and gastric cancer was implemented. This was followed by a triple and quadruple therapy treatment (T. Dorji, Wangmo, et al., 2024; Pempa et al., 2024). For cervical cancer, Bhutan adopted the DNA-based screening method, improved skills and quality of colposcopy and strengthened the capacity for management of cervical cancer (N. Dorji et al., 2026). In fact, Bhutan has achieved the 90-70-90 targets for cervical cancer in 2022, way ahead of the WHO targets for 2030 (N. Dorji et al., 2025). Through the flagship programme, the country now has improved capacity for the diagnosis and management of the top-three common cancers in Bhutan. In addition, the Ministry of Health is in active pursuit of establishing an oncology centre as well as implementing preventive measures at a public health level (Ministry of Health, 2019).

Another challenge with rising burden of NCDs is the high proportions of its risk factors. According to the National Health Survey 2023, 40.2% of the surveyed population consumed alcohol in the past 12 months and 34.5% consumed alcohol in the past 30 days. Beer was the most popular beverage followed by home-brewed *ara*, *bangchang*, and *singchang*. There were 31.4% who reported using various forms of tobacco products and 14.4% were current smokers with mean age of smoking initiation at 18.2 years. The proportion of those who consumed areca nut (*doma*) or areca nut-containing products was 59.7% with 45.4% reported daily consumption. The prevalence of insufficient fruits and vegetables intake (less than 5 servings per day) was 74.6%. The average daily intake of fruits was 1.6 servings and average vegetable intake was 3.7 servings. The average daily intake of salt was higher than recommended daily allowance. The average daily salt intake was 8.5 grams. The percentage of population with insufficient physical activity was 18.3%. The proportion of adults who were overweight was 33% and the proportion who were obese was 12.5%. The proportion of population with raised blood sugar was 5.6%. Among these individuals, 59.4% of them were not aware of their raised blood sugar levels. Among those who were aware about their raised blood sugar levels, 1.3% were not on any treatment, 13.5% were on treatment but had uncontrolled good sugar, and 25.8% were on treatment and had controlled sugar levels.

The prevalence of raised blood cholesterol was 20.9%. Among these individuals, 90.5% were not aware of their raised cholesterol levels. Among those who were aware about their raised cholesterol levels, 2.4% were no receiving any treatment, 0.9% were on treatment but had uncontrolled cholesterol levels, and 6.1% were on treatment and had controlled cholesterol levels. Among population older than 40 years, the proportion with >30% CVD risk was 5.3%.

To address the rising burden of NCDs, the country has piloted the WHO Package of Essential NCD (PEN) protocol since 2009, and from 2019 onwards, it adopted the enhanced People-Centered Care-PEN HEARTS project. The program is now implemented as Service with Care and Compassion Initiative (SCCI) that was awarded the 2022 UN Interagency Task Force and the WHO Special Programme on Primary Health Care Award. The award was received virtually by the Health Minister during the 77th Session of the United Nations General Assembly side event held on 21 September 2022 in New York, United States.

Bhutan's maternal mortality ratio declined dramatically from 969 per 100 000 live births in 1985 to 53 per 100 000 live births in 2024, achieving the SDG-3 target (< 70 per 100 000 live births) ahead of time (Dorjey et al., 2026). This reduction was supported by expansion of healthcare infrastructure, increased skilled birth attendance (> 98%), high antenatal care coverage (98.5%), and implementation of key programs such as the Safe Motherhood Initiative, Emergency Obstetric and Newborn Care (EmONC), and Maternal and Perinatal Death Surveillance and Response.

1.8.4 Efforts for rabies and malaria free status

Over last several years, the health system has undergone two rounds of transformation reflecting its dynamisms to prepare for the needs and challenges of the future. These changes also reflect Bhutan's commitment to provide the best health for its people while COVID-19 brought in significant changes and strengthening of the overall health system in Bhutan. In the recent times, in addition to the impressive coverage and management of COVID-19 in the country (Phuntsho et al., 2022), the country has completed another impressive public health intervention to prevent rabies deaths. The intervention was strongly influenced by Buddhist principles of compassion and non-harm to all beings including animals. The interventions were a humane and sustainable approach to dog population management, recognizing both animal welfare and public health considerations. The strategy focuses primarily on Catch–Neuter–Vaccinate–Release (CNVR) programme, with some dogs given shelters in protected areas. Large-scale sterilization and vaccination campaigns have been implemented across urban and rural areas through collaboration between the government, local authorities, and animal welfare organizations. By October 2023, over 150,000 street dogs were treated across all 205 *gewogs*, and more than 32,000 pet dogs were microchipped for digital identification with a coverage of 100% over multiple rounds of campaigns. As a result of this initiative, Gelephu has become the first town in the country that is free of stray dogs.

As health is one of the domains of the GNH index, as well as an in important topic of wellbeing, a national with the best health remains a priority for the Royal Government of Bhutan. Elimination of malaria from the country, taking into consideration all factors related to malaria transmission, is one of the components of the overall vision for health in the country.

Bhutan's pursuit of WHO malaria elimination certification by 2025 was delayed due to an outbreak in neighbouring India in 2024 which resulted in an increase in imported malaria cases and a small number of epidemiologically linked introduced cases in border localities, without any indigenous transmission. The country has made significant strides in reducing both the incidence and the impact of malaria over recent decades, positioning itself well to meet its elimination objectives. In 2023, there were 18 reported cases, an increase from 6 cases in 2022. Among these 18 cases, 14 were imported, 4 were introduced cases, and 0 indigenous cases. Alongside its efforts to control malaria, Bhutan faced a substantial dengue outbreak in 2019, with over 5000 cases reported across 19 *dzongkhags* with six deaths (Tsheten et al., 2021). Responding decisively, the Ministry of Health implemented proactive prevention and control measures in 2020, resulting in a remarkable 95% decrease in reported dengue cases, with only 238 cases recorded in 2020. This proactive approach underscores Bhutan's commitment to safeguarding public health and mitigating the impact of vector-borne diseases. Bhutan has made commendable progress in malaria control and

elimination, yet dengue remains a growing challenge. Continued efforts on integrated vector control measures, public awareness campaigns, effective usage of bed nets, early detection and management of cases and community engagement are essential to mitigate the burden.

1.9 Health system

Bhutan's healthcare system is overseen by the Ministry of Health. Healthcare delivery follows a structured three-tier model consisting of primary, secondary, and tertiary care centres. Patients requiring advanced care are referred from primary facilities to higher-tier institutions. A limited number of complex cases are referred to empaneled tertiary hospitals in neighbouring countries.

As part of transformative reforms to enhance clinical care delivery, National Medical Services was launched in 2023 to provide centralized stewardship of clinical services nationwide. Its mandate encompasses clinical service management, human resource coordination, quality assurance and standardization, and operational efficiency across hospitals and health centres. The Department of Public Health and the district public health office are responsible for implementing public health interventions and measures.

The Ministry of Health is guided by the National Health Policy 2011 (Ministry of Health, 2011). Guided by the principles of GNH, social justice, equity, and universal access, the policy recognizes health as a prerequisite for national development and the well-being of the population. It reaffirms the Royal Government of Bhutan's commitment to providing free healthcare services, including both modern and traditional medicine, as enshrined in the Constitution of the Kingdom of Bhutan (Royal Government of Bhutan, 2008).

The Ministry of Health further promotes disease prevention, health promotion, community participation, multisectoral collaboration, and the integration of traditional (*Sowa Rigpa*) and modern medicine (Thinley et al., 2017). It also prioritizes the development of a competent health workforce, strengthening of health information systems, sustainable health financing, and access to essential medicines and technologies to support universal health coverage and improve overall health outcomes across the country.

The mission of the Ministry of Health is to:

- Provide quality healthcare services in both traditional and modern medicines.
- Prevent, control, eliminate and eradicate diseases.
- Rehabilitate and promote healthy living.
- Ensure sustainable, responsive, equitable, accessible, reliable and affordable health services.

The organogram of the Ministry of Health is shown in Figure 6.

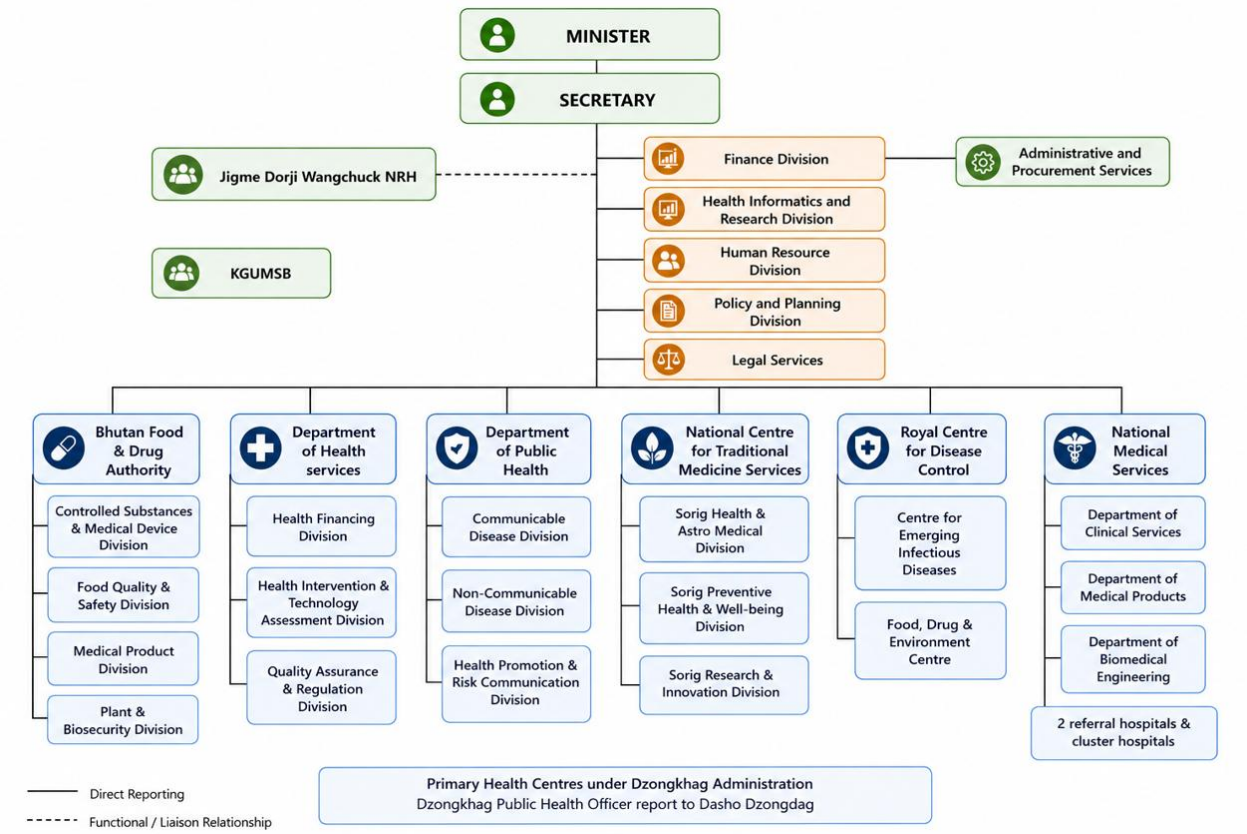


Figure 6. Overall structure of the healthcare system after Transformation 2.0 (2026)

1.9.1 Healthcare service delivery

There are two major forms of healthcare services provided by the Ministry of Health: *Sowa Rigpa* (traditional medicine) and allopathic medicine services.

Sowa Rigpa, the traditional medical system of Bhutan, has been practiced for centuries and forms an important part of the country's cultural and spiritual heritage. The system developed through the knowledge and practices of Bhutanese physicians, scholars, and spiritual masters, drawing upon indigenous healing traditions and Buddhist principles. *Sowa Rigpa* adopts a holistic approach to health, emphasizing the balance of the body's energies, proper nutrition, lifestyle, medicine, and mental well-being. Historically, it served as a primary source of healthcare for many communities and continues to play a significant role in promoting health and preventing disease (T. Dorji & Melgaard, 2017).

The formal integration of *Sowa Rigpa* into Bhutan's national healthcare system began 1960s with vision of His Majesty Jigme Dorji Wangchuck for the preservation and development of traditional medicine (Tenzin et al., 2024). The National Traditional Medicine Hospital and the Faculty of Traditional Medicine were established to provide clinical services, education, research, and the production of traditional medicines. Traditional medicine units are co-located with allopathic hospital, enabling citizens to access *Sowa Rigpa* services free of charge within the public healthcare system. In 2025, the National Centre for Traditional Medicine Services was established

to consolidate clinical services, training, research and promotion of *Sowa Rigpa* in the country and beyond.

For the modern medicine services, there is a three-tiered, fully-government funded system. As per the healthcare. The system has a wide network of primary healthcare centres, out-reach clinics and sub-posts, with clinical services streamlined through a referral pathway to secondary level district/general hospitals and tertiary level referral hospitals. The structure of the three-tiered systems as of 2026 are as follows:

- Primary Level: Sub-posts, Out-Reach Clinics (ORCs), Primary Healthcare Centres (PHC) in rural areas and *Thromde* Health Centres (THC) in urban areas. These provide basic, preventative, and primary care.
- Secondary Level: District Hospitals or General Hospital. These provide comprehensive services, including minor surgeries and child deliveries to referral services.
- Tertiary Level (National/Regional): Referral hospitals with specialist services. The apex facility is the Jigme Dorji Wangchuck National Referral Hospital (JDWNRH) in Thimphu. There are two regional referral hospitals, one each in Mongar (East) and Gelephu (Central).

As per the Healthcare Services Rules and Regulations 2025 and with the ongoing efforts of the Ministry of Health to establish multi-disciplinary and super-speciality hospitals, the healthcare system is in the process of transitioning to a four-tiered structure (Ministry of Health, 2025b).

1.9.2 Health infrastructure

With an extensive network of Primary Healthcare Centres, 96.8% of the population live within 2 hours of travel distance from the nearest health centre (Ministry of Health, 2025a). The health centres are staffed with healthcare workers as per the Healthcare Services Rules and Regulations. All health workers are employed by the Royal Civil Service Commission.

In 2025, there were a total of 59 hospitals which includes the IMTART Hospital in Haa and the Indo-Bhutan Friendship Hospital in Thimphu. There are 194 PHC/THC centres (including 5 THC in Thimphu and 1 in Phuentsholing). Additionally, there are 51 sub-posts, which serve as smaller healthcare units extending services to rural communities. Outreach clinics (ORCs) play a crucial role in providing healthcare access in remote areas. They are categorized based on infrastructure, with 479 ORCs having sheds and 76 operating without sheds (Figure 7). The distribution and location of the health care centres are shown in Figure 8.

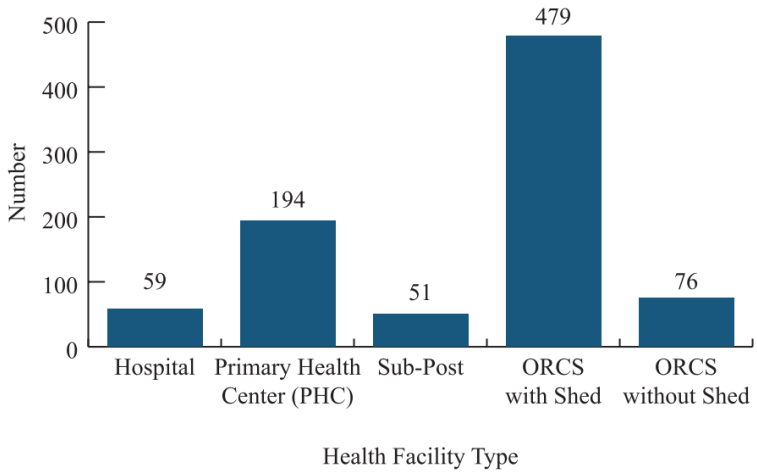


Figure 7. Number and types of healthcare facilities by levels on the three-tiered system (all are government institutions), 2025

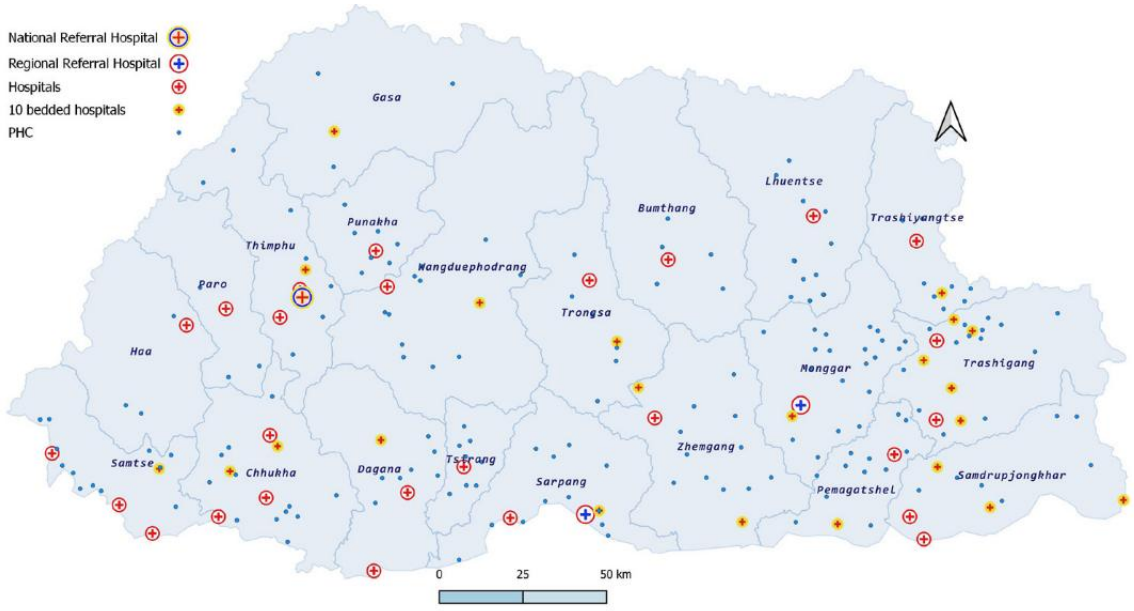


Figure 8. Network of distribution of health centres in Bhutan, 2025 (Source: Annual Health Bulletin 2025)

For malaria control at the community level, PHCs and ORCs support malaria prevention through health education, and surveillance. At PHCs, suspected malaria cases can be diagnosed and confirmed using Rapid Diagnostic Tests (RDTs) and microscopy, and uncomplicated cases are managed with appropriate antimalarial treatment as per the national management guideline (Ministry of Health, 2024b). Patients with severe or complicated malaria are rapidly identified and referred to the district or regional or national referral hospitals equipped with advanced diagnostic, inpatient, and critical care services. This integrated continuum of care ensures timely diagnosis

and treatment, reduces malaria-related morbidity and mortality, optimizes resource utilization, and strengthens the overall effectiveness of malaria control and elimination efforts.

When malaria cases are detected, Malaria Technicians and other health workers from the nearest health care facility respond with reactive case detection, foci investigation and public health interventions including indoor residual spray. These reflect the decentralization of response and intervention activities while the national programme has an oversight supervision and monitoring role and providing technical support wherever necessary.

1.9.3 Health workforce

Bhutan witnessed notable improvements in several key health workforce indicators over the five-year period. The number of doctors increased steadily from 336 in 2020 to 411 in 2024, with a corresponding rise in density from 4.62 to 5.29 per 10,000 population in 2025, indicating improved physician availability. Among the key categories, General Specialists and Sub-Specialists account for a total of 177 individuals, with a majority being male (111 males and 66 females). The Medical Officers (MS/CMO/MO/GDMO) category comprises 173 individuals, with a fairly balanced gender distribution of 85 males and 88 females (Ministry of Health, 2025a). There are about 25 medical doctors, nurses and midwives per 10,000 population who are responsible for treating illnesses under the allopathic system (Figure 9), the highest among all healthcare professionals.

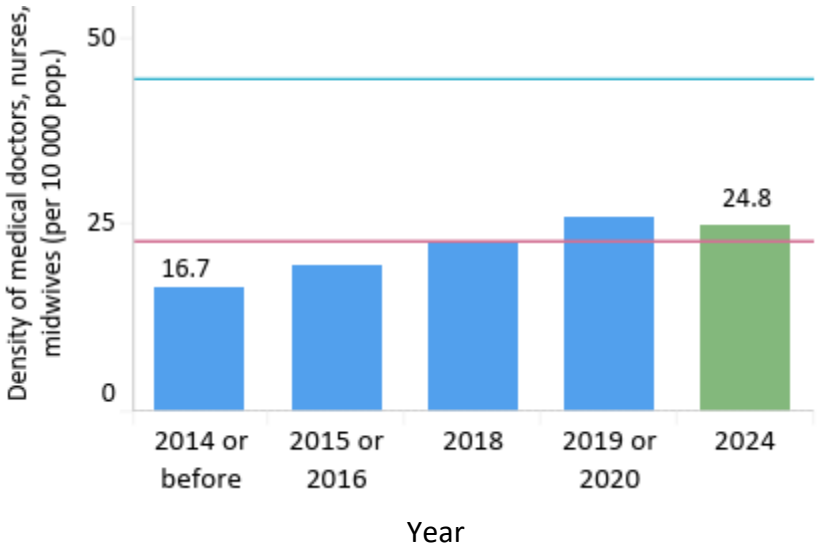


Figure 9. Density of medical doctors, nurses and midwives per 10,000 population in Bhutan (red horizontal line indicates the average number in Bhutan and the blue horizontal line indicates the average value in the region)

The distribution of health personnel in the country is skewed with the greatest proportion of health personnel being located in Thimphu and in Sarpang districts; a significant number of imported malaria cases are detected in Sarpang district. The majority of health personnel are stationed in secondary and tertiary care institutions. The majority of Health Assistants are stationed in primary care institutions (Figure 10).

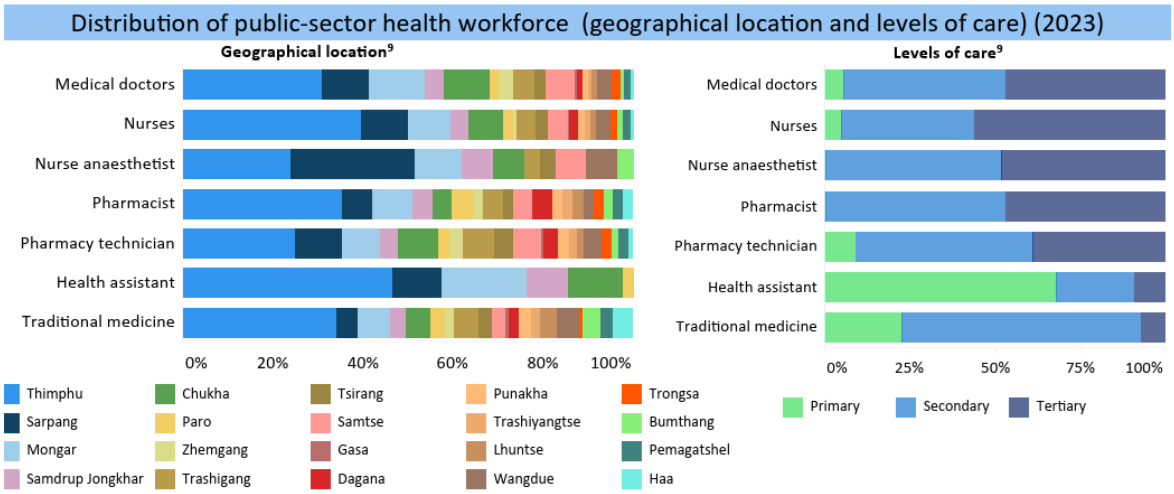


Figure 10. Distribution of public sector health workforce by geographic location and level of care in Bhutan in 2023. Source: Ministry of Health, National Medical Services as of 10 September 2024

The Royal Civil Service of Bhutan serves as the administrative backbone of the government and all categories of healthcare workers are employed by Royal Civil Service Commission (RCSC). The civil service operates through a structured framework that promotes merit-based recruitment, clear career progression, professional accountability, and efficient service delivery. The framework classifies civil servants into 21 positional levels distributed across the four categories (Figure 11):

- Executive and Specialist (ES)
- Professional and Management (P&M)
- Supervisory and Support (SS)
- Operational (OG)

The ES, P&M, SS and OG categories are is further organized into occupational groups under five super structures to ensure effective human resource management across government agencies. The five Super Structure groups are Executive and Specialist Service, Administrative Service, Finance Service, Educational and Technical Service (Royal Civil Service Commission, 2023).

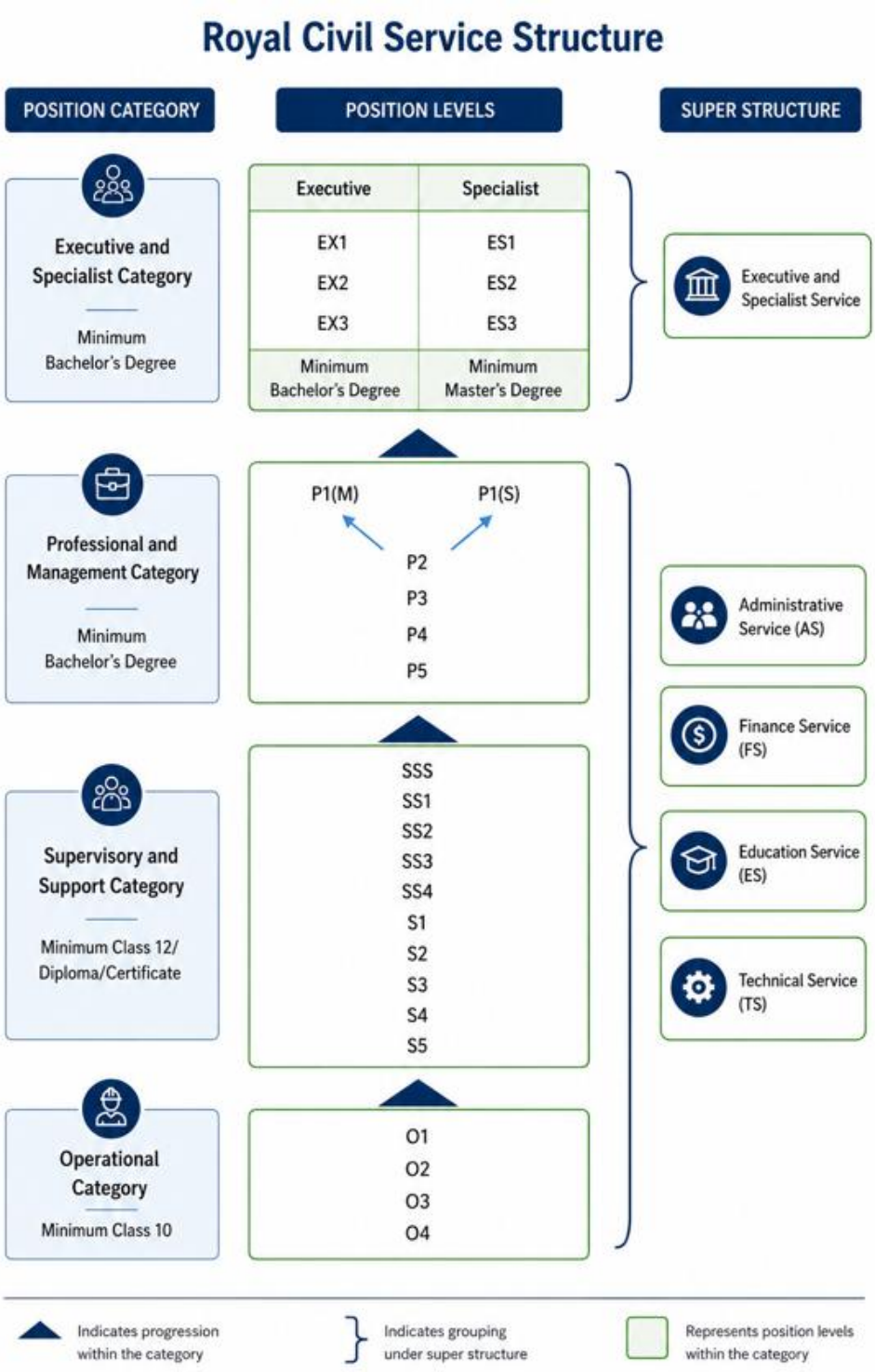


Figure 11. Structure of the Royal Civil Service under the Position Classification System. The Malaria Technicians are under SS category, program managers under P&M category. Source: Bhutan Civil Service Rules and Regulations, 2023

The Ministry of Health serves as the parent agency for Public Health Service under the Technical Service Super Structure. The VDCP is a national program established in 1964 under the

Communicable Disease Division (CDD) of the Department of Public Health, Ministry of Health and is based at Gelephu in Sarpang Dzongkhag in the southern belt of Bhutan. The program is responsible for prevention and control of vector borne diseases such as malaria, dengue, leishmaniasis and Japanese Encephalitis. The programme has 16 staff at the national headquarter in Gelephu supported by 31 Malaria Technician, under SS category, across eight malaria risk dzongkhags. The program operates through a centralized technical structure comprising entomology, laboratory, information management, and administrative support units, while implementation is carried out through district health services and malaria technicians stationed in high-risk districts. The program works closely with district health services, hospitals, and community health workers to ensure timely detection, investigation, and response to disease cases and outbreaks.

1.9.4 Health work force education and capacity development

The Khesar Gyalpo University of Medical Sciences of Bhutan (KGUMSB), established in 2013, is the first and only medical university in the country. The University serves as the apex institution responsible for overseeing medical and health sciences education and training in Bhutan. Mandated by an act of the Parliament, KGUMSB is entrusted with advancing medical education, promoting research, and strengthening the quality of healthcare services in the country. It currently comprises four faculties: the Faculty of Nursing and Public Health, the Faculty of Traditional Medicine, the Faculty of Postgraduate Medicine, and the Faculty of Undergraduate Medicine (Figure 12). In addition, it is affiliated with four private nursing institutions across the country. Diploma programs are offered under the Faculty of Nursing and Public Health. The Diploma in Entomology and Diploma in Medical and Laboratory Technology was established in 2023 and is delivered in collaboration with the VDCP, Gelephu (T. Dorji, Dorjee, et al., 2024). MBBS graduates trained abroad are also provided with a one-year internship programme by KGUMSB to ensure their orientation to the national health system and clinical practices in Bhutan.

The Bhutan Qualifications and Professionals Certification Authority (BQPCA), established in 2023 is the national authority for accreditation of qualification and professional certification. Its mandate encompasses monitoring the quality of education and training, awarding and recognizing qualifications and certifying, and regulating professional practices. To achieve this, the BQPCA functions through four specialized councils: Medical and Health Professionals Council (MHPC), Higher Education Quality Council, Technical and Vocational Education and Training – Quality Council and Engineering Professionals Council.

The Medical and Health Professionals Council (MHPC) functions as a specialized council under the BQPCA. Established originally under the Medical and Health Council Act (2002) and its Regulations (2005), the MHPC is responsible for regulating medical and health professionals, maintaining registers, and enforcing standards of professional ethics, etiquette, and conduct. It ensures uniform standards of medical and health education and training, accredits institutions, and mandates continuous professional development through ongoing medical education. By requiring practitioners to keep their knowledge and skills up to date, the MHPC guarantees that health staff remain competent and responsive to evolving public health challenges.

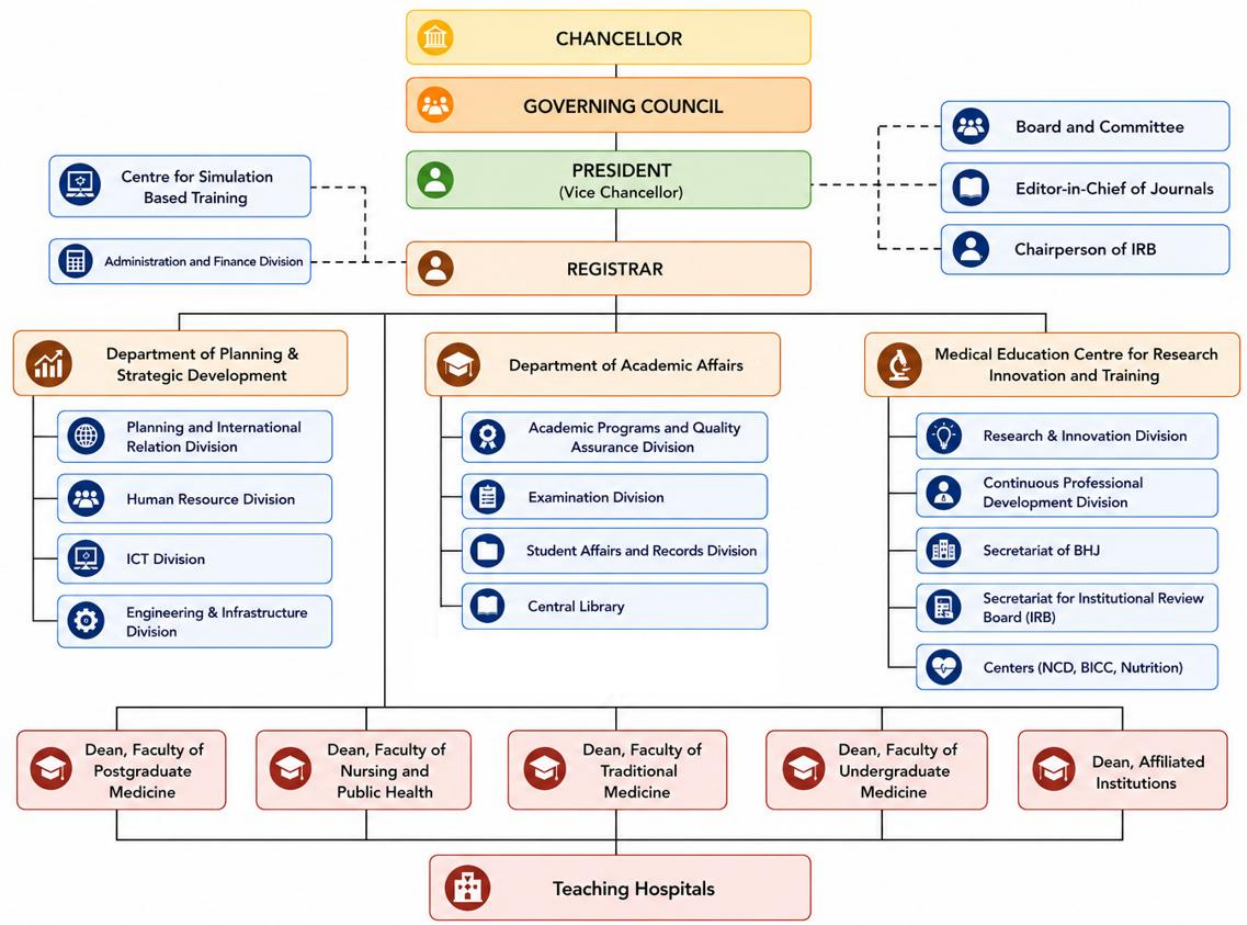


Figure 12. Overall structure and organogram of the Khesar Gyalpo University of Medical Sciences of Bhutan, 2026

Malaria is a key topic extensively covered across the curricula of all programmes under KGUMSB. Malaria-related learning is reinforced through outreach programmes, field activities, and community-based health interventions. Trainings also emphasize case management, prevention strategies, and the public health approach required for malaria control and elimination.

Given its role as the sole institution responsible for producing health professionals in Bhutan, KGUMSB plays a critical role in ensuring that graduates are adequately trained in malaria diagnosis, management, and prevention. This strong foundation of locally trained healthcare professionals and technical experts has enabled the development and implementation of nationally adapted policies, including the National Malaria Case Management Guidelines (Ministry of Health, 2024b) and the National Malaria Surveillance and Response Guidelines (Ministry of Health, 2020). These guidelines provide standardized approaches for malaria diagnosis, treatment, reporting, surveillance, and outbreak response. Such interventions are tailored to Bhutan's epidemiological context while aligning with international best practices. This positions the University as a central contributor to national malaria control and elimination efforts through education, training, and capacity building of the healthcare workforce.

KGUMSB promotes lifelong learning through its Continuous Professional Development (CPD) and Continuing Medical Education (CME) programmes. In addition, the national programme provides CME activities. As per the regulations of the MHPC, all healthcare workers must undergo a dedicated amount of continuing medical education such as on-site training, online courses, research publication, etc to accumulate CPD points. A minimum of 30 CPD credits, include at least 3 CME credits in the core subject) must be registered on the online portal maintained by the Council for the renewal of practice licences (Bhutan Medical and Health Council, 2009).

1.9.5 Health financing

Bhutan has a predominantly publicly funded, free healthcare system, mandated by its Constitution, with government revenue covering most costs and keeping out-of-pocket (OOP) expenses low (15-18%). Health expenditure has grown significantly, though rising NCD burdens and fiscal tightening pose sustainability challenges. Key focus areas include strengthening the Bhutan Health Trust Fund (BHTF), finding alternate sources of funding and strengthening health technology assessment (U. Tshering et al., 2024). Funds for healthcare services are allocated by the Ministry of Finance and all expenditures and procurements are as per the financial rules of the Royal Government of Bhutan.

Government revenue is the main source of health financing (approx. 73.4% in 2019/20) as shown in Table 3 and Figure 13 (Ministry of Health, 2021a). Health spending has increased from $30 per capita in 2000 to $134 in 2020, representing roughly 4 – 4.5% of GDP. BHTF is a self-sustaining mechanism used to procure essential vaccines and medicines, with efforts underway to strengthen its capital through diversification. Increasing NCD-related costs, rising demand for specialized services, and limited fiscal space post-pandemic are creating pressure on the public budget. Policy discussions focus on implementing health taxes, improving health technology assessment (HTA) for efficient resource allocation, and fostering public-private partnerships.

Table 3. Percentage of current health expenditure by source and financial year, 2016 – 2020

Source	Percentage of current health expenditure in financial year			
	2016/17	2017/18	2018/19	2019/20
Government	74.60	79.6	70.20	73.40
Corporations	0.30	0.30	0.30	0.10
Households	13.40	13.30	18.00	15.40
NPISH	0.0	0.0	1.30	1.20
Rest of the world	11.10	6.10	7.10	5.10
Others	0.60	0.70	3.10	4.70
NPISH: Non-Profit Institutions Serving Households				

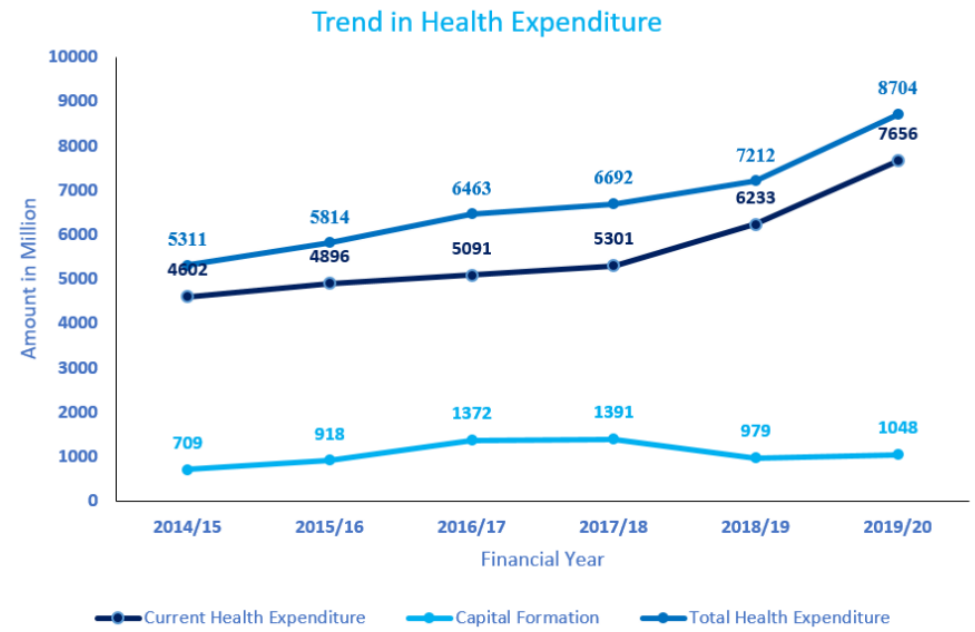


Figure 13. Trend of healthcare expenditure (million Ngultrums) between 2014 and 2020 (Source: Ministry of Health, 2021)

In general, per capita health spending and health spending as a percentage of GDP has been increasing from 2015 to 2022 (Figure 14).

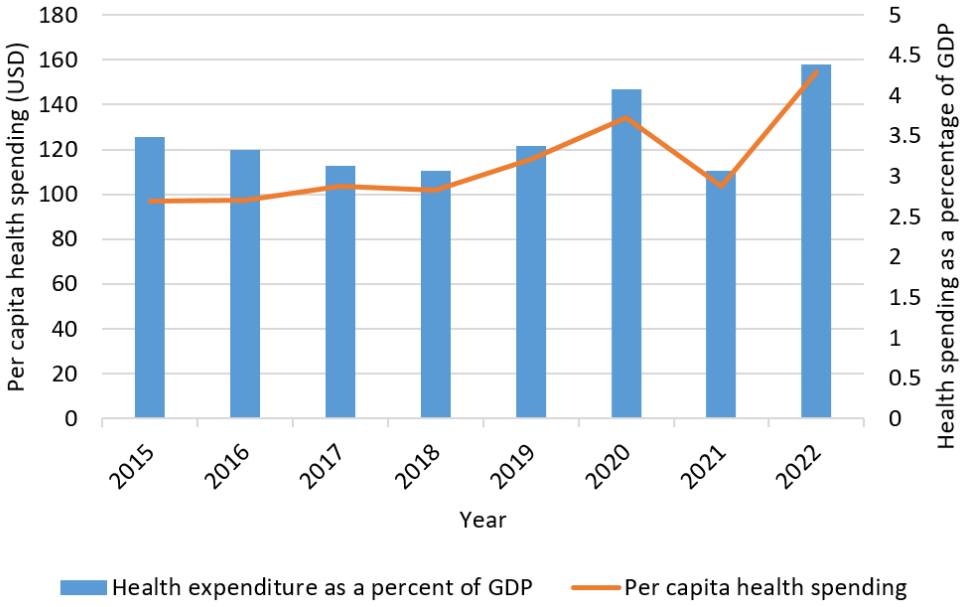


Figure 14. Per capita health spending and health spending as a percentage of GDP in Bhutan 2015 - 2022

The 13th FYP, Nu 19.125 billion, out of the total Nu 512 billion outlay for the plan period, is allocated to the health sector for the overarching Healthy *Drukyul* Programme, which serves as the primary national initiative to ensure universal health coverage and improved well-being for the

Bhutanese population. These funds are distributed across key areas such as improving health governance and delivery, investing in preventive and promotive healthcare, and strengthening health services and infrastructure. Specific investments include the construction of major infrastructure such as a National Cancer and Transplant Centre in Thimphu and a Mother and Child Hospital in Mongar, alongside the expansion of digital health solutions like electronic patient information systems. The key areas of expenditure under the social sector spending for the 13th FYP is shown in Table 4.

Table 4. Key areas of expenditure for the 13th Five Year Plan, 2024 – 2029

Project	Fund (Nu in million)	Funding Source
Health Promotion and Disease Prevention	122.7	RGoB/WHO/UNICEF
Safe and nutritious food	10	RGoB/ WHO/ UNICEF
Prevention, Control and Elimination of Infectious Diseases	864.39	RGoB/ WHO/ GFATM
People Centred Health Care Services for NCDs	121.5	RGoB/WHO
Bhutanese Traditional Medicine as a Centre of Excellence	108.1	RGoB
Access to Essential Medical Products and Vaccines	2.25	RGoB/WHO
Appropriate Use of Essential Medical Products	43	RGoB/WHO/UNDP
Quality and Safety of Healthcare Service Delivery	60.7	RGoB/WHO
Reference Centre for Disease Control and Prevention	399.98	RGoB/WHO Pandemic Fund/ CDC-USA/WHO
Environmental health	95	RGoB/WHO/UNICEF
Disability Prevention and Management	49.7	RGoB/UN/WHO
Reproductive, Maternal, Newborn, Child and Adolescent Health	440	RGoB/UNFPA/WHO/ World Bank/UNICEF
Capacity Building of Health Workforce	23.38	RGoB/WHO
Adequacy of Health Workforce	10	RGoB/WHO
Innovative Health System Governance	30	RGoB
Sustainable Health Financing	34.68	RGoB/WHO
Sustainable Health Financing	214.02	RGoB/WHO/STDF
International Regulations and Standards	43.08	RGoB
Pre and Post Market Control of Medical Products	165.45	RGoB
Sanitary and Phytosanitary Certifications Capacity	254.81	RGoB/STDF
Regulation of Healthcare and Wellbeing Services	51.3	RGoB/WHO
Health Emergency Preparedness and Response	221.5	RGoB/ WHO-Pandemic fund
National & International Standards	90.8	RGoB
Research and Development	91.77	RGoB/WHO
Digital health	38.38	RGoB/WHO/STDF
People Centred Health Care Services – healthcare infrastructure	8886.29	RGoB/WHO/GoI/JICA
Access to essential medical products and vaccines	5445.5	RGoB
Quality and safety of healthcare service delivery	25	RGoB/WHO

Next page

Continued

Disability Prevention and Management	100	RGoB/WHO
Antimicrobial resistance	30	Fleming fund
Capacity building of health work force	331.5	RGoB/WHO/GoI
Adequacy of health work force	17.5	RGoB
Research and development	5	RGoB
Digital Health	19	RGoB/ADB
Holistic and compassionate mental health care (The PEMA)	797.5	RGoB/GoI/ UNICEF/WHO/World Bank
Adequacy of health workforce (The PEMA)	12.5	RGoB/GoI/ UNICEF/WHO/ World Bank
Total	**19,125.19**	

2 Malaria in Bhutan

2.1 History of malaria

Malaria has been known for centuries in the southern belt in Bhutan and has been described as a deathly disease. In the Bhutanese language, it is called as *tshed-pai naed*, the deathly illness with fever.

2.1.1 Malaria eradication programme (1964 − 1970)

In 1964, Bhutan launched its own National Malaria Eradication Programme (later renamed National Malaria Control Programme, NMCP), led by Dr N. Sarkar of the Government of India. In 1961, there were only 2 hospitals, 11 dispensaries and three doctors in the country. As per the records of the First Five Year Plan between 1961 and 1966 (Royal Government of Bhutan, 1965), "A Public Health Department under a chief medical officer was set up at Thimphu. Steps were taken to eradicate malaria. 3 hospitals and 40 new dispensaries were established in different parts of country".

A reported 32 surveillance inspectors were in place by 1969, and, until 1975, the programme was largely overseen by Indian staff who trained local personnel in malaria control. Programme efforts were in line with the Global Malaria Eradication Programme, led by WHO, with the goal of eliminating malaria in Bhutan. The lowest number of recorded cases (114 cases) was reported in 1966 as shown in Figure 15. At that time, however, surveillance activities were still in their infancy, with a limited number of centres identifying and reporting cases.

Reported malaria cases and trends in Bhutan from 1964 – 1970 just after the national malaria eradication porgramme was set up is given in Table 5. During this period, less than 700 cases were reported each year. The Annual Blood Examination Rate (ABER) was above 10% and the API was above 2 per 1000 population (Kondrashin & Rashid, 1987; World Health Organization, 2015).

Table 5. Historical malaria cases and trends in Bhutan, 1964 – 1970

Year	Blood films	Positive cases	ABER	API	SPR	% PF[1]
1964	N/A	N/A	N/A	N/A	N/A	N/A
1965	10 189	518	11	5.5	5.1	20.1
1966	7148	114	7.1	1.5	2	15.5
1967	15329	405	7.6	2	2.6	11.2
1968	12913	247	6.4	1.2	1.9	12.3
1969	25531	672	12.4	3.1	2.6	28.8
1970	30886	630	14	2.9	2	24.5

[1]% PF= percentage of cases due to *P. falciparum*
Source: (Kondrashin & Rashid, 1987; World Health Organization, 2015)

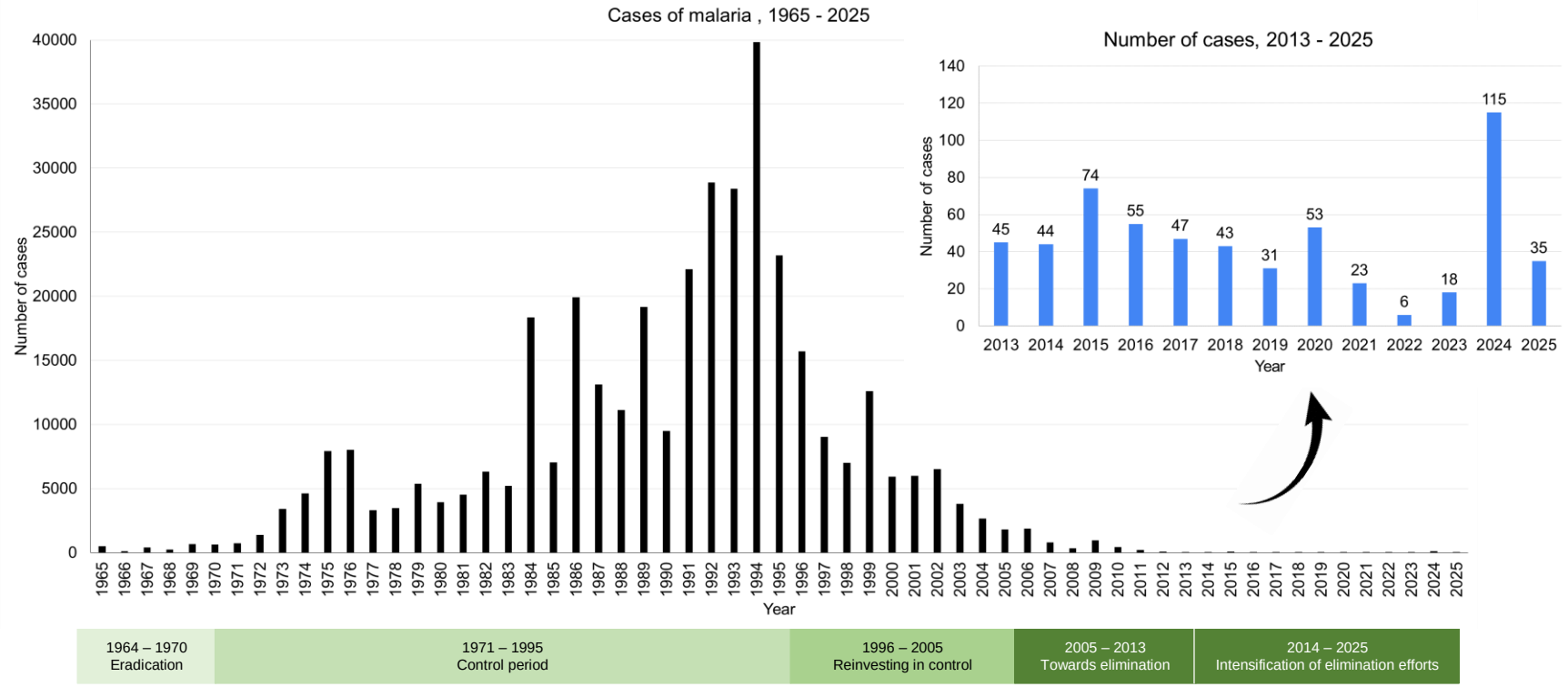


Figure 15. Malaria cases by phases of programme, 1964 – 2025. Data not available for 1964. Data for N1 + N2 for 2013 – 2025

Starting in 1969, several centres for active case detection were established in the southernmost *dzongkhags*, areas which generally experienced the highest burdens of malaria (Tobgay et al., 2011). In these areas, surveillance workers collected samples from every household and sent slides to the Indian malaria technician in Sarpang Dzongkhag for testing (Kondrashin & Rashid, 1987) until 1989. The number of health facilities increased dramatically during this period (Royal Government of Bhutan, 1976). By 1977 there were 10 hospitals, 31 Basic Health Units (BHUs) and 52 doctors.

Through the 1960s and 1970s, the main vector control intervention was indoor residual spray (IRS) with Dichlorodiphenyltrichloroethane (DDT). Between 1965 and 1974, the Bhutan programme conducted three rounds of IRS in malaria-endemic areas each year (Kondrashin & Rashid, 1987). An estimated 40% of the at-risk population for malaria were reached in 1965, but by 1973 an estimated 89% coverage had been achieved (Kondrashin & Rashid, 1987). The impact of IRS was rapidly apparent, reducing the API from 5.1 per 1000 population in 1965 to 2.6 in 1967 (Table 5). In 1974, however, the application of IRS was reduced to twice a year, and the programme struggled for the next five years to provide IRS to more than 50% of the country's at-risk populations. While this altered spraying schedule was in force, no malaria prevention activities preceded the June to September transmission (Kondrashin & Rashid, 1987). From 1971 onwards, malaria cases rose rapidly and the programme transitioned from an eradication programme to that of malaria control.

2.1.2 Malaria control (1971 − 1995)

The number of reported cases of malaria rose rapidly from 720 in 1971 to 3 402 in 1973 as shown in Table 6 (Kondrashin & Rashid, 1987; D. Tshering & Sithey, 2008). This rise was believed to be due to the increase in surveillance in the southern districts and greater access to passive case detection in the new hospitals and BHUs. Reported malaria cases peaked in 1975 and 1976, with approximately 8 000 cases each year. Over this period, too, the proportion of cases due to *P. falciparum* increased, from 11.2% in 1967 to 56.9% in 1975, possibly due to the reduction in IRS frequency that began in 1974.

In 1979, the programme shifted its objective to focus once again on malaria control and was integrated into the Government's general health services platform. The Fifth Five Year Plan of Bhutan (1981 − 1987) laid out goals of higher health standards in the country to be achieved by means that included health education, sanitation, hygiene and better nutrition, and prevention and control of common epidemics and communicable diseases including malaria (Royal Government of Bhutan, 1981). Basic health facilities for treatment and care were also to be extended. The Alma Ata Declaration of 1978, calling for the expansion of the primary health care approach, had been formally adopted by Bhutan in 1979 (T. Dorji & Melgaard, 2017) and the functions to be decentralized to *dzongkhag* level were set out by the Planning Commission in that year (Royal Government of Bhutan, 2002).

Table 6. Historical malaria cases and trends, 1971 − 1995

Year	Blood films	Positive cases	ABER	API	SPR	% PF[1]
1971	31 369	720	14.2	3.3	2.3	22.3
1972	38 703	1 376	16.2	5.7	3.6	25.3
1973	47 909	3 402	21.5	15.2	7.1	37.3
1974	47 874	4 623	21.3	20.5	9.6	48.4
1975	48 170	7 929	20.7	33	16.5	56.9
1976	47 699	8 035	31.3	50.6	16.9	53
1977	33 619	3 328	29	27.5	9.9	48
1978	39 518	3 483	30.3	28.7	8.8	42
1979	41 079	5 375	43.2	44.3	13.1	59
1980	45 487	3 993	41.5	45.9	8.7	55.7
1981	48 361	4 522	35	32.7	9.4	60.4
1982	51 939	6 328	34.8	42.4	12.2	48.2
1983	42 633	5 213	32.6	39.3	12.2	59
1984	62 667	18 368	48	140	29.3	55.9
1985	31 763	7 043	24.3	53.9	22.2	56.3
1986	82 639	19 916	52.5	126.4	24.1	52
1987	69 029	13 134	53.9	120.7	19	47.3
1988	51 164	11 134	44.6	97.2	21.7	46.8
1989	71 653	19 162	20.4	54.7	27	43.9
1990	33 973	9 497	19	54	28	43.5
1991	67 699	22 126	19	63	33	59.3
1992	73 986	28 900	21	83	39	48.7
1993	80 980	28 392	23	81	35	45.9
1994	97 425	39 852	28	114	41	42.3
1995	83 899	23 195	24	66	28	31.5

Note: Cases during this period were considered indigenous. The N1-N2-N3 classification system was not yet implemented

[1]% PF = percentage of cases due to *P. falciparum*

In 1985, four years after integration within the primary health care system and six years after the programme began reorienting towards malaria control (1979), the malaria eradication programme was renamed the National Malaria Control Programme, NMCP (Royal Government of Bhutan, 2002). Malaria control was integrated within the primary health care system, which at the same time expanded to service 65 additional BHUs by 1987 (Kondrashin & Rashid, 1987). The central level was still responsible for administration, training and major referrals, while the *dzongkhags* managed the delivery of basic services to the population through a network of *dzongkhag*-based hospitals, BHUs and ORCs.

During the same period, there was an increase in malaria incidence across the country with cases rising from 5 213 in 1983 to 18 368 in 1984 (Table 6). Most infections at this time were due to *P. falciparum*, which accounted for 59% of all infections in 1983 (Table 6). From 1985 to 1993, malaria cases fluctuated, from a low of 7 043 reported cases in 1985 to 28 900 in 1992. The increase

in transmission in 1984 was thought to be the result of several changes to the programme. In 1974, IRS, the primary malaria control intervention, had been reduced from three rounds to two each year (Kondrashin & Rashid, 1987). Moreover, because of integration, administration of IRS was handed over to *dzongkhags*. During this transition period, the quality of spraying activities was lower because of lack of supervision and guidance. In addition, the programme had introduced voluntary labour for IRS operations, but discontinued this practice around 1987 because it was found that coverage had decreased when volunteers were used.

In 1984, a stock-out of insecticide also resulted in reduced IRS coverage and contributed to the increase in cases. Reports for 1984 − 1987 also indicate the presence of resistance to chloroquine for treatment of *P. falciparum* (Kondrashin & Rashid, 1987). Vulnerability to malaria transmission at this time was increased by the movement of itinerant labourers, in particular those who moved between the state of Assam in India and Bhutan, coming into Bhutan for work (Kondrashin & Rashid, 1987). The 1985 outbreak began in Gurung Village in the Samtse District, and all cases occurred in male members of itinerant population groups. Those affected had reportedly travelled to Assam to sell potatoes some two to three weeks before becoming symptomatic. Frequent crossing of the porous border between Assam and Bhutan by migrant labourers was documented during this time (Kondrashin & Rashid, 1987). In the 1990s Bhutan was also affected by the armed insurgency in Assam, India. Indian separatist groups established illegal camps in Bhutan's southern forests.

2.1.3 Reinvesting in control (1996 − 2005)

From 1996 to 2005, Bhutan's development goals included the further decentralization of authority to the *dzongkhags* as capacity continued to increase in the lower administrative units. In addition, delegation of authority and functions from *dzongkhag* to *gewog* level, which had begun in 1990, was scaled up (Royal Government of Bhutan, 2002). To facilitate this transfer of authority, *Gewog Yargye Tshogchung* (Block Development Committees) were established in each of the 196 *gewogs* (Royal Government of Bhutan, 1997). With this further decentralization, the Royal Government reinforced the role of community involvement in all aspects of Bhutan's development. Throughout this transition, it remained the responsibility of line ministries to create the frameworks and standards for the operation of *dzongkhag* and *gewog* administrations (Royal Government of Bhutan, 2002).

In 2003 Bhutan's NMCP was renamed the Vector-borne Disease Control Programme (VDCP), extending its programmatic activities to include other diseases. The VDCP continued to be responsible for coordinating *dzongkhag* health teams and ensuring their capacity to carry out prevention of malaria and other vector-borne diseases (dengue, leishmaniasis, chikungunya, and Japanese encephalitis). It is part of the Communicable Disease Division within the Department of Public Health of the Ministry of Health and comprises four main units – Administration, Information Unit, Entomology and Parasitology Unit, Laboratory Unit and General Support Unit.

The VDCP relies upon the structure of Bhutan's national health system to provide malaria surveillance, case management, and prevention through an integrated community health approach (Vector-borne Disease Control Program, 2008). The national primary health care system comprised of BHUs, ORCs and sub-posts. The service delivery structure of the VDCP is based on

multipurpose malaria health workers, referred to as medical technicians (malaria), deployed to hospitals and BHUs in endemic districts as well as some epidemic-prone districts that have active foci of transmission (World Health Organization Regional Office for South-East Asia, 2010).

These medical technicians (malaria), whose salary is paid by the Ministry of Health, worked only on malaria and provided a wide range of services, including reading blood slides for malaria diagnosis, issuing treatment, case reporting and case follow-up. They supported IRS and Long-Lasting Insecticidal Net (LLIN) distribution, entomological surveillance, and information, education and communication (IEC) activities. Medical technicians were supported by health assistants, nurses and doctors who provided malaria treatment and care. Village Health Workers helped in carrying out IEC activities while spray operators conducted IRS, coordinated by the medical technicians.

The major goals of the VDCP during this period included accessing remote and rural, hard-to-reach populations, combating malaria transmission through cross-border prevention and management, and increasing public awareness of malaria (Royal Government of Bhutan, 2002). From 1994 onwards, malaria cases were classified as N1, N2 and N3; N1 refers to malaria cases among Bhutanese citizen, N2 refers to malaria cases among foreign nationals with overnight stays or temporary stays for work in Bhutan, and N3 refers to malaria cases among foreign nationals who do not stay overnight in Bhutan (daily commuters). N1+N2 cases declined by 55.7% between 1996 (15 696 cases) and 1998 (6955 cases) as shown in see Table 7 (Kondrashin & Rashid, 1987; D. Tshering & Sithey, 2008). In 1996, a relatively low proportion (38.3%) of recorded malaria cases were caused by *P. falciparum* (Ministry of Health and Education, 2002).

Table 7. Historical malaria cases and trends (N1+N2), 1996 − 2005

Year	Blood films	Positive cases	ABER	API	SPR	% PF[2]
1996	76 019	15 696	22	45	21	38
1997	68 153	9 029	19	26	13	40
1998	58 086	6 955	17	20	12	49
1999	79 859	12 591	23	36	16	51
2000	76 445	5 935	2	17	8	46
2001	65 974	5 982	19	17	9	53
2002	74 696	6 511	20	18	9	54
2003	61 246	3 806	17	9	5	44
2004	54 892	2 670	9	5	5	41
2005	60 152	1 825	14	4	3	52

[1]N1 refers to malaria cases of Bhutanese origin and N2 refers to malaria cases among foreign nationals with overnight stays in Bhutan.
[2]% PF = percentage of cases due to *P. falciparum*
Source: (Kondrashin & Rashid, 1987; D. Tshering & Sithey, 2008; World Health Organization, 2015)

Between 1996 and 2000, API fell from 45 to 17 per 1 000 population, respectively, but increased again to 36 in 1999, when there were 12591 cases and 53 deaths (Table 7); the worst affected age group in 1998 and 1999 was 15 − 49 years (Ministry of Health and Education, 2002). Between 2001 and 2004, malaria cases declined by nearly half, with only 2 670 confirmed cases in 2004 of

which 41.0% were due to *P. falciparum* infection. Reported malaria deaths declined from 39 in 1995 to 11 in 2002 and five in 2005 (World Health Organization, 2012)

2.1.4 Moving towards malaria elimination (2006 − 2012)

Bhutan established its most recent national malaria elimination agenda in 2010, aiming to achieve a 75% reduction in malaria morbidity and mortality from 2005 levels by 2013, elimination by 2016 and certification by 2020 (Yangzom et al., 2012). Although the VDCP operates as a central programme, covering the 20 *dzongkhags*, its principal focus is on areas where vector-borne diseases are more prevalent, including the seven endemic and nine epidemic-prone *dzongkhags* (Figure 16). The 2008 − 2013 malaria control strategy focused on: programme planning and management; prevention and control; early diagnosis and prompt treatment; epidemic and outbreak prediction and control; and human resources development (Vector-borne Disease Control Program, 2008).

This period saw the role of malaria technicians beginning to be integrated with control of other vector-borne diseases; these newly integrated health workers were then renamed "medical technicians (malaria)." It was expected that this integration of the position's roles may diminish malaria vigilance as other vector-borne diseases become a greater priority. Laboratory workloads in hospitals, especially during the peak malaria season, resulted in medical technicians (malaria) having to forgo malaria field activities, such as outreach (World Health Organization, 2013).

Furthermore, malaria microscopy training has not consistently been carried out; the last sessions were conducted in 1992, 1997, and 1998 (Ministry of Health, 2004) leading to possible decline in malaria diagnostic skills. In 2006, Bhutan received a Round 4 grant of US $ 1.34 million (total signed amount) from the Global Fund to Fight AIDS, Tuberculosis and Malaria. This grant supported the scale-up and integration of new malaria interventions, including the introduction of LLINs and the introduction of artemisinin-based combination therapy (ACT), artemether-lumefantrine (Wangdi et al., 2011)

A Round 7 grant began in 2008, with a total signed amount of US $ 2.65 million; Phase 2 of the grant was still ongoing in 2013. The Round 7 grant continued support of LLIN procurement and distribution, capacity building, and community leadership and action through Community Action Groups (CAGs). In 2006, Bhutan documented 1 868 malaria cases considered to be indigenous (N1+N2), 408 cases in foreign nationals considered to be imported (N3), and 6 malaria attributable deaths as shown in Tables 8 and 9 (World Health Organization, 2008), as well as a declining API of four per 1 000 population (Yangzom et al., 2012). Between 2008 and 2009 malaria cases increased almost threefold, from 329 to 972. In 2009 there was an increase in cases in all health centres in Sarpang Dzongkhag, along the southern border, which often receives cases from foreign nationals south of the border (World Health Organization Regional Office for South-East Asia, 2010). Another outbreak was reported in Tsirang Dzongkhag (World Health Organization Regional Office for South-East Asia, 2010).

Table 8. Malaria confirmed cases in Bhutan (N1 + N2), 2006 – 2012

Year	Blood films	Total positive	Total PF	% PF[1]	ABER	SPR	Death	CFR/100
2006	66 079	1 868	772	41.3	13.9	2.8	6	0.7
2007	51 446	793	288	36.3	10.7	1.5	2	0.5
2008	47 268	329	136	41.3	9.7	0.7	2	1.1
2009	62 341	972	474	48.8	12.6	1.6	4	0.7
2010	54 709	436	140	32.1	20.9	0.8	2	1.1
2011	44 481	194	87	44.8	6.5	0.4	1	1
2012	42 512	82	33	40.2	5.9	0.2	1	2.9

[1]%PF = percentage of cases due to *P. falciparum*
CFR = Case-fatality rate.

Table 9. Malaria confirmed cases in non-Bhutanese (N3) considered to be imported 2006 – 2012

Year	Blood Films	Total Positive	Total PF	% PF[1]	SPR
2006	9,692	408	255	62.50%	4.2
2007	9,020	60	28	46.70%	0.7
2008	4,038	32	18	56.30%	0.8
2009	6,043	126	99	78.60%	2.1
2010	8,529	29	14	48.30%	0.3
2011	10,205	45	35	77.80%	0.4
2012	16,047	24	14	58.30%	0.1

[1]%PF = percentage of cases due to *P. falciparum*

There were malaria outbreaks reported and investigated in 2009 (World Health Organization Regional Office for South-East Asia, 2010). These outbreaks were attributed to a combination of unusually early monsoon rains in 2009, delays in focal IRS application, fishery project development, and reduced insecticide effectiveness of the ageing LLINs distributed in 2006 and used beyond their intended 3-year lifespan (World Health Organization Regional Office for South-East Asia, 2010; Yangzom et al., 2012).

From 2010 to 2012 the number of cases declined, from 436 to 82 (N1+N2); 57.3% of the 82 cases in 2012 were attributed to *P. vivax* infection (Table 8). There were also 24 cases in foreign nationals (N3) in 2012, of which 58.3% were due to *P. falciparum* (Table 9). A new Malaria Case Notification Form was introduced in 2013, to identify cases as indigenous or imported. Using this form, the programme reported 17 N1 cases, of which 14, after analysis of travel history and taking into account an incubation period of 10 to 14 days, were considered indigenous.

All indigenous cases of 2013 were traceable by place of infection in Bhutan; the two N1 infections classified as imported were contracted in India. All 26 N2 cases were considered to be imported as they occurred in migrant hydropower project workers in areas where elimination had already been achieved. Three N3 cases were reported. Thus, there were 14 indigenous cases and 34 imported cases in 2013. As yet there was no evidence of the reintroduction of parasites due to

cases considered to be contracted outside Bhutan. During mass malaria screening of migrant labourers at development project sites, none had patent gametocytes (sexual stage of parasite) and no secondary transmission was identified. These results could be attributable to low numbers, or absence, of vectors as a result of ecological disturbances, cool climate or other factors. Overall, there as a case reduction of 97.4% in 2013 compared to 2005. It was hoped that the programme can conduct parasite genotyping to identify the exact location of the origin of infection but this has yet to be established.

2.1.5 Progressing towards malaria elimination (2013 – 2025)

Although Bhutan adopted a national malaria elimination agenda in 2010 aiming to achieve a 75% reduction in malaria morbidity and mortality from 2005 levels by 2013 and elimination by 2016 and certification by 2020 (Yangzom et al., 2012), these milestones could not be achieved primarily due to malaria being endemic in Assam state of India which comprises the southern land border of Bhutan coupled with free movements across the border which were largely unregulated. During this period, less than 100 cases of malaria were reported but, in 2024, 115 cases were reported due to a major outbreak of malaria in adjoining Assam state of India (Table 10 and 11). The land border in this stretch shared with India extends for 605 kilometres. Although entry and exit points are limited, there is free movement and migration of the population across the border both directions. In some regions, the border cuts through the villages and the community on either side of the border, though divided, freely move within the village. In addition, there is unrestricted movement of cattle and other animals which provides a blood meal source for the gonotrophic cycle of the mosquito which further facilitates malaria transmission in the area.

Although the percentage of *P. falciparum* infections was traditionally low in Bhutan in the past, during the 2013 – 2025 period the percentage of *P. falciparum* infections was approximately 20% except in 2024 and 2025 (Table 10 – 12). The ABER was consistently above 10% indicating adequate screening during this period in the elimination phase.

There have been no malaria deaths in the country since 2018 indicating the existence of an effective screening programme that detects cases early before going into complications that may be fatal. It also indicates that effective treatment is instituted early as per WHO guidelines. The low case fatality rate may also be due to the predominance of *P. vivax* infections which traditionally have a relatively low case fatality rate, though not uncommon, as compared to *P. falciparum* infections. The low case fatality rate also endorses the preparedness of the country to detect infections early and to provide early and effective treatment.

Table 10. Malaria confirmed cases in Bhutan (N1+N2), 2013 – 2025

Year	Blood films	Total positive	Total PF	% PF[1]	ABER	SPR	Death	CFR/100
2013	31 632	45	13	29	13	0.1	0	0
2014	33 593	44	13	30	14	0.1	0	0
2015	74 127	74	30	41	31	0.1	0	0
2016	30 460	55	12	22	13	0.2	0	0
2017	42 135	47	5	11	14	0.1	1	2.1
2018	37 331	43	13	30	12	0.1	1	2.3
2019	33 997	31	8	26	22	0.1	0	0
2020	29 741	53	8	15	19	0.2	0	0
2021	25 943	23	5	22	21	0.1	0	0
2022	42 221	6	1	17	26	0	0	0
2023	56 917	18	10	56	35	0	0	0
2024	39 962	115	6	5	24	0.3	0	0
2025	55 927	35	1	3	33	0.1	0	0

[1]% PF = percentage of cases due to *P. falciparum*

Table 11. Malaria confirmed imported cases in non-Bhutanese (N3), 2013 - 2025

Year	Blood Films	Total positive	Total PF	% PF[1]	SPR
2013	442	3	0	0	1
2014	45 676	10	2	20	0
2015	65 511	30	10	33	0
2016	88 381	19	8	42	0
2017	97 782	15	5	33	0
2018	91 795	11	4	36	0
2019	85 978	11	3	27	0
2020	541	1	0	0	0
2021	2 736	0	0	0	0
2022	43 886	5	0	0	0
2023	86 623	6	1	0	0
2024	76 426	29	1	0	0
2025	80 099	8	0	0	0

[1]% PF = percentage of cases due to *P. falciparum*

2.1.6 Factors contributing to change over time

Bhutan has shown an ongoing receptivity to malaria, having several types of vectors thought to be efficient transmitters of malaria. *Anopheles pseudowillmori* and *An. culicifacies* are suspected to be the main vectors, and both species are relatively abundant during the peak transmission season. In the areas bordering India, houses on both sides of the border are within the flight range of vectors and the environment appears suitable for transmission (World Health Organization, 2013).

The rapid economic development underway in Bhutan may change, or may have already changed, the level of receptivity. Between 2000 and 2011, GDP per capita increased from US $ 768.8 to US $ 2 346.3 (current US $, meaning that dollar figures for GDP are converted from domestic currencies for that particular year—2000 and 2011). According to the Bhutan Living Standards Surveys (BLSS) and the Bhutan Poverty Analysis reports, the proportion of the population living below the national poverty line declined from 23.2% in 2007 (National Statistics Bureau, 2007a, 2007b) to 12.0% in 2012 (National Statistics Bureau, 2012a, 2012b). Poverty continued to decrease to 8.2% in 2017, reflecting sustained improvements in living standards, access to services, and economic opportunities across the country (National Statistics Bureau, 2017a, 2017b).

The socioeconomic impacts of the COVID-19 pandemic, however, reversed some of these gains. The national poverty rate increased to 11.6% in 2022, although it remained substantially below the levels recorded in 2007 and 2012 (National Statistics Bureau, 2022a, 2022b). Rural populations continue to experience higher levels of poverty than urban populations, indicating persistent disparities in income and access to economic opportunities and services. The combination of these two factors, leading to improvements in household structure and an increase in urbanization, may have reduced the country's receptivity to malaria.

The road network in Bhutan increased by 43% between 2001 (3 746 kilometre) and 2008 (5 363 kilometre), creating potential for increased access to health services and also urbanization. In addition, almost all houses are now supplied with electricity, and the greater availability of lighting and use of electric fans may be having a deterrent effect on mosquito feeding. What is not yet known is the possible shift in receptivity in development sites, such as fishery projects and dam construction. These sites may be less conducive to transmission than previously thought; in the case of dams, water level management may be a means of controlling risk (World Health Organization, 2013). However, the temporary housing built for labourers, which is generally located near vector breeding areas, may pose a risk of transmission should parasites be introduced. Vulnerability Bhutan is highly vulnerable to the continual introduction of malaria parasites across its southern border.

Table 12. Confirmed cases of malaria in Bhutan by case classification, species, and age-sex and nationality (N1, N2 and N3), 2013 – 2025

Year	Number of cases		Case classification				Species			Nationality			Sex		Age (years)	
	Cases	Deaths	Indigenous	Imported	Introduced	Relapse	*Pv*	*Pf*	Mixed	N1	N2	N3	Male	Female	<5	≥5
2013	48	0	14	34	0	0	34	13	1	17	28	3	44	4	0	48
2014	54	0	19	34	1	0	39	15	0	23	21	10	44	10	0	54
2015	104	0	32	69	3	0	64	40	0	57	17	30	86	18	1	103
2016	74	0	15	56	3	0	50	20	4	26	29	19	70	4	1	73
2017	62	1	11	38	13	0	52	10	0	39	8	15	41	21	0	62
2018	54	1	6	34	14	0	36	17	1	31	12	11	39	15	0	54
2019	42	0	2	30	10	0	31	11	0	28	3	11	32	10	2	40
2020	54	0	22	9	23	0	46	8	0	49	4	1	36	18	1	53
2021	23	0	9	13	0	1	18	5	0	21	2	0	19	4	0	23
2022	11	0	0	8	3	0	10	1	0	6	0	5	8	3	0	11
2023	24	0	0	20	4	0	13	11	0	13	5	6	20	4	0	24
2024	144	0	0	135	9	0	137	7	0	114	1	29	105	39	8	136
2025	43	0	0	42	1	0	42	1	0	30	5	8	34	9	0	43

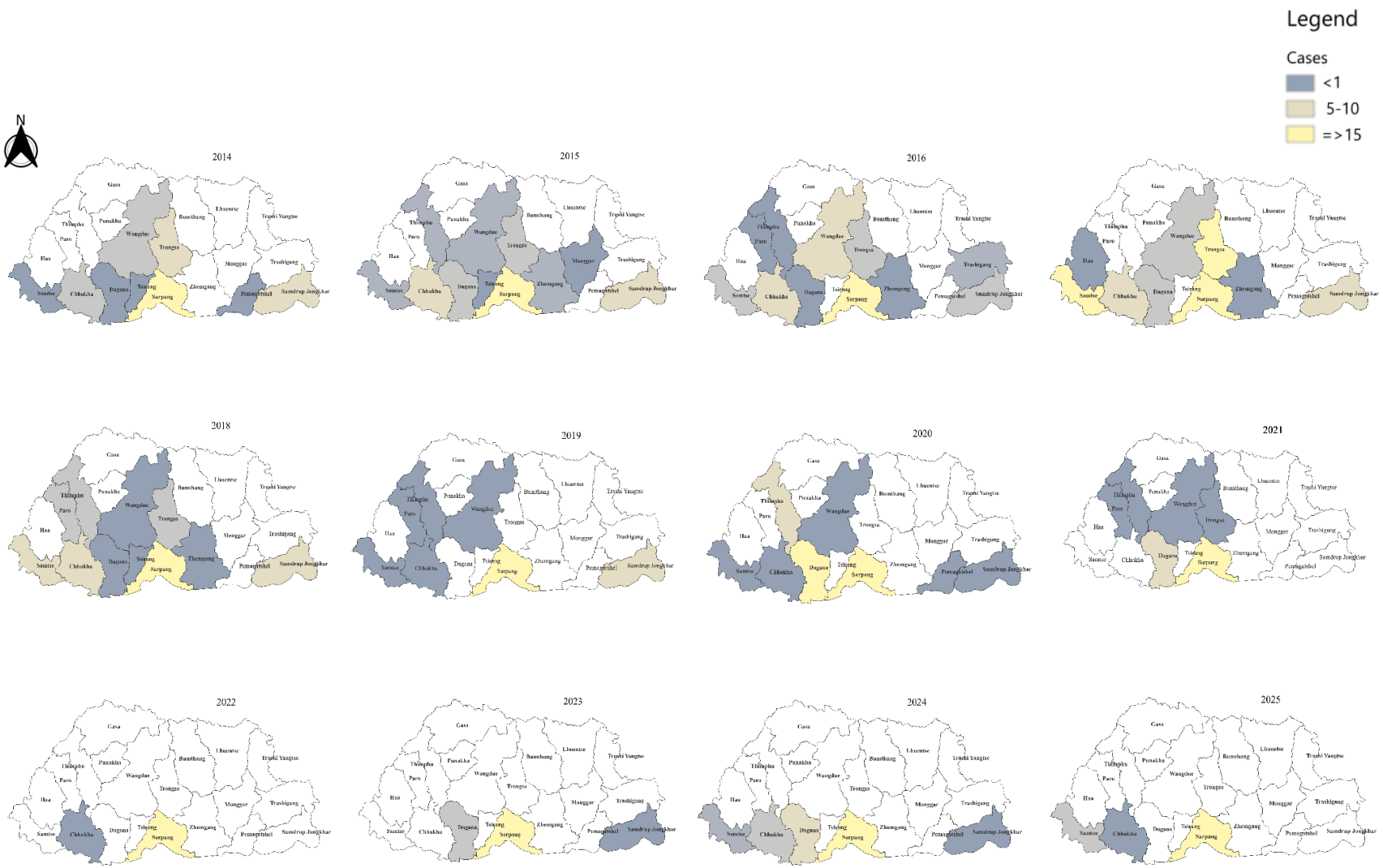


Figure 16. All cases of malaria (N1, N2 and N3) reported in Bhutan, 2014 – 2025

The country is bordered in the east, west and south by the Indian states of Arunachal Pradesh, Sikkim, Assam and West Bengal. Assam, the largest of the bordering Indian states, is composed principally of forest reserve and is malaria-endemic. Historically, the area is characterized by political instability, transient and semi-permanent settlements, mobile populations and impoverished conditions, all of which hinder malaria prevention and control efforts (Dev, 2010). As a result, members of various Assamese population groups often enter Bhutan to seek health care, in particular at the dzongkhag hospital in Sarpang. Other migrant groups include daily contractual workers and casual labourers. It is estimated that 1 000 people enter Bhutan daily through each regulated checkpoint in 10 border towns, and the number of crossings is expected to increase over time. How many migrants pass through unregulated border areas is unknown, so there are no reliable estimates of total cross-border movement.

Malaria cases identified as occurring in foreign nationals accounted for 21.8% of all confirmed cases in 2006 and 29.3% in 2012. From 2000 to 2012, Sarpang Dzongkhag, bordering Assam, consistently recorded most of the cases occurring in foreign nationals; moreover, 61% of cases in Bhutanese nationals in 2012 occurred in Sarpang. Between 2000 and 2010, Sarpang recorded an average of 86.5% of foreign national cases and 48.8% of Bhutanese cases occurring in the whole of Bhutan. In 2009 an outbreak of malaria reported in Assam resulted in a 26.8% rise in reported cases (Dev, 2010); this increase was mirrored in Sarpang, where a threefold rise in cases was reported that year (Metereology Unit, 2011).

Current major development projects may further increase movement across the border into Bhutan. Construction of hydropower dams and other projects have led to large influxes of migrant workers, typically from malaria-endemic areas within India and Bangladesh, thus increasing the risk of both importation and onward transmission of malaria. Most of the 35 000 documented migrant workers in Bhutan are employed in large-scale development projects in the interior of the country and in southern *dzongkhags*. In 2011, there was only one *P. vivax* case out of the 1 148 migrant workers screened for malaria in the survey (Dev, 2010). The majority of workers were from the Indian states of West Bengal, Bihar, Jharkhand and Uttar Pradesh (Dev, 2010). In 2012, a cross-sectional prevalence survey conducted at two hydroelectric plant construction sites in Wangdue Phodrang and Dagana Dzongkhags indicated that only a small proportion of workers were parasitaemic; there were eight positive cases among the more than 5 000 workers screened by microscopy, and all but one was asymptomatic (Dev, 2010). Other population movements resulted from the national resettlement programme, which relocates Bhutanese from areas of low transmission to endemic areas to increase access to arable land. These resettled populations lacked both malaria immunity and knowledge about the disease and its prevention and treatment (Tobgay & Lhazeen, 2010).

2.1.7 How did the programme respond to outbreaks from 1980 to 2005?

Malaria infections rose sharply from 1983 to 1984, when nearly 19 000 cases were reported. There are no records of the cause of the outbreak, although it is suspected that resistance to the first-line malaria treatment, chloroquine, may have been a factor. In addition, a report from 1990 indicates that active surveillance was discontinued during the decentralization process of 1981; the national malaria eradication programme relied entirely on passive surveillance, reinstating active surveillance activities only in the event of an outbreak. Records indicate that IRS was maintained in malarious areas from 1980 to 1986, with coverage ranging from 38.6 to 58.0% of the population

(Kondrashin & Rashid, 1987) however, IRS coverage was reported to be much lower in 1984 because of a stock-out of insecticide.

The major outbreak of malaria in 1994, resulting in nearly 40 000 cases, was thought to be caused by growing insecticide and treatment resistance, disruption of IRS in the southern region because of security problems, and increased vulnerability (as described above). In 1995, the Bhutan NMCP stopped using DDT and introduced deltamethrin, a pyrethroid that was considered to be safer, more effective and more acceptable (Tobgay et al., 2011).

A "two-pronged attack" on malaria was launched in 1997 when the NMCP implemented bioenvironmental control measures and started distributing ITNs (Ministry of Health and Education, 1997). Under this new strategy, IRS was largely halted by 1998, and Insecticide-Treated Nets (ITNs) became the primary vector control measure (Ministry of Health and Education, 2002; Wangdi et al., 2011). The ITN distribution programme was launched in the context of the Roll Back Malaria initiative, aiming to rely on personal protection sustained by community involvement and participation (Ministry of Health and Education, 2000); in some areas, however, IRS activities continued alongside ITN distribution (Wangdi et al., 2011). In addition, to improve the NMCP's capacity for rapid detection of and response to malaria outbreaks, a "rapid response team" was launched in 1998 (Ministry of Health and Education, 2000). The number of cases almost doubled in 1999 compared to the previous year, rising from 6 955 in 1998 to 12 591 in 1999; the proportion of infections due to *P. falciparum* rose from 40% to 51%.

In 2000, the NMCP began supplying all health centres with rapid diagnostic test (RDT) kits in an effort to improve response to emergency situations (Ministry of Health and Education, 2000). Nevertheless, the cornerstone of the programme throughout this period remained microscopy, and all health centres in malaria-endemic areas had at least one functioning microscope (Ministry of Health and Education, 2000). The programme underwent a comprehensive review in April 2001. Following this, the NMCP renewed its malaria control strategies, emphasizing the continued scale-up of vector control interventions and treatment availability.

In 2001, the cross-border malaria challenges in the country, particularly malaria transmission along the border with the Indian states of Assam and West Bengal (Ministry of Health and Education, 2002). Records indicate a lack both of coordination of malaria control activities along the border and of standardization in vector control and treatment strategies. Foreign nationals (N3) sought treatment in Bhutan on a daily basis, underlining the possibility of cross-border malaria transmission. However, the low slide positivity rate (SPR) in the N3 group may translate to a lower risk than previously thought. The programme's objectives for 2001 included ensuring microscopy and treatment facilities and diagnostic and treatment skills in all health centres and endemic areas (Ministry of Health and Education, 2000)

In addition, IEC advocacy activities were to be intensified, with the goal of increasing awareness of malaria and basic knowledge of its prevention and control. Distribution of ITNs was to coincide with the initiation of collaborative control activities in the southern *dzongkhags* and strengthening of *dzongkhag*-level capacity to manage malaria control activities. In 2004, the VDCP reinstituted IRS on a focal basis to supplement the use of ITNs, which were found to be less effective than IRS for vector control. Two rounds were conducted immediately before the two transmission peaks but

only in targeted areas that had met the following criteria for the past three years: API exceeding 5 per 1 000 population; SPR above 3%; *P. falciparum* rate over 50%; or at least one malaria-attributable death within the designated area or village (Tobgay et al., 2011).

Use of ITNs continued, but the malaria programme and local community health workers struggled to successfully retreat all ITNs every six months, further reducing the effectiveness of the intervention.

2.1.8 How did Bhutan progress to pre-elimination status between 2006 and 2013?

Between 2006 and 2012, there was a 95.6% decline in malaria cases found in Bhutan (N1+N2), from 1 868 to 82, although small outbreaks were reported in 2009, mainly in the southern endemic *dzongkhags* and one in the seasonal malaria transmission zone in the middle of the country (World Health Organization Regional Office for South-East Asia, 2010). On the basis of this success, and of the strengths of the national health system and the VDCP, Bhutan embarked on malaria elimination during this period. In 2013, only 14 cases were considered to be indigenous. Bhutan has reported no indigenous malaria cases since 2022 and now aspires to be certified malaria-free by WHO.

2.2 Epidemiology of malaria in Bhutan

2.2.1 Classification of cases by nationality

Bhutan has reported zero indigenous malaria cases since 2022 and zero deaths due to malaria since 2018. In 2024, 114 cases were reported among N1, of which 105 cases were imported and nine cases were introduced with zero indigenous cases (Table 13); these cases comprised 108 *P. vivax* cases and 6 *P. falciparum* cases (Technical Advisory Group for Malaria Elimination, 2025). In 2025, 29 cases were imported and 1 case introduced among N1 with zero indigenous cases as shown in Figure 17 (Technical Advisory Group for Malaria Elimination, 2026). All cases among N2 were imported.

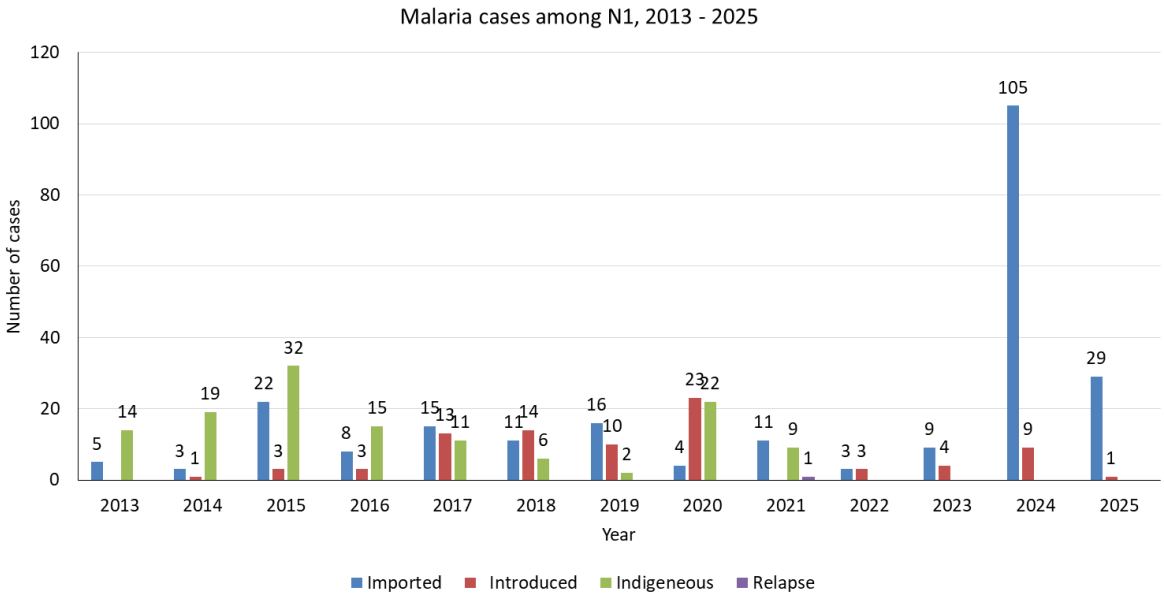


Figure 17. Number of cases of malaria among N1, 2013 – 2025

Table 13. Classification of malaria cases among N1 and N2 individuals, 2013 – 2025

Year	N1				N2
	Imported	Indigenous	Introduced	Relapsed	Imported
2013	5	14	0	0	26
2014	3	19	1	0	21
2015	22	32	3	0	17
2016	8	15	3	0	29
2017	15	11	13	0	8
2018	11	6	14	0	12
2019	16	2	10	0	3
2020	4	22	23	0	4
2021	11	9	0	1	2
2022	3	0	3	0	0
2023	9	0	4	0	5
2024	105	0	9	0	1
2025	29	0	1	0	5
Total	241	130	84	1	133

2.2.2 Deaths due to malaria

The records of deaths due to malaria before 1993 are not available. The number of deaths due to malaria recorded by the malaria program since 1993 is given in Figure 18. The number of cases increased gradually from the late 1960's onwards until about the mid-1990s, after which a gradual decline is seen. Since recording began, a decreasing trend is seen for deaths due to malaria. The last two cases of mortality due to malaria were recorded in 2017 and 2018 (Figure 18).

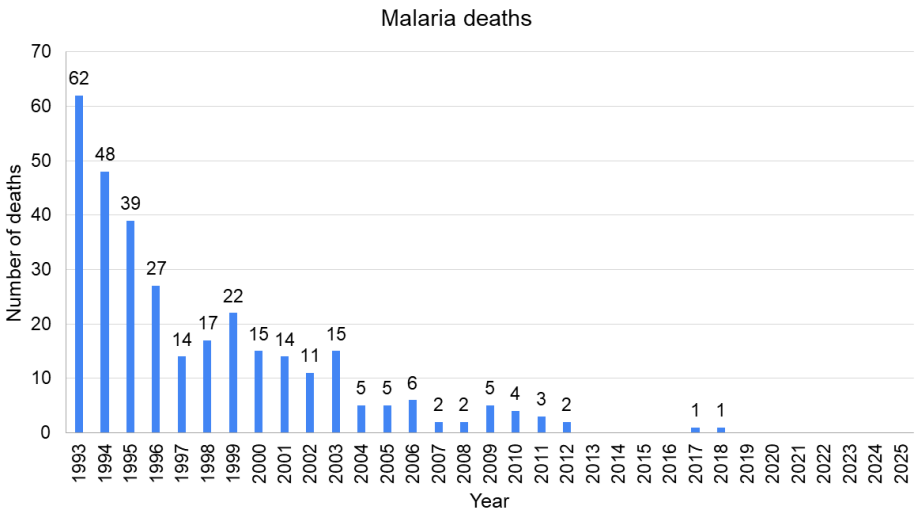


Figure 18. Data for malaria deaths, 1993 – 2025. The last recorded malaria death in Bhutan was in 2018

2.2.3 Malaria species detected

The majority of cases over the years have been *P. vivax* cases; *P. falciparum* cases comprise less than 40% of cases except in 2023 when the proportion exceeded 50% of the cases (Figure 19 and 20). The distribution of cases is similar to that seen in Assam state of India which borders Bhutan.

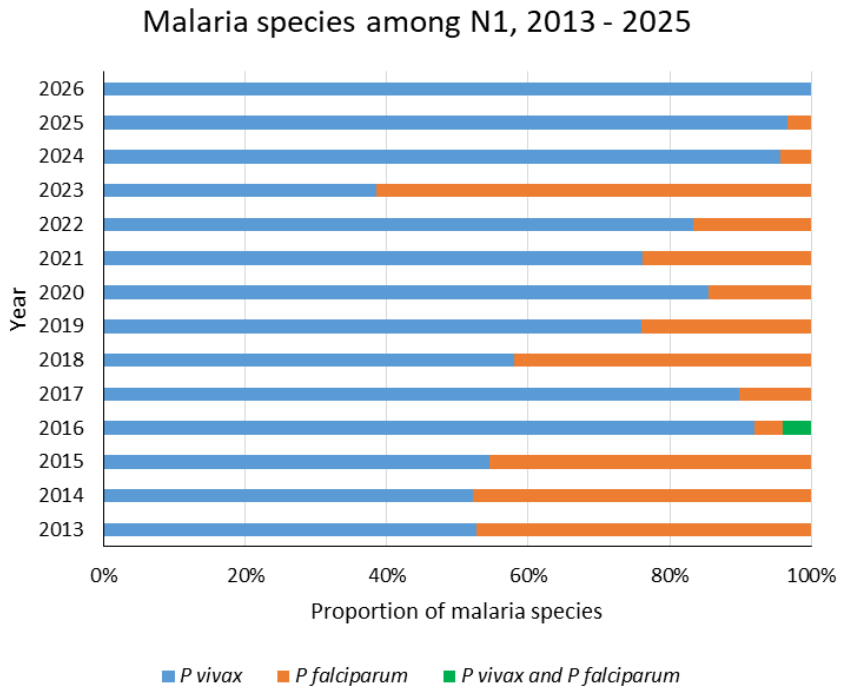


Figure 19. Malaria species detected among N1 individuals, 2013 – 2025

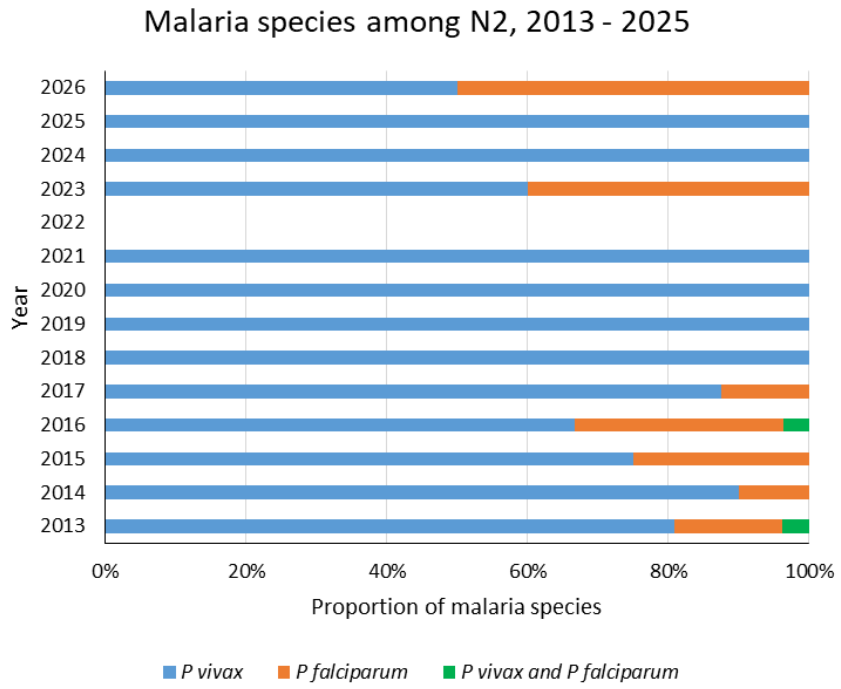


Figure 20. Malaria species detected among N2 individuals, 2013 – 2025

Malaria is diagnosed across all levels of the healthcare system including the RBA Hospitals (Table 14). Subposts are manned by Health Assistants and/or malaria technicians. Selected PHCs are manned by Health Assistants and/or malaria technicians while some PHCs, labelled as 10-bedded hospitals, staffed by doctors.

Table 14. Detection of malaria cases across among N1 across all levels of healthcare system in Bhutan, 2013 – 2025

Year	Subpost	Primary Healthcare Centre	District Hospital	Regional Referral Hospital	National Referral Hospital	RBA Hospital
2013	0	3	10	5	1	0
2014	0	4	16	3	0	0
2015	0	17	27	10	3	0
2016	0	9	10	7	0	0
2017	0	4	31	4	0	0
2018	3	9	13	4	1	1
2019	0	3	17	7	1	0
2020	0	11	18	19	1	0
2021	0	3	12	5	1	0
2022	0	1	5	0	0	0
2023	0	1	6	2	1	3
2024	0	23	52	36	3	0
2025	0	0	7	21	1	1
2026	0	0	3	5	0	0
Total	**3**	**88**	**227**	**128**	**13**	**5**

The time to diagnosis of malaria is shown in Figure 21.

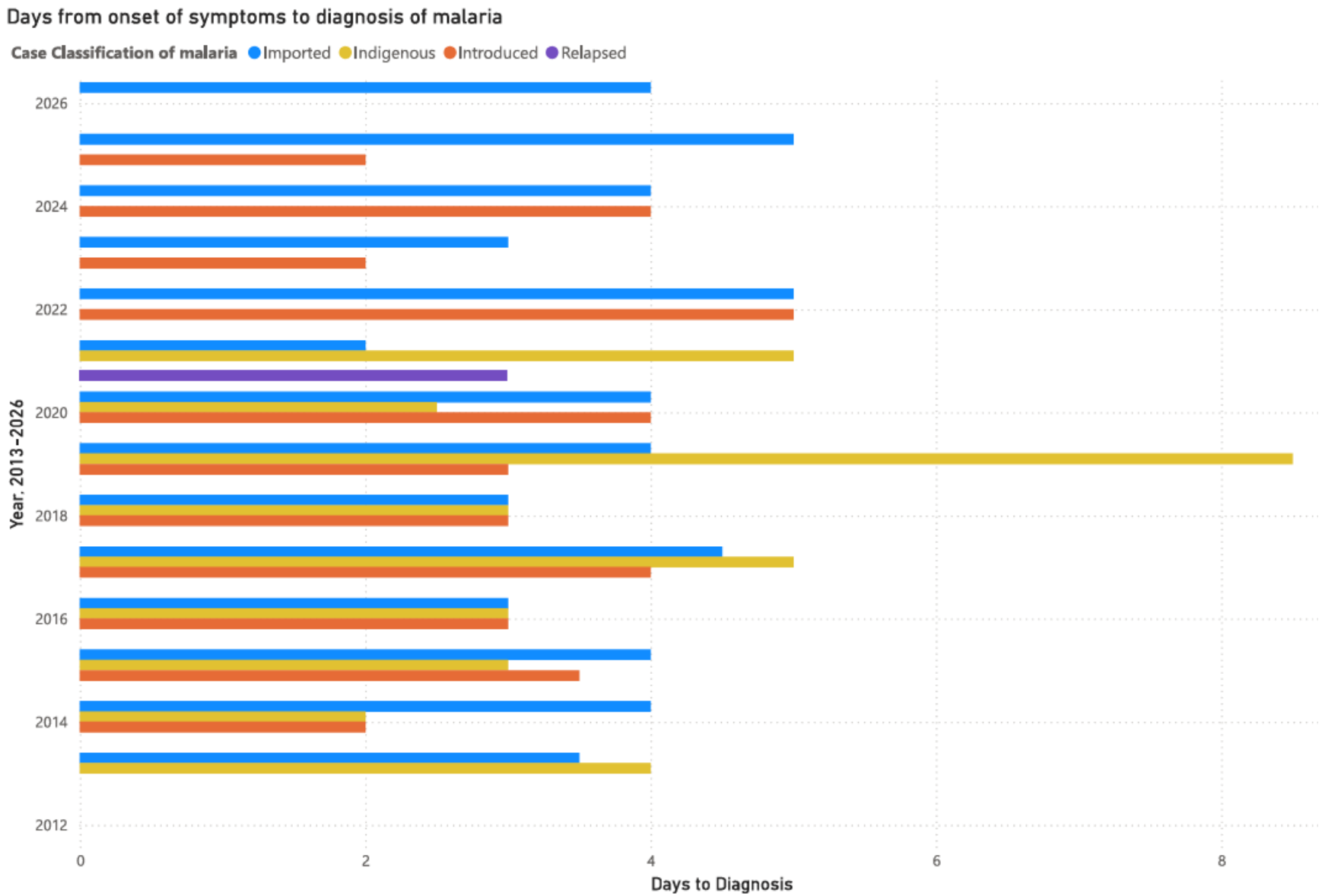


Figure 21. The time from onset of symptoms to diagnosis of malaria, 2014 – May 2026 (n = 447)

The number of patients with past history of malaria is shown in Table 15.

Table 15. Number with past history of malaria among N1, 2013 – 2026

Year	Past History of Malaria		Total
	Yes	No	
2013	3	7	10
2014	5	15	20
2015	9	43	52
2016	4	19	23
2017	7	30	37
2018	9	20	29
2019	5	22	27
2020	14	33	47
2021	4	17	21
2022	0	6	6
2023	2	11	13
2024	11	103	114
2025	4	26	30
2026	1	5	6
Total	78	357	435

2.2.4 Age group, sex distribution and occupation

The majority of malaria cases reported in Bhutan has been among farmers engaged in farming activities along the border. Some migrants have also contributed to imported cases. Students also comprise an important source of imported malaria cases. Deploying army personnel for UN peacekeeping missions in Africa is another source of malaria importation (Table 16).

The majority of malaria cases have been reported among adult males. However, in 2024, there were 2 cases reported among children under 5 years from an N1 family residing across the border, and 13 cases among those 5 – 14 years (11 imported) indicating exposure through travel across the border with friends or family members.

Border malaria along the Indo-Bhutan land border was a major constraint to malaria elimination and is a threat to prevention of re-establishment of malaria in Bhutan. Transmission across the border occurs through infected vectors crossing borders and movement of humans, animals and trade across the border. Although migration across the 699-kilometre border is restricted to a limited number of border crossings, this by itself is sufficient to result in importation of malaria and occasional introduced cases, as observed during the 2024 outbreak in neighbouring India.

The ‘Indo-Bhutan no man’s land’ is not a single, official zone but refers to border areas where the boundary is unclear or marked by natural features like rivers (e.g., Jaldhaka at Bindu, Samtse), sometimes with stretches or areas where people live close to the line, leading to unique situations like shared resources or small communities existing in a buffer zone, with areas sometimes fenced off by India for security, affecting local life and livelihoods, though the border itself is generally

peaceful and open. These features required detailed epidemiological investigation and review because of the complex cross-border context. The ability of the VDCP to control the outbreak and prevent further transmission in the next transmission season provides evidence of the resilience and the responsiveness of the health system to mount an adequate response when required.

Table 16. Age, sex and occupation of N1 with malaria, 2013 – 2025

Characteristics	n	Percent
Sex		
Male	330	71.1
Female	134	28.9
Age group		
0 – 4	6	1.29
5 – 14	49	10.56
15 – 49	311	67.03
50 – 59	39	8.41
≥60	59	12.72
Occupation of the patient		
Farmer	224	48.28
Student	83	17.89
Armed forces	51	10.99
Private Business	38	8.19
Civil servant	27	5.82
Housewife	15	3.23
Minor	11	2.37
Driver	10	2.16
Cattle herder	2	0.43
Labourer	2	0.43
Monk	1	0.22

The majority of confirmed cases from 2015 onwards has been imported cases except in 2020 probably due to travel restrictions following the COVID pandemic (Figure 22). Since 2021, imported malaria cases have predominated. 2024 was an exceptional year where an outbreak of malaria occurred with a large proportion of imported cases being reported (Figure 22); this outbreak coincided with an outbreak reported across the Indian border. Given the population dynamics and the organisation of villages and cultural and behavioural characteristics of the resident population, classification of cases was extremely difficult. The VDCP implemented a round of training of field workers to re-evaluate the factors surrounding malaria infection among the N1 cases. The patterns of transmission after field evaluation and review by the Technical Advisory Group for Malaria Elimination (TAGME), however, indicated that the majority of cases were imported. The ability of the health system to detect, control and prevent the further indigenous transmission in the next transmission cycle provides sufficient evidence of the

resilience of the health system to prevent re-establishment of malaria in the country in an area having a land border where malaria is endemic and migration in unregulated.

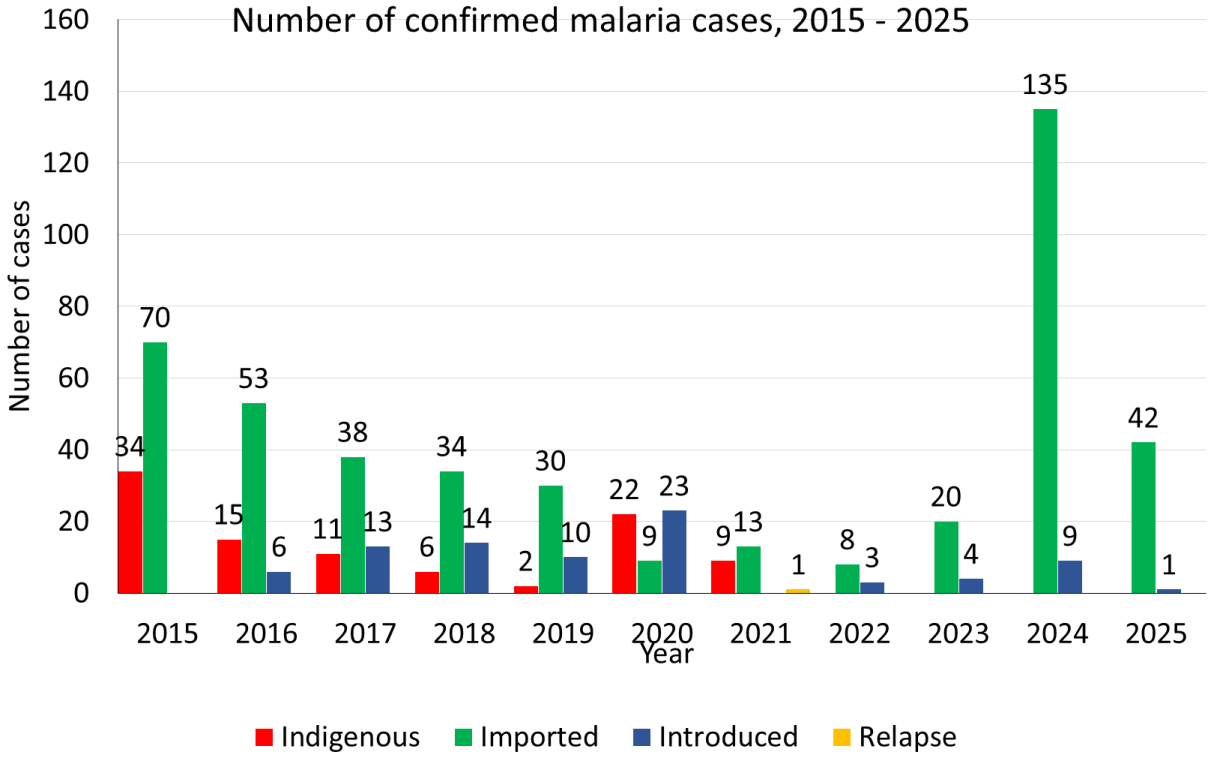


Figure 22. Case classification of malaria detected in Bhutan among N1, N2 and N3, 2015 – 2025

2.3 High risk populations and hard to reach areas

Farmers working along the Indo-Bhutan border are the primary risk groups for malaria. Some migrants of both Bhutanese and non-Bhutanese origin have also contributed to the imported malaria burden in the country. Although all diagnosed cases of malaria receive quality assured malaria treatment as per national treatment guidelines, non-residents who do not stay overnight in Bhutan comprise an important risk group as they cannot be followed up for drug compliance; besides some of these migrants who may not have completed the recommended course of treatment are likely to return to Bhutan in the future in search of work and may pose an immediate threat to prevention of re-establishment of malaria in the country.

In addition, there are a number of students and workers from Bhutan who go to India for various purposes and many Indians who come to Bhutan for work who bring imported malaria to the country. The land border between Bhutan and India is an open one that does not require additional travel documents which enables a free flow of migration across the border though restricted to certain entry/exit points. There is a system that tracks foreign labourers coming into the country; approved foreign labourers are mandatorily screened by private diagnostic centres (PDC) and results of the screening programme are shared with the VDCP which enables provision of treatment and tracking of foreign labour; this system is working efficiently.

The security forces are exposed to higher risk of malaria infection in two ways: 1) by participating in UN peace keeping missions in malaria endemic countries, and 2) by patrolling forested areas along the India-Bhutan border where malaria transmission occurs. Armed forces personnel on UN peace keeping missions are provided chemoprophylaxis and are screened for malaria on their return; if found positive for malaria, they are treated as per national treatment guidelines. There is no evidence to suggest that security forces personnel patrolling the forested areas of the Indo-Bhutan border contribute significantly to the imported malaria burden of Bhutan; as such no chemoprophylaxis is recommended for this group but the possibility of administering chemoprophylaxis will be discussed.

In general, malaria risk areas are mainly forest and forest-fringe human settlements, in particular those with irrigation or development projects, such as hydropower project sites (Yangzom et al., 2012). Males, particularly farmers and students aged 15 – 49 years, are the population groups at highest risk for malaria (Wangdi et al., 2011). Although there is no comprehensive assessment of risk factors, an increased risk is most likely to be the result of various occupational factors, such as forest work, firewood collection, guarding fields at night from animals, or travel to India for business (Tobgay et al., 2011; World Health Organization Regional Office for South-East Asia, 2010). For example, students living in dormitories often stay outdoors late into the night, increase their chance of being bitten by infected mosquitoes (World Health Organization, 2013). Likewise, late-night television watching or resting on the veranda during the night are other behaviours that may increase risk (World Health Organization, 2013).

Border malaria along the Indo-Bhutan land border is a major threat to malaria elimination and prevention of re-establishment of malaria in Bhutan. The risk of malaria importation and introduced malaria remains due to movement of infected persons and the potential movement of vectors across the border mainly during the summer months. Access to these areas is generally good. Malaria transmission does not take place at higher elevations where access is poor and the threat of local transmission in these areas are almost non-existent. In addition, the distribution of health services in higher elevations are limited. Although migration across the 699-kilometre border is restricted to a limited number of border crossings, this by itself is sufficient to result in importation of malaria from across the border as seen in 2024.

2.4 Last indigenous malaria cases and foci in the country

From 2013 to 2025, most number of malaria cases have been reported from Sarpang district that borders Assam state of India, followed by Chhukha district (Table 17 and Figure 23). After 2020, most of these infections have originated from India for the reasons already described above such as having a porous land border where travel between the two countries is largely unregulated. The number of imported malaria cases reported by district from 2021 to 2025 is given in Table 17 and Figure 24 which also indicates that the majority of imported cases are also reported from Sarpang district; in 2025, Sarpang district was followed by Chhukha district (Figure 25).

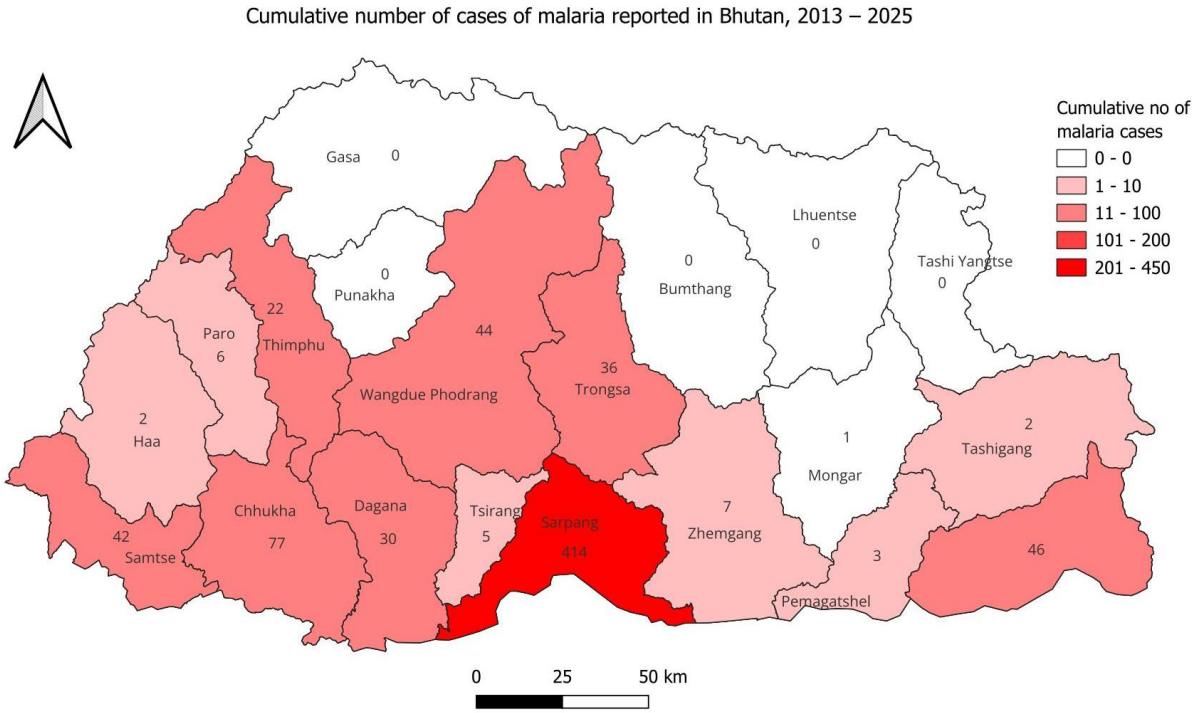


Figure 23. Cumulative number of malaria cases reported in Bhutan, 2013 – 2025

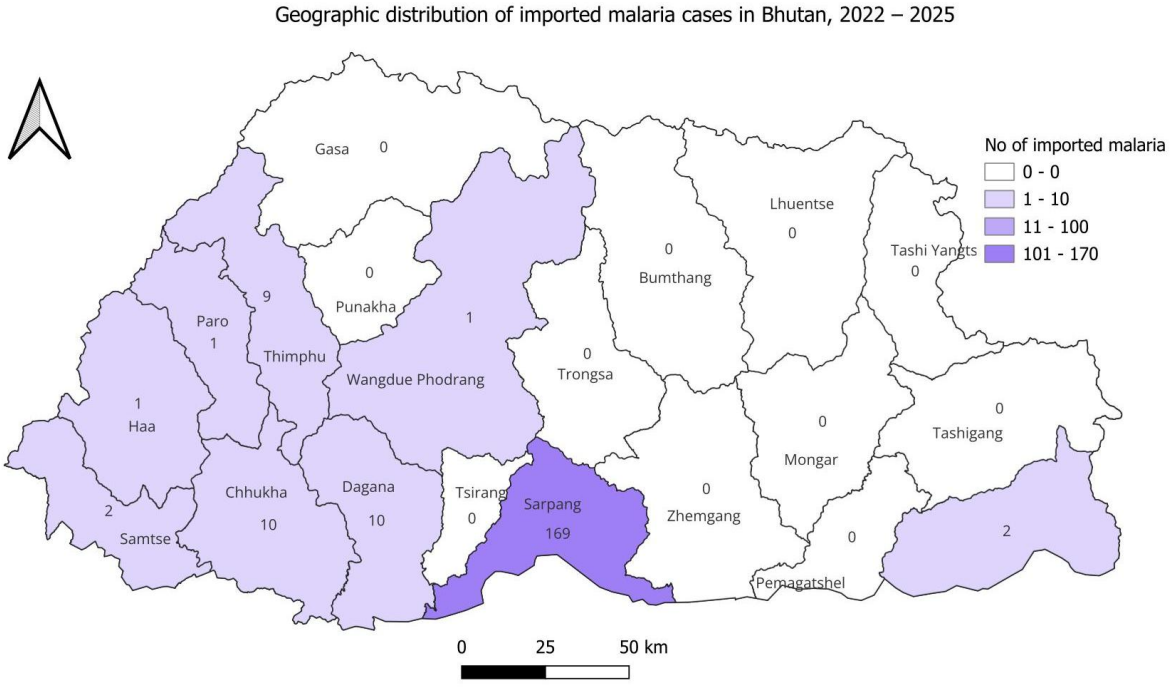


Figure 24. Cumulative number of imported malaria cases in Bhutan, 2022 – 2025

Table 17. Cases of malaria reported in Bhutan by *dzongkhag* (N1, N2 and N3), 2013 – 2025

Dzongkhag	Year													Total
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
Bumthang	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Chukha	2	7	23	16	14	5	2	1	0	1	1	1	7	**80**
Dagana	2	1	5	1	2	1	0	3	5	0	2	8	0	**30**
Gasa	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Haa	0	0	0	0	1	0	0	0	0	0	1	0	0	**2**
Lhuntse	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mongar	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Paro	0	0	0	1	0	2	1	0	1	0	1	0	0	**6**
Pemagatshel	1	1	0	0	0	0	0	1	0	0	0	0	0	**3**
Punakha	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Sarpang	19	19	47	24	13	23	27	44	14	10	12	128	33	**413**
Samtse	0	1	1	3	20	7	3	1	0	0	0	2	2	**40**
Samdrup Jongkhar	0	8	13	3	5	8	5	1	0	0	1	2	0	**46**
Thimphu	3	0	2	1	0	2	2	2	1	0	5	3	1	**22**
Tashigang	0	0	0	2	0	0	0	0	0	0	0	0	0	**2**
Tashiyangtse	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Trongsa	12	9	5	5	1	3	0	0	1	0	0	0	0	**36**
Tsirang	2	1	1	0	0	1	0	0	0	0	0	0	0	**5**
Wangdue	6	7	3	17	5	1	2	1	1	0	1	0	0	**44**
Zhemgang	1	0	3	1	1	1	0	0	0	0	0	0	0	**7**
Total	**48**	**54**	**104**	**74**	**62**	**54**	**42**	**54**	**23**	**11**	**24**	**144**	**43**	**737**

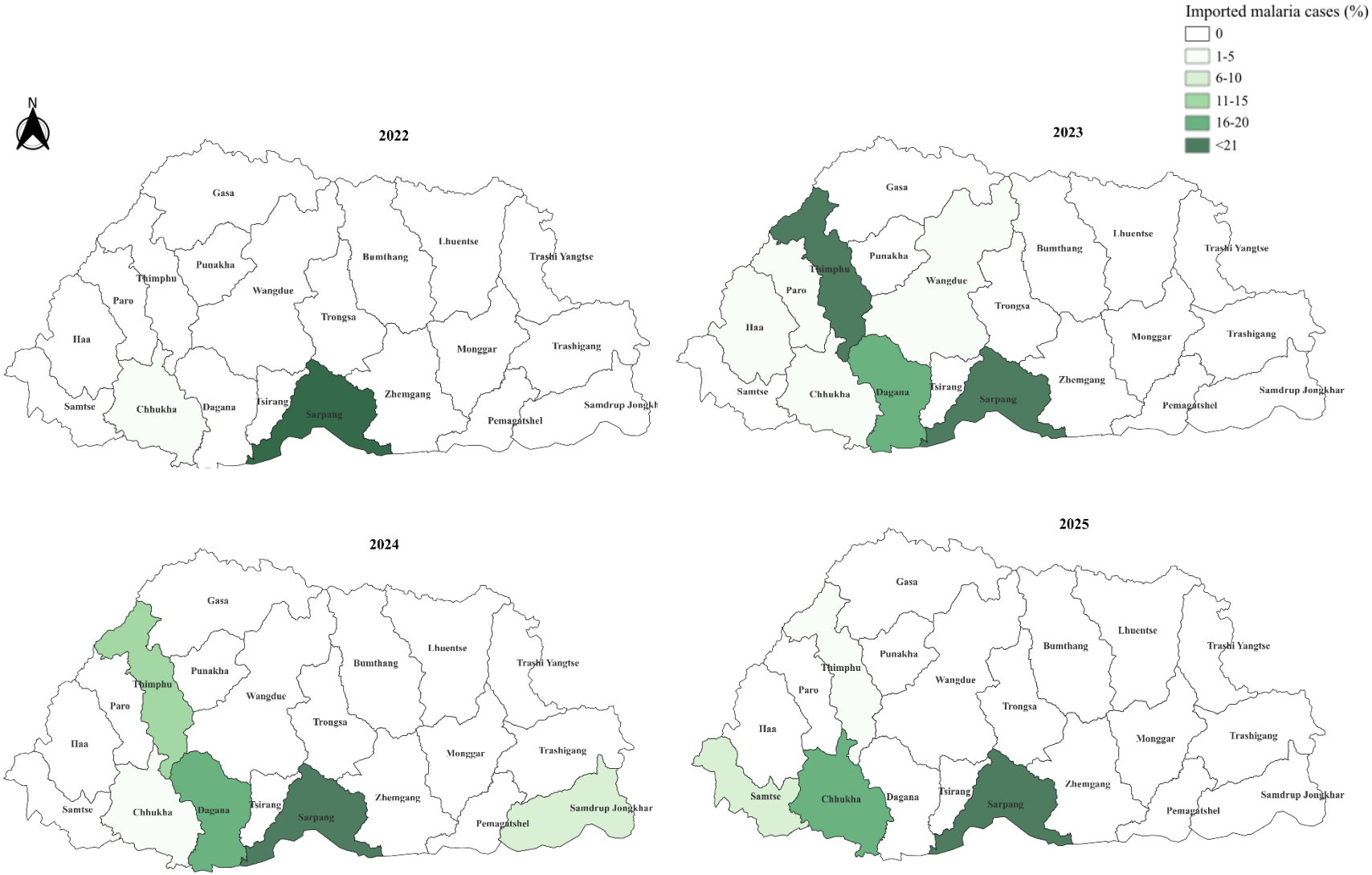


Figure 25. Imported cases of malaria in Bhutan, 2022 - 2025. Sarpang dzongkhag reported the highest proportion of imported cases of malaria.

While Sarpang Dzongkhag has witnessed the maximum cumulative number of imported malaria (Table 18, Figure 25), the Gelephu Mindfulness City is being developed as a Special Administrative Zone spanning Sarpang and neighbouring districts. With development, more people are expected to migrate into Gelephu while immigration and social services are being strengthened. As a part of GMC activities, there were six major religious gathering that were conducted in Gelephu town, with an estimated 10 000 to 60 000 attendees participating over sessions ranging from 4 days to 19 days (Central Regional Referral Hospital, 2026). As per surveillance report from VDCP and clinical report from the Central Regional Referral Hospital, there were no cases of malaria during the gathering period.

Among the malaria cases reported from 2021 to 2025, the majority of infections were acquired in India or along the Indo-Bhutan land border. A few infections were classified as introduced cases, with epidemiological evidence linking them directly to imported cases. The few infections in Africa were reported among armed forces personnel deployed in UN peace keeping missions in Africa.

Table 18. Geographic distribution of imported malaria cases reported in Bhutan by dzongkhag, 2022 – 2025

Dzongkhag	Year				Total
	2022	2023	2024	2025	
Chhukha	1	1	1	7	10
Dagana		2	8		10
Haa		1			1
Paro		1			1
Samdrup Jongkhar			2		2
Samtse				2	2
Sarpang	7	9	121	32	169
Thimphu		5	3	1	9
Wangdue Phodrang		1			1

When there was indigenous transmission of malaria in Bhutan prior to 2022, transmission foci were identified in malaria endemic areas. A focus was classified as a village reporting an indigenous malaria case. The details and status of these foci since 2021 are given in Table 19. Table 19 also indicates all villages in which introduced cases were reported during this time period. There were five active foci identified in 2021; for three years there were no reported cases of indigenous malaria in these areas and they were classified as cleared foci in 2025. Of the 13 foci which were classified as residual non-active in 2021, no further transmission of indigenous malaria took place and they too were classified as cleared foci. With no indigenous transmission of malaria in the country since 2022, all foci that were categorised as active or residual non-active in 2021 were classified as cleared by the beginning of 2025.

No village reported indigenous malaria transmission after 2021. Villages listed below reported introduced cases only (Table 19).

Table 19. Status of malaria foci in Bhutan 2021 – 2025

Village	Year				
	2021	2022	2023	2024	2025
Chhoekhorling				Introduced	
Jigmeling	1				
Menchuthang					
Tshojan					
Dzombabi					
Chasakhar	2				
Dawathang					
Thongjabi					
Pangzor	3				
Namkhaling					
Jampeling				Introduced	
Sheteykhari					
Norbuling					
Pema yedling				Introduced	
Pangkhar					
Tashiphu				Introduced	
Lodari	4				
Gakiling Umchhunang (Kwapani)					Introduced
Bunakha (Bisty)				Introduced	
Gaden					
Samtenthang					
Dungkarling				Introduced	
Tashichhoeling				Introduced	
Jampani					

Active foci
Residual non-active
Cleared

2.5 Entomological aspects of malaria transmission in Bhutan

2.5.1 Policy framework on vector control

Bhutan has a well-organised national programme, VDCP, and its strategy vector control is a key intervention component. Vector control is based on an integrated vector management (IVM) approach promoted by World Health Organization, which is implemented under an overarching Global Vector Control Response 2017 – 2030 strategy adopted by the 17th World Health Assembly in 2017 (World Health Organization, 2017).

Bhutan is a signatory to the International Health Regulations, 2005 (IHR), which requires developing core capacity for vector surveillance and control along the international borders.

Safety measures are routinely undertaken during the indoor residual spray operations, handling of insecticides in store and during IRS operation, application of larvicides in aquatic habitats, post-spray cleaning and maintenance of spray equipment, and distribution of LLINs. Pesticide products registered in the country are only used in accordance with the WHO guidance on International Code of Conduct on Pesticide Use 2014 (FAO & WHO, 2014).

Environmental risk assessment and clearances associated with developmental projects are being conducted by the national environment commission as per Environment Assessment Act 2000 and Regulation for Environmental Clearance of Projects 2016.

Bhutan's pesticide policy is governed by the Pesticides Act of Bhutan 2000, which was enacted to regulate the import, registration, distribution, sale, handling, storage, and use of pesticides while protecting human health and the environment.

2.5.2 Framework for entomological surveillance and control

At the national level, vector surveillance and control activities are supported by two entomologists and one technician with competencies in mosquito larval surveys, adult vector surveys, vector identification, insecticide susceptibility testing, integrated vector management, and vector control monitoring and evaluation. The programme maintains insectaries, reference mosquito strains, entomological surveillance equipment, laboratory facilities, WHO-approved susceptibility testing kits, data management systems, statistical analysis capacity, and GIS mapping capabilities. Operational activities include larviciding, indoor residual spraying, environmental management, public health communication, stakeholder engagement, routine surveillance, bio-efficacy testing of vector control tools, and operational research (Table 20).

Table 20. Skills and capacity for vector surveillance and control at the national level

Skills and/or capacity	Entomologists	Technician
Mosquito larval surveys	2	1
Adult vector surveys	2	1
Vector identification skill (taxonomic)	2	1
Molecular species identification capacity	0	0
Insectary with climate control	Insectary room available with air conditioning	
Reference mosquito strains	Yes	
Equipment of vector collection	Manual aspirator, dipper, scoop net, CDC light trap, BG-sentinel trap, pipettes, cattle-baited nets	
Laboratory equipment	Dissection microscopes, deep freezer (-80 & -20˚C), Environment chamber, cages, trays, breeder, incubator, humidifier and dehumidifier	
Kits for insecticide susceptibility testing	WHO test tubes, Cone bio-assay kits	
Insecticide susceptibility testing skill	Central programme staff are competent to implement	
Guidelines and taxonomic keys	Yes	
IVM planning and implementation	Routinely practiced at the field level	

Larviciding for mosquito control	Temephos, insect growth regulators (Diflubenzuron) used in rotation
Indoor residual spraying	Targetted and focal IRS
Environmental management	Practiced where feasible, ususally with community involvement
Pesticide management	The Pesticide Act of Bhutan 2000 and Pesticide Rules and Regulations 2019
Vector control product efficacy testing for registration	Only WHO pre-qualified products are procured
Monitoring bio-efficacy of vector control tools	Yes (Cone test-Residual bio-efficacy for IRS and LLINs)
Data management	Central programme maintains data on all the entomological surveillance and monitoring
Statistical analysis	Descriptive. Data being collected for spatial and predictive modelling
Mapping / GIS	Yes
Monitoring and evaluation	Remotely and during field visit
Stakeholder engagement	Yes
Behaviour change communication	Yes
Epidemiology	Entomological data being collected for regression analysis and predictive modelling
Public health	Public education and risk communication are routinely being implemented. Community volunteers monitor effective use and implementation of vector control tools
Operational research	Susceptibility test, bio-efficacies and routinely carried out as planned activity

The VDCP is supported by a decentralized surveillance structure with technical oversight and review provided by the TAGME. Vector surveillance and control activities are coordinated through the TAGME and involve collaboration with community malaria volunteers, *De Suups*, and academic institutions such as KGUMSB. Insecticide resistance monitoring is conducted annually at eight sentinel sites in accordance with the National Insecticide Resistance Monitoring and Management Plan 2021 (Ministry of Health, 2021b).

Human resource capacity for vector surveillance and control includes two entomologists, one malaria technician, three insect collectors at the national level, and 33 malaria technicians and 13 insect collectors at the sub-national level (Table 21). Capacity strengthening is supported through succession planning, including postgraduate training in entomology and annual pre-service training in laboratory and medical entomology. The programme maintains competency in routine bio-efficacy and insecticide susceptibility testing, while laboratory capacity exists for parasite species confirmation and can be extended to support additional entomological studies and xenomonitoring activities. Regular training on entomological methods and techniques is provided to surveillance personnel.

Infrastructure and operational capacity include a functional entomology laboratory and insectary, availability of pesticide application equipment, quality-assured insecticides, and materials for bioassays. Vector surveillance and control data are managed through a web-based District Health Information Software 2 (DHIS2) platform, with all surveillance data centrally processed,

integrated with epidemiological information, and routinely analyzed. Surveillance findings are utilized for decision-making on vector control interventions, supporting programme implementation and monitoring activities nationwide.

Table 21. Review of the vector surveillance system in Bhutan, 2026

System capacity	Current situation
Organizational structure	
Presence of a vector-borne disease control programme	Yes, VDCP
Multisectoral coordination committee	Technical Advisory Group For Malaria Elimination
Central vector surveillance and control Unit	Integrated unit for investigation, response, routine surveillance, etc
Whether vector surveillance centralized or decentralized?	Decentralized
If decentralized, who provides technical support for vector surveillance?	National programme
Collaborative agencies e.g. those in involved in vector collections, analytical techniques, training on entomology and vector control	Community Action Groups (community malaria volunteers), *De Suung*, KGUMSB.
Is insecticide resistance monitored regularly? Whether resistance management strategy or plan in place?	IR monitored annually in 8 sentinel sites. Follow National Insecticide Resistance Monitoring & Management Plan 2021
Capacity	
Human resource plan with job responsibilities	As a succession planning, one in M.Sc entomology and annually 5 students in diploma in laboratory and medical entomology are trained as pre-service training.
Number of senior entomology staff at national level	Two entomologist, one malaria technician and 3 insect collectors
Number of senior/ supporting entomology staff at sub-national level	33 Malaria Technicians and 13 Insect Collectors
Competencies available for bioefficacy & insecticide resistance testing	The central programme have competent staff to carry out the routine bio-efficacy and susceptibility testing.
Competencies available for PCR analysis for insecticide resistance mechanisms?	Capacity exists at RCDC for parasite spp. confirmation. The capacity can be extended to other entomological studies and xenomonitoring.
Do vector surveillance staff receive regular training on entomological methods and techniques?	Yes, periodically
Infrastructure and supplies	
Availability of an entomology laboratory and functional insectary?	Yes
Availability of pesticide application equipment	Yes
Availability of quality-assured insecticides	Yes
Availability of materials and equipment for insecticide resistance bioassays, cone bioassays, and PCR analysis?	Yes for bio-assays and no for PCR

Next page

Continued

Presence of molecular or biochemical laboratory for determination of the mechanism of insecticide resistance?	No
Data management	
How are vector control data sent from periphery to central level (e.g. by smartphone application, paper forms)?	Web based (DHIS2)
Are all vector surveillance data centrally processed and managed?	Yes
Are vector surveillance data adequately integrated with epidemiological data?	Yes
Are vector surveillance data timely and adequately analysed and interpreted?	Yes
Data utilization	
Are surveillance results adequately utilized for decision making on vector control?	Yes

3. Organization and malaria programme management

Decentralization of malaria control prevention through IRS, diagnosis and treatment to the *dzongkhag* level is thought to have contributed significantly to the decline in malaria cases in Bhutan (Vector-borne Disease Control Program, 2008). The process has increased access to diagnosis and treatment for communities through the expansion of facilities and deployment of malaria workers in all health centres of endemic *dzongkhags* (Vector-borne Disease Control Program, 2008). Diagnosis and treatment of malaria are provided free-of-charge for both Bhutanese and foreign nationals. Malaria control activities have been continued by maintaining a cadre of medical technicians (malaria). These medical technicians comprise the backbone of malaria diagnosis, treatment and control, providing microscopy, RDTs, recording and reporting, sharing IEC materials, case follow-up, support for the delivery of both IRS and LLINs, and entomological surveillance and larval source control. Later on the programme was converted in to the VDCP since 2003.

The role of the dedicated malaria staff changed with integration in to the VDCP. It was a concern at the time of integration to maintain elimination activities. Beyond the medical technicians, there have historically been shortages of highly trained workers in Bhutan: there was no medical college in the country until 2024 and physicians and most technical professionals are trained abroad. Between 2000 and 2012, however, the number of physicians in Bhutan rose from 109 to 181 (Ministry of Health, 2012). Since 2009, there has also been an increase in the number of technical staff; entomological capacity has been strengthened and more malaria vector surveys have therefore been carried out on a regular basis. With the establishment of the KGUMSB, an autonomous body, in Thimphu in June 2012, the country is now developing the local institutions necessary to support malaria workers and research needs of the country. Further progress has been achieved with the institution of a two-year in-service Bachelor of Public Health programme; an increase in the recruitment of nurse-assistants, pay rises and more expatriate recruitment are also planned.

Access to hard-to-reach populations, given the difficult terrain in parts of the country, has increased over the past five years, particularly because of additional support from the Global Fund. These groups have been targeted with LLINs, and expansion of PHCs has brought advancements in providing diagnosis and treatment services to remote areas.

3.1 Vector-borne disease control programme (VDCP)

The VDCP focuses on eliminating malaria (and being certified as malaria-free by the WHO) and visceral leishmaniasis as well as managing other diseases like dengue, using integrated strategies including mass distribution of LLINs, IRS, larval source management, and robust entomological and parasite surveillance, target advocacy with strong cross-border collaboration to tackle importation risks, all guided by national strategic plans to build capacity and adapt to climate change impacts. The organogram of the VDCP is shown in Figure 27.

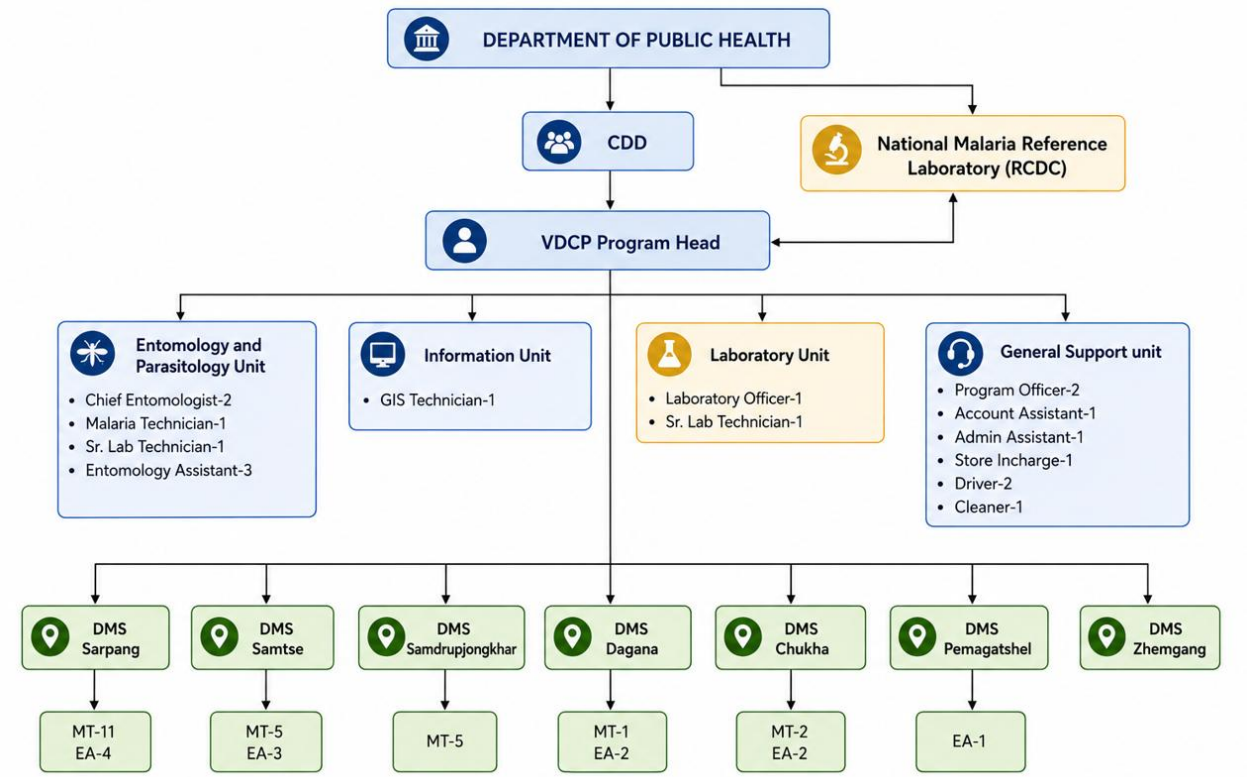


Figure 26. Organogram of Vector-borne Disease Control Program, located in Gelephu, under the Department of Public Health, Ministry of Health (2026)

The VDCP, a highly committed and dedicated programme with competent staff, has been integrated for over 2 decades, with success in malaria elimination, providing excellent opportunity to eliminate / control other vector-borne diseases. The main targeted diseases include Malaria, Dengue, Japanese Encephalitis and Visceral Leishmaniasis. The programme promotes community engagement through Village Health Workers (VHW) and CAG for integrated house-to-house monitoring and health education, including fever surveillance, regular clean-up and monitoring of ITN/LLIN use in malarious areas.

An innovative approach is adopted through engagement of private diagnostic centres for migrant workers in routine screening for diseases (malaria, Syphilis, HIV, Hepatitis B, Hepatitis C, random blood sugar, drug test, chest X-ray for tuberculosis) for issuing work permits. Procurement of commodities required in small quantities is facilitated by a pharmacist stationed in the Consulate in Kolkata, India. Mandatory establishment of a health facility (PHC or District Hospital) in areas of developmental projects, through public-private partnership, for example, hydroelectricity dam construction projects are another example of private-public mix in disease prevention, control and management. Progressive transition from paper-based formats to paperless digital environment is another positive feature.

Key strategies and interventions include strong leadership and commitment from the Ministry of Health, a strong VDCP programme, integrated vector management combining multiple methods for cost-effectiveness and efficiency; insecticide-based methods comprising mass distribution of LLINs every few years (usually every three years) with high coverage in high-risk areas and two

rounds of IRS annually in high-risk southern districts; intensified surveillance and monitoring through continuous entomological monitoring (vector density, insecticide susceptibility), regular refresher training on malaria microscopy, and insecticide resistance monitoring; strengthened case management through expanded access to diagnosis and treatment, including ACTs for malaria; and fostering community engagement through citizen-centred programmes and community clean-up campaigns for larval source reduction.

External Competence Assessment of Malaria Microscopists (ECAMM) is being done every 2 – 3 years through WHO to maintain the competency and quality of microscopy skills of malaria technicians.

3.2 Technical Advisory Group for Malaria Elimination (TAGME)

A Technical Advisory Group on Malaria Elimination (TAGME) has been established in Bhutan in 2020. In collaboration with the Ministry of Health and WHO, TAGME was guiding the country toward eliminating malaria. This group monitors, reviews surveillance data including case and foci classification, and manages importation risks to sustain zero indigenous cases. This group meets on a regular basis and reviews and approves all malaria elimination and prevention of re-establishment activities.

Key aspects addressed by TAGME includes targeting certification by assisting in preparation of the malaria elimination country report; focusing on strengthening surveillance systems to prevent re-establishment of malaria; overseeing cross-border strategies and activities with neighbouring India; and establishing and working with partners.

It is proposed that TAGME be renamed as Technical Advisory Group for Prevention of Re-establishment (TAGPoR) of malaria but having the same scope of work focusing on PoR. TAGPoR shall be appointed by the Minister of Health. It is proposed that the composition of the TAGPoR be reconstituted to include Ministry of Health officials, academics, epidemiologists, clinicians, entomologists, and other relevant experts; the committee may also include overseas malariologists with experience in malaria elimination and prevention of re-establishment who may join meetings virtually. TAGPoR will review and classify all cases/foci based on available evidence. The case and foci classification will be based on WHO criteria and definitions. TAGPoR may meet once every month if cases are reported or less frequently if cases are reported less frequently. At the end of the meeting, all cases will be signed off by the TAGPoR and the decisions made will be entered into the national malaria database and used for official national malaria statistics.

3.3 Collaborating partners

The Government of India has provided financial and technical support to Bhutan in its malaria prevention and control activities since the inception of the programme. Since the start of the five-year plans (Royal Government of Bhutan, 1965), when Bhutan began taking control of its malaria activities, India has provided 40 million ngultrum (US $ 423 800 in 2026 US $) every five years to procure chemicals for IRS.

Over the past few years, Bhutan has been closely collaborating with many organizations including the World Health Organization for technical support and guidance, other development partners and donor agencies such as the Global Fund to Fight AIDS, Tuberculosis and Malaria. The WHO has also been an important partner, providing technical support in all areas of malaria prevention and control when requested by the Programme and the Ministry of Health, including the development of funding proposals and human capacity development. Bhutan has received grants from the Global Fund.

In addition, VDCP has been closely collaborating with the malaria elimination programme developed by the National Centre for Vector Borne Disease Control of India through district malaria offices for cross border collaboration to combat border malaria between India and Bhutan. This collaboration may be further facilitated and extended. In addition, there is close collaboration with Indian Council of Medical Research – National Institute of Malaria Research. Information sharing via WhatsApp messaging takes place.

As part of the External Quality Assurance (EQA) programme, collaborations are in place with Research Institute for Tropical Medicine, Manila (for malaria microscopy) and WHO Malaria Nucleic Acid Amplification Tests (NAAT) and molecular markers of antimalarial drug resistance EQA scheme. Regular ECAMM have been conducted with assistance from WHO.

The VDCP collaborates with private diagnostic centres in screening non-nationals who come for employment in Bhutan as a successful private-public partnership; all positive cases are notified to the VDCP for treatment and further investigation.

The VDCP also collaborates with CAGs to enhance community surveillance; structured guidelines need to be developed to further strengthen this collaboration and optimize the community surveillance system.

Collaborations have also been established with KGUMSB to train personnel in parasitology and entomology and in providing continuous medical education to the health staff on a regular basis.

4. Strategies and activities undertaken to achieve malaria elimination

4.1 Malaria elimination activities

The elimination goal and strategies are dependent on the incidence of malaria cases across the border in India. Due to this trend, initially Bhutan set a national elimination goal of 2020 but this too had to be postponed; currently the goal is to obtain WHO malaria-free certification in 2026 as the country has successfully ensured zero indigenous cases of malaria since 2022 even though there was a relatively massive outbreak of malaria in 2024. Given the difficulties in case classification in contiguous villages across the Indo-Bhutan land border, it is likely that re-establishment of transmission of indigenous malaria was prevented as evident from the number of cases reported in 2025 being only 35, similar to the norm during non-outbreak years.

To achieve the elimination goal, the country focused on interrupting transmission in the seasonal areas, maintaining malaria-free zones, and intensifying malaria control activities in the southern border *dzongkhags* to reduce the potential for importation of parasites from Assam State of India extent. The nine *dzongkhags* considered to be epidemic-prone (i.e. areas of seasonal transmission) were targeted first for malaria elimination and the seven endemic *dzongkhags* for intensified malaria control.

4.1.1 Epidemiological surveillance

The programme strengthened the surveillance system and introduced the use of GIS and mobile technology for data input and collection in all areas of the country. Mobile technology was piloted in a few health centres of Sarpang Dzongkhag and expanded later. Case-mapping began in 2013 still continues: the identification and classification of foci assist the VDCP in outbreak forecasting and response. A further objective of the strategic plan is the development and maintenance of case-registers at the central level.

Active case detection was conducted through screening of internal mobile and migrant populations, in epidemic prone areas, in order to identify and contain imported malaria. RDTs were used in these campaigns and expanded while passive case detection remained the main surveillance tool.

4.1.2 Management of disease prevention, imported malaria and its consequences

A major component of previous strategic plans was the management of imported malaria, specifically the identification, treatment and prevention of malaria in migrant workers. A first step towards this goal was the implementation of a system of classifying imported and indigenous cases. Use of the new Malaria Case Investigation Form in 2013 identified a total of 34 imported and 14 indigenous cases.

While these numbers are relatively low, and evidence of imported malaria resulting in onward transmission in Bhutan is limited, importation is still a major issue, particularly considering the estimated number of daily migrants crossing the border into Bhutan and longer-term workers who arrive to work in Bhutan for three months or more. Currently, malaria screening is a prerequisite for permits to hire migrant labour.

Border screening centres were considered but were not feasible because of the number of people to be screened. Instead, health check-up facilities have been established at the major development project sites, with delivery of LLINs to all site workers; some health facilities have already been established at project sites in remote areas by project authorities.

Additional physicians, nurses and technicians have been deployed at some of the existing health facilities close to project sites, and a number of PHCs have been upgraded to hospitals. Project authorities have helped to meet these additional costs, contributing a reported 60% of hospital and PHC costs.

Health centres at the project sites have been supplied with RDTs, and the VDCP provides technical support for IRS, mass screening and vector surveillance. Migrant workers are targeted for IEC by project authorities.

The programme has increased access to early, reliable detection (with microscopy), prompt and radical treatment and passive case detection in the endemic and epidemic-prone areas, particularly for migrant workers. Radical treatment for all parasite carriers, in all areas of the country, is the goal. This is accomplished through treatment with ACTs, plus primaquine as a gametocytocidal drug for *P. falciparum* malaria; patients with *P. vivax* will continue to receive the current 7-day treatment regimen of primaquine after testing for glucose-6-phosphate dehydrogenase (G6PD) deficiency as per national treatment guidelines. All *P. vivax* or *P. falciparum* cases are followed up as per the national malaria management guideline (Ministry of Health, 2024b).

Drug efficacy monitoring is being carried out. A quality assurance system for antimalaria drugs and a quality control/quality assurance system for diagnosis is implemented.

4.1.3 Field investigations and reporting

Planned field activities include surveillance along both sides of the border, seeking to identify infections in both symptomatic and asymptomatic individuals and to understand the extent of transmission; this results in radical treatment for those with asymptomatic infection. A WHO report recommended an increase in passive and active case detection for the Indian states along the border, which could be accomplished with help from nongovernmental organizations and communities (Dev, 2010). A malaria epidemic prediction and response unit was established, with response units available in each *dzongkhag*. There is countrywide notification of all positive cases by place of transmission and case-based investigation of all positive cases in the nine epidemic-prone *dzongkhags*. Positive indigenous cases are reported to the VDCP within 24 hours for case and foci investigation. The programme uses GIS dynamic malaria surveillance systems and foci identification using mobile technology.

4.1.4 Entomological surveillance

The programme aims to strengthen entomological surveillance and monitoring at sentinel sites throughout the malarious dzongkhags; there is a lack of expertise for this purpose. This will require

increased human resource capacity, capital equipment and supplies, and further skill development in the entomological workforce. Insecticide resistance monitoring will be enhanced.

4.1.5 Vector control activities

Focal IRS continues to be used to guard against outbreaks and the combined IRS/LLIN strategy is maintained. Distribution of LLINs in previously endemic *dzongkhags* is continued, and LLINs are introduced for use by migrant workers on development projects, including those in epidemic-prone areas. These activities complement bioenvironmental methods.

4.1.6 Epidemic preparedness and rapid response strategy

The programme has improved epidemic forecasting and preparedness capacity through the establishment of *dzongkhag*-level rapid response teams to contain outbreaks, use of GIS for malaria case surveillance, and ensuring availability of buffer stocks of antimalarials, including ACTs, and insecticides for IRS.

The Pandemic Fund-supported project, *Strengthening Pandemic Prevention, Preparedness and Response through the One Health Approach* in Bhutan, has contributed substantially to national health security by strengthening laboratory systems, integrated surveillance, multisectoral coordination, and workforce preparedness. Since its launch in 2024, the project has supported the operationalization of the Bhutan One Health Secretariat, enhanced collaborative surveillance across human and animal health sectors, and upgraded diagnostic capacity through the provision of advanced laboratory equipment to the RCDC, Thimphu. These investments have improved Bhutan's ability to detect and respond to emerging infectious diseases and other public health threats. While the project does not include disease-specific interventions for malaria or dengue, its investments in surveillance, laboratory diagnostics, and emergency preparedness are expected to strengthen the country's capacity to detect, monitor, and respond to vector-borne diseases alongside other epidemic and pandemic threats (World Health Organization, 2025a).

Laboratory support for surveillance, and external quality assurance/control diagnostic capacity, in particular in the epidemic-prone areas, was enhanced through training of health workers on microscopy and improvements in microscopy facilities.

4.2 Legislation and regulations relevant to malaria elimination

Management of malaria in Bhutan is primarily governed by national strategic plans and guidelines rather than a single standalone legislation. The country operates under a whole-of-government approach to achieve and maintain its zero indigenous malaria status.

Key regulatory frameworks and strategic plans include the following:

- National Strategic Plan (NSP) for Prevention of Re-establishment of Malaria 2026 – 2030: This is the primary document guiding current efforts. It focuses on obtaining WHO malaria-free certification in 2026 and prevention of re-establishment of malaria in the country from 2026 onwards.

- TAGME: This committee oversees all malaria elimination and prevention of re-establishment of malaria activities in the country. It provides policy guidance across multiple government sectors to ensure political and financial sustainability for malaria elimination and prevention of re-establishment of malaria in the country.
- International Health Regulations (IHR 2005): As a signatory, Bhutan is legally bound to international standards for disease surveillance and reporting at points of entry, which includes malaria monitoring.
- Bhutan Medicines Rules and Regulations (2019): Regulates the quality, safety, and efficacy of all medicinal products, including antimalarial drugs.

Mandatory health requirements include the following:

- Screening requirements: Bhutan mandates malaria screening for all migrant workers and conducts active case detection at worksites, particularly in the southern border districts.
- Integrated border screening: Malaria screening is often integrated with HIV and tuberculosis testing for foreign workers entering the country through border towns.
- The "1-3-7" Response Strategy: A standardized protocol requiring:
    - 1 day for case notification.
    - 3 days for case investigation.
    - 7 days for the implementation of response measures to contain potential outbreaks.

The Ministry of Health issues technical guidelines that reflects the official policy for healthcare providers:

- National Guideline for Diagnosis and Treatment of Malaria (2024).
- National Insecticide Resistance Monitoring and Management Plan (2021)
- Guideline for National External Quality Assessment Scheme for Malaria Diagnosis.

Cross-Border Legal & Informal Agreements:
As approximately 77% of Bhutan's malaria cases are imported from neighbouring India, Bhutan participates in:

- Joint action plans: Collaborative efforts with Indian states (Assam and West Bengal) for synchronized vector control and data sharing.
- Asia Pacific Leaders Malaria Alliance (APLMA): A regional commitment to a malaria-free Asia-Pacific by 2030.

4.3 Risk stratification and targeted strategies

With the transition from elimination to a prevention of re-establishment of malaria phase, an initial epidemiological risk stratification will be conducted taking into consideration importation risk of malaria, receptivity to malaria transmission and future development activities in the country that will attract foreign labour from malaria endemic regions. The risk stratification strategy will be based on mathematical models and GIS technology already developed for this purpose at *gewog*/*chiwog* levels. This procedure will be carried out every 3 years or as when required depending on the evolving epidemiology of malaria in the country.

Epidemiological risk stratification and mapping exercise will also be used to train personnel (entomologists, epidemiologists, DHOs, MTs etc.) on use of GIS tools and IT (information

technology) for surveillance purposes as part of capacity development for sustained prevention of re-establishment of malaria. New modules such as report generation will be incorporated into the system and manuals and guidelines will be updated as necessary. All databases (household data, village-wise data, case data and entomological findings) will be updated at *chiwog* level. Health volunteers who collect data will also be introduced to the system and the importance of their role will be communicated.

For intervention purposes, epidemiological risk stratification for malaria transmission based on the epidemiology of malaria at the end of 2025 at the sub-district (*gewogs*) level is defined as follows:

No Risk: *Gewogs* free of malaria transmission due to high altitude and absence of vectors;

Potential/low risk: *Gewogs* having a receptive ecosystem and high importation risk of malaria (vector present at least during summer, presence of mega projects with high volume of migrants from malaria endemic areas) but without local malaria transmission within last three years; and

High-risk: *Gewogs* with high receptivity, high importation risk, evidence of local malaria transmission prior to interruption of indigenous transmission in 2021, and sharing a direct border with India. All *gewogs* with common and porous borders with malaria endemic India, lying within the mosquito flight range and have high number of population influx and reflux to and from across the border are included in this category.

The microstratification of malaria transmission in 2026 is shown in Figure 27.

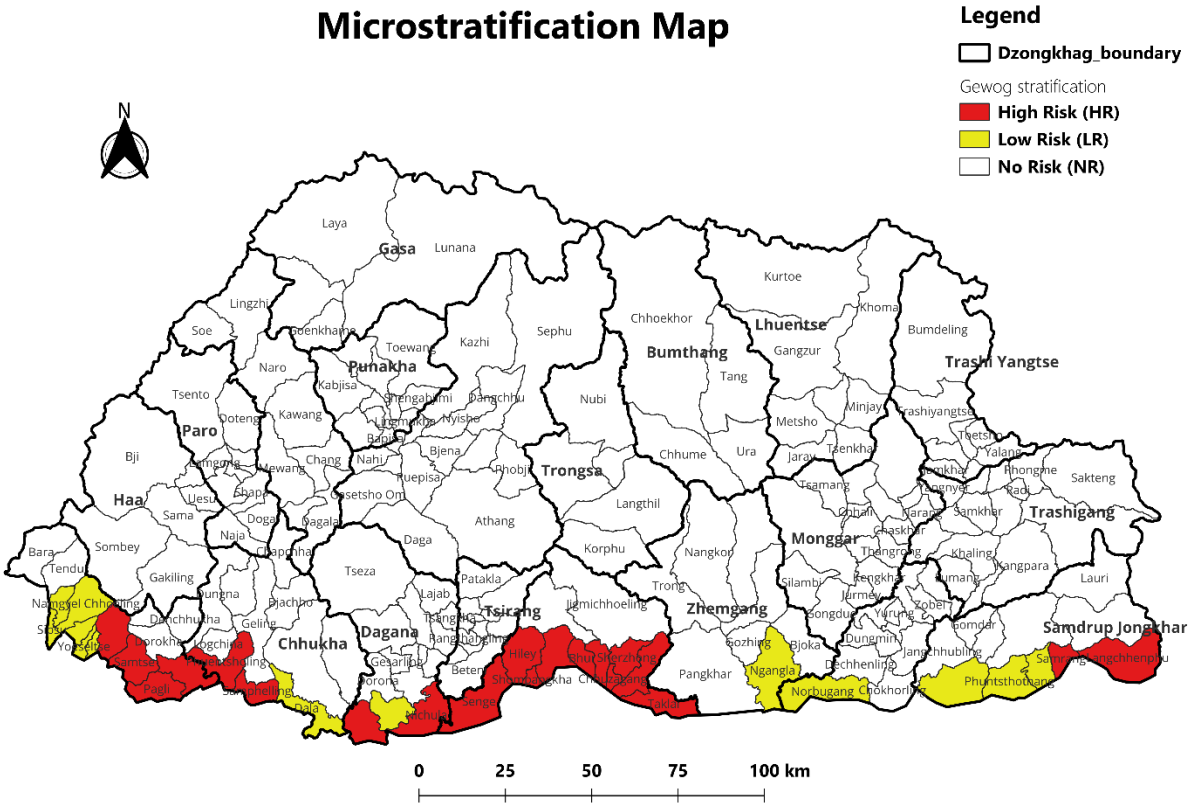


Figure 27. Risk stratification for malaria transmission in Bhutan, 2026

4.4 Surveillance and response systems

Case detection is a coordinated effort of the VDCP, the district teams, hospitals, PHC, community volunteers, outreach clinics and private diagnostic centres. Passive case detection, proactive and reactive case detection are employed with high level of vigilance, especially in areas with previous malaria transmission. VHWs, placed throughout the country, are trained on house-to-house fever surveillance, health education on communicable diseases, symptomatic treatment and referral. In areas with high risk of malaria, they are well-oriented on suspecting malaria cases, referral, and education on bed net use. Additionally, these areas have CAG composed of local stakeholders and VHWs, integrating malaria elimination and prevention of re-establishment activities at community level (support net distribution, IRS, community awareness, fever surveillance, elimination of breeding sites, DOTs, referral etc.). A highly commendable proactive surveillance approach is already in place near the border entry points for screening of migrant workers for malaria (and other diseases) through private laboratories.

The procedures for case detection, notification, case investigation, case classification, and focus investigation, classification and response are clear, well documented and followed by staff as per the 1-3-7 approach (as early as possible). Positive cases are notified almost immediately using mobile phones and WhatsApp groups to communicate and ensure rapid information sharing. Cases are investigated and initially classified by PHC (malaria technician, health assistant) and district level staff (district malaria supervisor, chief medical officer, district public health officer). Annual trainings are conducted by the national programme for healthcare staff at these levels especially in high-risk areas. The classification of every case is reviewed and certified by the TAGME, and reclassified if necessary. Case investigations are mostly complete; where discrepancies in formation are noted in certain instances, additional field visits and investigations are carried out. Narratives in Case Investigation Forms require special attention with specific information related to transmissions cycle and sociocultural context of the community that determine the epidemiology of malaria to adequately justify the final case classification.

4.4.1 Health management information system and integrated disease surveillance system

Bhutan has developed a national health management information system and integrated disease surveillance system with the objectives of providing information as a management tool for decision-making; assessing the state of the health of the population; identifying major health problems; setting priorities at all levels; monitoring the progress towards stated goals and targets of the health services; providing indicators for evaluating the performance of the health services/programmes and their impacts on the health status of the population; and providing information to those who need to take action, those who supplied the data and the general public.

Bhutan has modernized its health management and disease surveillance systems by integrating digital technologies, primarily using the DHIS2 and the National Early Warning, Alert and Response Surveillance (NEWARS) system (Ministry of Health, 2018). These systems are central to the Ministry of Health's efforts to enhance data accuracy, track public health indicators, and respond to disease outbreaks.

The National Health Management Information System (HMIS) uses the DHIS2 platform. The DHIS2 platform, an open-source web-based platform that is online since 2014, is used replacing

the previous manual, paper-based reporting systems. The system is managed by the Health Informatics and Research Division, Ministry of Health. DHIS2 is used for collecting, storing, and analyzing health data, such as service delivery (outpatient/inpatient), immunization rates, and mortalities, across all 20 districts. Aggregate data are used to produce the Annual Health Bulletin, which informs policy and tracks national health indicators.

Bhutan has adopted digital health as a strategic priority to improve healthcare delivery, strengthen health information systems, and enhance access to services across its geographically challenging terrain. The country's digital health agenda, guided by the National eHealth Strategy and subsequent digital health initiatives, focuses on interoperable health information systems, electronic medical records, telemedicine, digital disease surveillance, and data-driven decision-making (Gurung et al., 2019; Ministry of Health, 2024b). Key platforms include the Electronic Patient Information System (ePIS), electronic health management information systems, and digital surveillance systems such as NEWARS, which support continuity of care, health system efficiency, and public health monitoring (Ministry of Health, 2018).

To address the limitations of paper-based records, Bhutan has rolled out ePIS in 2023 to create electronic medical records for longitudinal patient care across all levels of hospitals (Figure 29). The system provides a standardized platform for electronic health records across the country in capturing, storing, and retrieving patient information. WHO's International Classification of Diseases, 11th Revision (ICD-11) is also integrated to ePIS to strengthen disease reporting by facilitating standardized diagnosis coding and real-time data entry. Through extensive capacity-building initiatives and the deployment of digital tools, ePIS has improved the accuracy, consistency, and timeliness of health information management. It ensures evidence-based planning and decision-making within the health sector.

Figure 28. User interface and modules in the Electronic Patient Information System (ePIS), 2026

The implementation of ePIS has significantly enhanced malaria surveillance, case detection, reporting, and data management in Bhutan. Electronic recording of malaria cases allows for timely capture of patient demographics, diagnostic test results, treatment details, referral information, and treatment outcomes. Standardized ICD-11 coding improves the consistency and quality of malaria data across health facilities. This facilitates accurate monitoring of disease trends and transmission patterns. Real-time availability of surveillance data supports early detection of outbreaks, identification of high-risk areas, and rapid public health response. The centralized data management enables efficient analysis, reporting, and evaluation of malaria control interventions in Bhutan.

The Integrated Disease Surveillance System also known as NEWARS comprises two main pillars: Notifiable Disease Surveillance System (NDSS) which tracks a set of pre-defined epidemic-prone diseases, vaccine-preventable diseases, and those targeted for elimination; and Event-based Surveillance (EBS) that allows for rapid reporting of unusual events, such as suspected outbreaks, animal deaths, or environmental hazards (Figure 30).

Figure 29. Event reporting and notification through the National Early Warning, Alert and Response Surveillance (NEWARS), Royal Centers for Disease Control. The dashboard shows event records on 06 June 2026

Health workers use web-based reporting or SMS to submit weekly or immediate alerts to the RCDC. The National Disease Surveillance and Epidemiology Unit at the RCDC validates data, assesses risks, and provides recommendations for response as part of outbreak management.

Despite progress, paper-based approaches still exist in some areas, and the ePIS project faces challenges with computer shortages and system user-friendliness. A major goal is to fully integrate

clinical and surveillance data into a unified national data centre for real-time analysis. There is an ongoing need to train health professionals in data management to improve the quality of data entered into the systems.

Despite the above limitations and challenges, the following results have been reported: 87% on time reporting and >95% complete report submission; Data submitted to DHIS2 and available for use by 15th of every month; Monthly morbidity reports, activity report, HIV/VCT report; Annual Household survey and RWSS; Traditional medicine (activity and morbidity report); and use of DHIS2 features; chart, tables and map for direct use.

For medical supplies and procurement of medicines, the Electronic Bhutan Medical Supply Inventory System (eBMSIS) is used. The eBMSIS is a web-based logistics management information system to monitor and manage the procurement, inventory, distribution, and consumption of medicines, vaccines, medical supplies, and health commodities across all levels of the health system. The system provides real-time stock visibility and supports evidence-based forecasting, reducing stock-outs and improving the efficiency of national supply chain management. It is utilized nationwide for the management of medical supplies, including both drugs and non-drug items procured through the Royal Government of Bhutan. The system facilitates efficient supply chain management across all levels of the health system by enabling the preparation of annual indent requests by store in-charges, generation and finalization of Bills of Quantification (BoQ), and placement of purchase orders to selected suppliers. It allows real-time tracking of supplies from suppliers to health facilities, internal requisition and distribution of items within facilities, and redistribution of excess stock between health centres through a notification system. eBMSIS also provides alerts for short-expiry items, minimum stock levels, and reorder requirements.

Malaria-related commodities, including antimalarial drugs and diagnostic test kits, are procured and managed through the eBMSIS platform, ensuring timely availability, improved stock monitoring, and efficient distribution to health facilities for effective treatment and control of malaria cases.

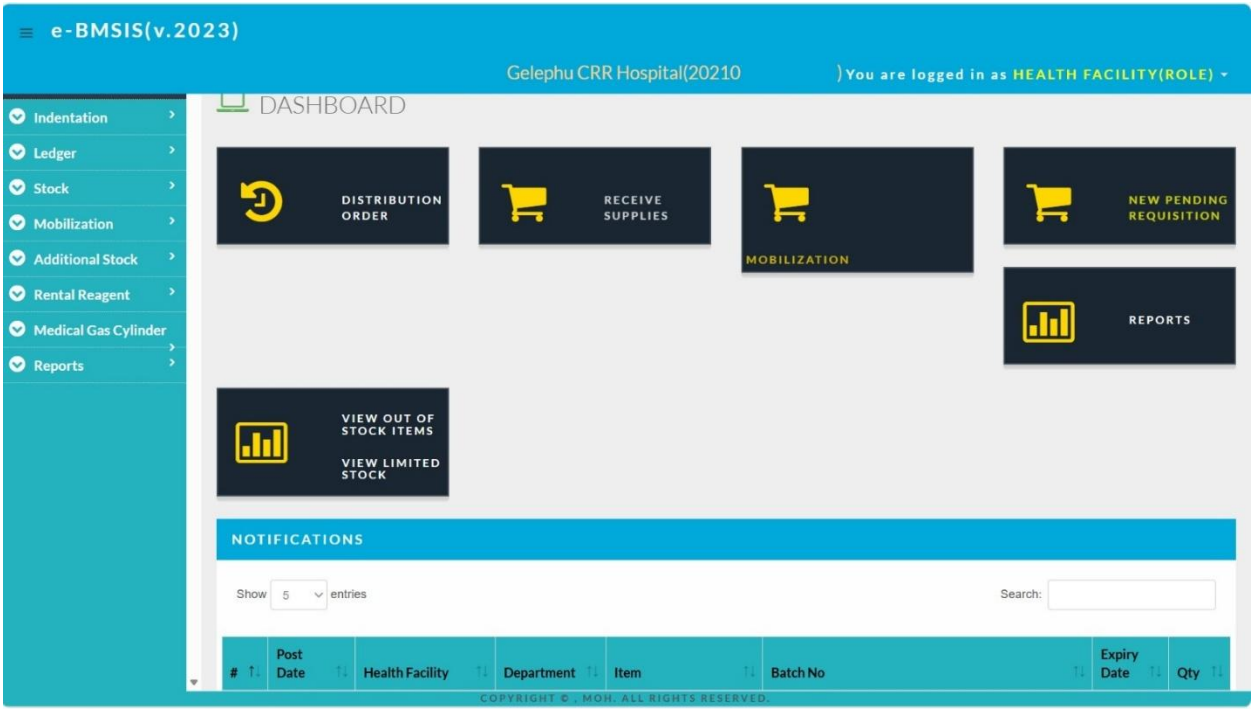


Figure 30. Electronic Bhutan Medical Supply Inventory System (eBMSIS) dashboard

4.4.2 Malaria case detection

4.4.2.1 Passive case detection (PCD)

Malaria cases detected when a person presents to a healthcare facility with clinical signs and symptoms is called passive case detection. Most malaria infections in low transmission settings where people have no malaria immunity produce fever periodically. Passive case detection should therefore lead to the detection of most malaria infections. The functional healthcare services and good access to health facilities is important for good passive case detection in active transmission foci and is preferable to periodic visits by mobile teams. However, in hard-to-reach areas with active transmission, periodic visits by mobile team of health workers are recommended. Passive surveillance for malaria is conducted by public health facilities, military health centres and private diagnostic centres.

As per the National Guideline for Diagnosis and Treatment of Malaria in Bhutan 2024 (Ministry of Health, 2024b), a suspected case of malaria is defined as a resident or traveller from an endemic area presenting with fever (>37.5 ºC) or a history of fever with no other obvious cause. As part of clinical practice, patients with fever persisting for more than three days are investigated at baseline by rapid diagnostic tests for malaria, dengue (NS1, IgM and IgG) and scrub typhus (IgM and IgG). In cases where fever persists, repeat testing is offered and additional blood samples are collected and transported to the RCDC as a part of the Acute Undifferentiated Febrile Illness (AUFI) sentinel surveillance. Under AUFI surveillance, enzyme-linked immunoassay (ELISA) tests are performed for dengue, scrub typhus, leptospirosis, chikungunya, Japanese encephalitis and brucella. These test findings are provided by the RCDC to the heads of the hospitals as a monthly report.

Passive case detection is conducted in all primary healthcare centres. RDTs are available in all such institutions (Table 22).

Table 22. Action plan for passive case detection

Component	Description
Objective of PCD	To identify malaria infections and provide prompt treatment as per the national treatment protocol.
Who	All febrile cases: • Residents of malaria-risk areas • Individuals with a travel history to high-risk areas/countries • Individuals arriving from high-risk areas/countries
Where	Public health facilities Military hospitals Private diagnostic centres
How	By microscopy or Rapid Diagnostic Tests (RDTs).
Responsible staff	Clinician: To advise and request diagnosis. Laboratory staff: To perform the diagnosis.

As per the national guideline, a case of malaria is diagnosed based on confirmation of presence of malaria parasite by a quality-assured positive RDT or microscopy performed by certified Malaria Technicians. A quantitative G6PD assay is performed in all *P vivax* cases. All reports of RDT, microscopy and G6PD testing are released through the ePIS. In places where G6PD testing are not available, the patient's blood sample is transported to the nearest hospital within the district where the tests are available.

4.4.2.2 Active case detection (ACD)

Apart from identifying cases through passive surveillance, an active case detection must be strengthened during the elimination and prevention of re-establishment phases to increase the sensitivity of the surveillance system. Active case detection is a complementary strategy that involves the detection of malaria infections at community and household level in population groups that are considered to be at high risk by health workers. Active case detection can be categorized into proactive and reactive case detection.

4.4.2.3 Proactive case detection (PACD)

PACD is done in high-risk groups such as migrant workers, mobile populations, vulnerable groups and hard to-reach populations, irrespective of whether a case is reported or not. For elimination and prevention of re-establishment of malaria, it is important to ensure that there are no residual cases in communities through adequate screening in high-risk transmission areas, vulnerable population and in active foci. At the programme level, the performance at case detection will be measured using ABER which is established at 20 percent. The Dzongkhag Malaria Supervisor (DMS) and local health authorities should identify the high-risk areas and population in their locality on the basis of local surveillance data and in consultation with VDCP and conduct targeted PACD (Table 23).

Table 23. Action plan for proactive case detection

Component	Description
Objective of PACD	Detection of symptomatic or asymptomatic malaria infection at community and individual levels based on perceived risk.
Who	All high-risk groups: • Migrant workers • Populations in hard-to-reach areas • Vulnerable populations in receptive areas
When	During the high transmission season.
How	By Rapid Diagnostic Tests (RDTs) or microscopy.
Responsible staff	District Malaria Supervisor (DMS)/Malaria Technician (MT): To identify high-risk groups. Laboratory personnel: To perform malaria screening.

The following activities are carried out:

- Line listing of the targeted population by household is prepared with the assistance of local authorities.
- Complete coverage of the target population. People from organizations associated with the target population are included in the lists, e.g. temporary developmental sites labourers, Indian migrant workers, seasonal labourers etc. People, who may not be recorded in the existing household lists, should also be covered.
- The DMS/DPHO at district level develop micro plan of visits, and the targeted population should are informed of the dates and times they will be visited. It is timed when family members are most likely be at home (before or after work or school).
- RDTs are conducted and people confirmed with malaria are treated immediately, and cases and foci are investigated epidemiologically.
- A register of all people whose blood has been taken during active case detection is filled. It includes the identification number of the household, the name of the head of the household, address, person's name, age and other risk factor information (e.g. occupation, insecticide-treated net ownership and use, indoor residual spraying in the past year), date blood taken, type of testing and results (species, stages, density, presence of gametocytes). The list of malaria screening conducted among expatriate workers for work permit at the point of entries are compiled by the VDCP.

4.4.2.4 Reactive case detection (RACD)

Reactive Case Detection (RACD) is an important surveillance strategy in elimination and prevention of re-establishment of malaria phases to detect early any possible local spread of infection in the community. RACD is initiated within 24 – 48 hours of notification of a case. This responsibility is entrusted with DMS/MLT/CMO/HA and epidemiologist or programme officers at the VDCP (Table 24). Reactive case detection is always in response to a confirmed case or cluster of cases in a locality. It is initiated and completed by the local investigating team. This reactive search for additional cases is conducted in a systematic approach guided by epidemiological information about the most probable location of the source of infection. The subsequent epidemiological information assists in a more directed investigation through house-house searching of cases around the index case. The scale of RACD depends on the type of case

(imported vs indigenous) and the malariogenic potential of the local area which should be obtained during case investigation.

Table 24. Action plan for reactive case detection

Component	Description
Objective of RACD	To detect additional infections and interrupt onward transmission of malaria in a focus following the identification of a confirmed case.
Who	All residents within the focus area and residents of places visited by the index case.
Where	Within approximately a 0.5 km radius of the likely location of the index case in a transmission focus.
How	By Rapid Diagnostic Tests (RDTs) or microscopy
Responsible staff	District Health Officer (DHO)/Medical Officer (MO)/District Malaria Supervisor (DMS)/Malaria Technician (MT)/Health Assistant (HA): To lead the team. Laboratory personnel: To perform the RACD.

RACD is more extensive if the index case has evidence of local transmission and limited in scale if the case is imported, relapsing or recrudescent, especially in an area with low receptivity (potentially- and risk-free districts). RACD screening can be primary or secondary based on the probable origin of index case, whether locally acquired or imported.

As a part of RACD, primary screening is done to detect any additional infections that may have been generated by the same source as index case (evidence of local transmission). Primary screening is not done in a clear imported case. This is done within 24 hours. Secondary screening is done to detect any additional infections that may be generated by the index case via mosquito vectors. It may also detect infection missed during primary infection and should be conducted after 14 days of primary screening.

The following general principles from WHO are used to facilitate decision making on case classification:

- The usual incubation period after an infectious mosquito bite and a primary clinical attack is 7 – 30 days. The minimal incubation period (i.e. from inoculation to onset of symptoms) of malaria in humans is about 9 – 14 days for *P. falciparum* and 12 – 17 days for *P. vivax* infection. Thus, detection of malaria infection within 9 – 14 days for *P. falciparum* or 12 – 17 days for *P. vivax* of arrival in country indicates imported nature of infection.
- If the time period between return from travel to endemic area and detection of malaria infection is more than 6 months, the probability that the case is truly due to an imported infection is less. The probability that the case is due to local transmission increases.
- If the case is resident in the area without malaria transmission for many years and supported with adequate surveillance, and the person travelled to an area with known malaria transmission within six months of detection, it is highly likely to be an imported infection.
- If the area has had no malaria reported for more than 3 years and has a good surveillance system in place or has no known vectors, local transmission is unlikely.

4.4.2.4 Screening of blood production

Bhutan's blood transfusion services operate under national blood safety guidelines that ensure all donated blood is screened for transfusion-transmissible infections before use. In addition to HIV, Hepatitis B, Hepatitis C, and syphilis, malaria screening is mandatory for all donated blood units to prevent transfusion-transmitted malaria (Ministry of Health, 2013). This requirement reflects Bhutan's commitment to maintaining malaria-free status and mitigating the risk posed by imported infections and asymptomatic parasitaemia among blood donors. Blood collection, testing, processing, and distribution are conducted through a nationally coordinated blood transfusion service to ensure the safety and quality of blood and blood products used in clinical care (Ministry of Health, 2013, 2024b).

4.4.3 Surveillance among foreign workers

Foreign workers entering Bhutan for employment undergo a regulated evaluation process governed by national immigration and labour policies to ensure national security, workforce regulation, and protection of public health (Figure 31). The process typically begins with employer sponsorship, where a Bhutanese employer identifies the need for foreign labour and submits a formal application to the Department of Labour under Ministry of Industry, Commerce and Employment through the Foreign Worker Management System (Ministry of Labour and Human Resources, 2022). Once approved, the worker is granted a work permit and visa clearance prior to entry.

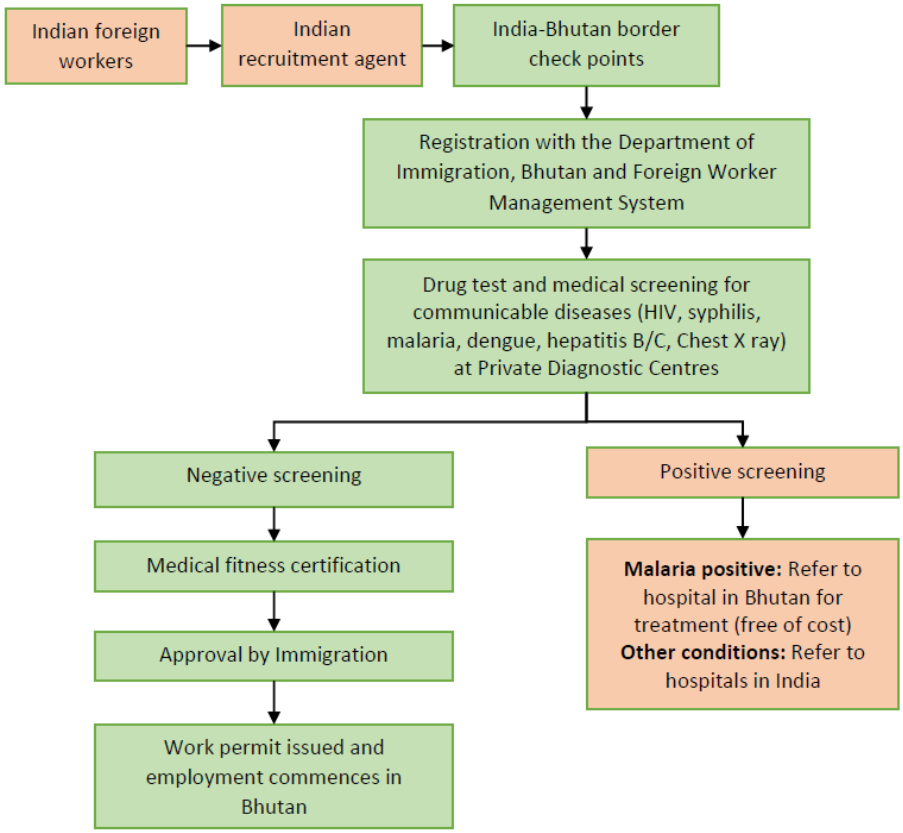


Figure 31. Medical screening of foreign workers entering Bhutan through the immigration checkpoints in Samtse, Phuentsholing, Gelephu and Samdrup Jongkhar (2026)

As part of pre-entry requirements, foreign workers are subjected to mandatory urine drug test and medical screening. This medical screening is designed to prevent the importation of communicable diseases. It includes screening for Malaria, Dengue, HIV, Hepatitis B and C, Syphilis, and other infectious diseases of concern during the time of entry (eg. COVID-19 was tested during the pandemic, but now discontinued) through the online Bhutan Labour Market Information System as shown in Figure 32 (T. Dorji, Gyaltshen, et al., 2024). The tests are done in PDCs upon payment of nominal fees. Only individuals who meet the required health standards are certified as medically fit for employment in Bhutan. Those workers tested positive for malaria are offered free treatment in Bhutan.

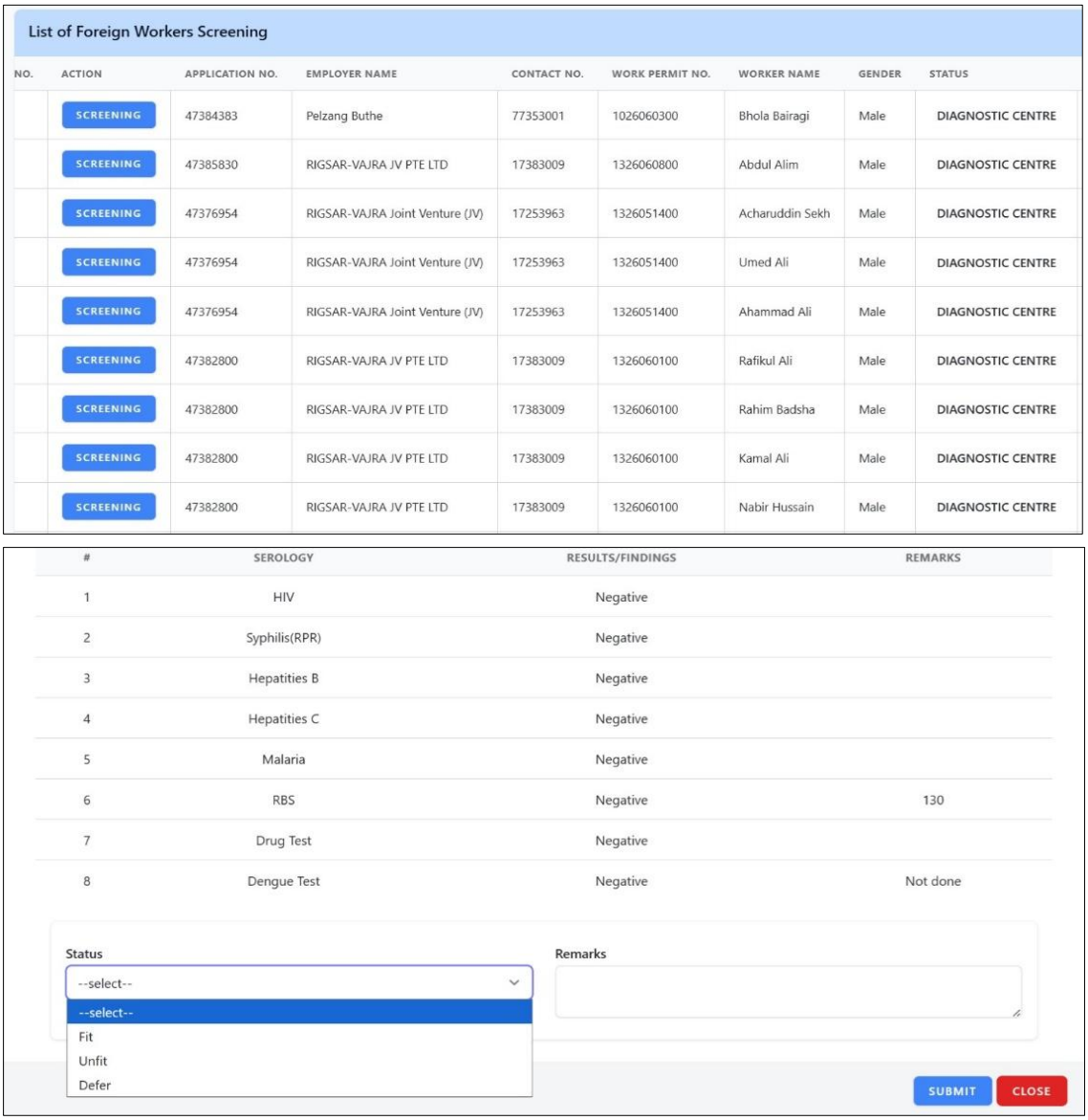


Figure 32. Foreign worker screening using the Bhutan Labour Market Information System portal, 2026. Foreign workers are tested for dengue, malaria, Hepatitis B, Hepatitis C, HIV, Rapid Plasma Reagin for syphilis and chest X-ray. A medical doctor reviews the reports and marks 'fit, unfit or defer' medical certificate for immigration into Bhutan

This verification serves as a critical public health safeguard. It helps reduce the risk of cross-border transmission of infectious diseases, protects the resident population, and ensures that foreign workers enter the country in a condition suitable for safe employment. This system contributes to broader national disease surveillance and supports Bhutan's efforts in controlling communicable disease such as malaria.

4.4.4 Surveillance in community and military health facilities

Surveillance is primarily conducted by VDCP with the help of the district teams, hospitals, PHC, community volunteers and outreach clinics. VHW, placed throughout the country, are trained on house-to-house fever surveillance, health education on communicable diseases, symptomatic treatment and referral. In areas with high risk of malaria, they are well-oriented on suspecting malaria cases, referral, and education on bed net use. Additionally, these areas have CAG composed of local stakeholders and VHWs, integrating malaria elimination activities at community level (support net distribution, IRS, community awareness, fever surveillance, elimination of breeding sites, DOTs, referral etc.).

There is no formal private health sector in Bhutan. Private diagnostic centres are engaged in a highly commendable proactive surveillance approach using mainly RDTs that is already in place near the border entry points for screening of migrant workers for malaria (and other diseases). The results of this screening programme are shared with VDCP; all suspected malaria cases are confirmed by microscopy or PCR by VDCP and treated as per the national guidelines for treatment of malaria.

The procedures for case detection, notification, case investigation, case classification, and focus investigation, classification and response are conducted by VDCP as per guidelines and described earlier. Annual trainings are conducted by national programme for healthcare staff at these levels especially in high-risk areas.

There are military hospitals under the RBA Medical Services. All medical doctors and malaria technicians in the military are provided training by the VDCP. The national guidelines are followed for management and follow up. The data of RDT and positive cases are reported through the DHIS2. One medical doctor from the RBA is a member of the TAGME and plays active role in providing health education to the military personnel before being posted to the border monitoring posts or for UN peacekeeping assignments.

4.4.5 Malaria case reporting

When a malaria infection is confirmed, it is reported to the Ministry of Health and the VDCP through the DHIS2 platform. In addition, the suspected/confirmed cases of malaria are reported to the NEWARS to alert the RCDC, Thimphu (Ministry of Health, 2018). Under the NEWARS system, there are designated focal points (doctors or nurses) in hospitals that report the suspected/ confirmed cases. This system functions as a part of national infectious diseases early detection and surveillance system.

4.4.6 Malaria case investigation and intervention

Following the reporting of a malaria positive case, the VDCP follows the 1-3-7 strategy for response (Ministry of Health, 2020). Case notification is done within 24 hours and reactive case detection is completed within 7 days by a team comprising of medical officers, Health Assistants, malaria technicians and public health officers. The epidemiological parameters linked to the case are investigated within 72 hours using the standard case investigation form. This case investigation is conducted by a team comprising of malaria technicians, medical officers, health assistants and public health officers. Focus investigation of the area for vectors and its breeding places and targeted response such as LLIN or IRS are completed within 7 days (Figure 33).

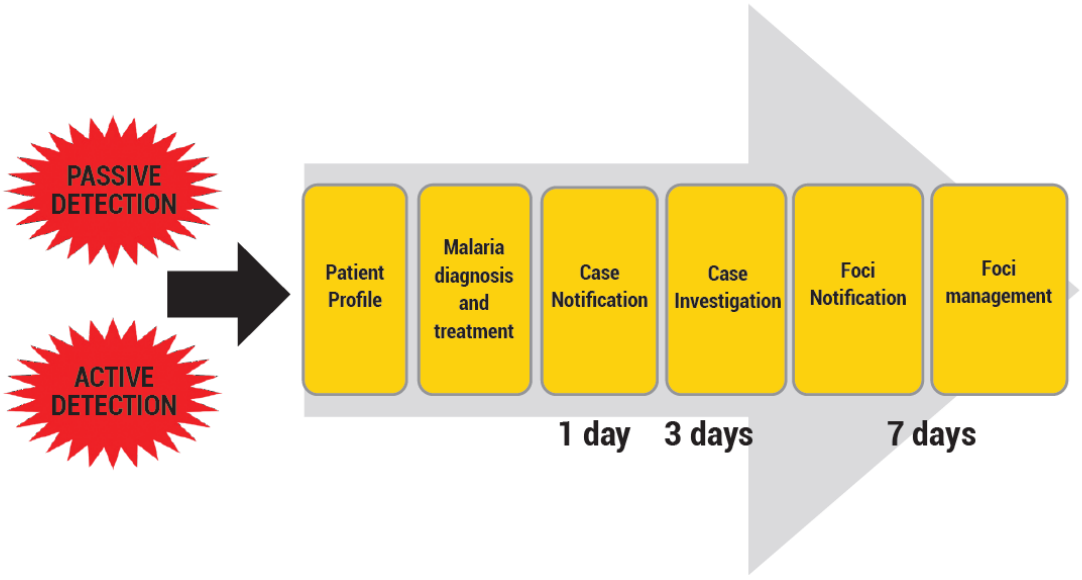


Figure 33. Case-based surveillance and activities under the 1-3-7 principle for programmatic response after detection of a malaria case

4.4.7 Malaria case classification

4.4.7.1 TAGME malaria case review and classification process

Malaria cases identified during the calendar year (January – December) are reviewed by the members of the TAGME, programme officers from the VDCP and field workers (Figure 34).

The case investigation form contains the basic details of the index case (name, age, sex, nationality, occupation, address of residence), clinical information (date of onset of symptoms, date of diagnosis, diagnostic test RDT/microscopy, parasite species, parasite stage), case investigation details (history of travel within and outside the country, arrival date, and likely place of infection, presence of migrant workers in the area), details of focus investigation within a radius of 500 metres (type of focus classification), vector surveillance (breeding sites, vector species, control measures implemented such as LLIN distribution and IRS), reactive case screening and testing, and larvicidal use).

Based on all the information in the case investigation form and discussion with the field workers (malaria technician, medical officers, and programme officers), the case is deliberated by the members of TAGME and classified.

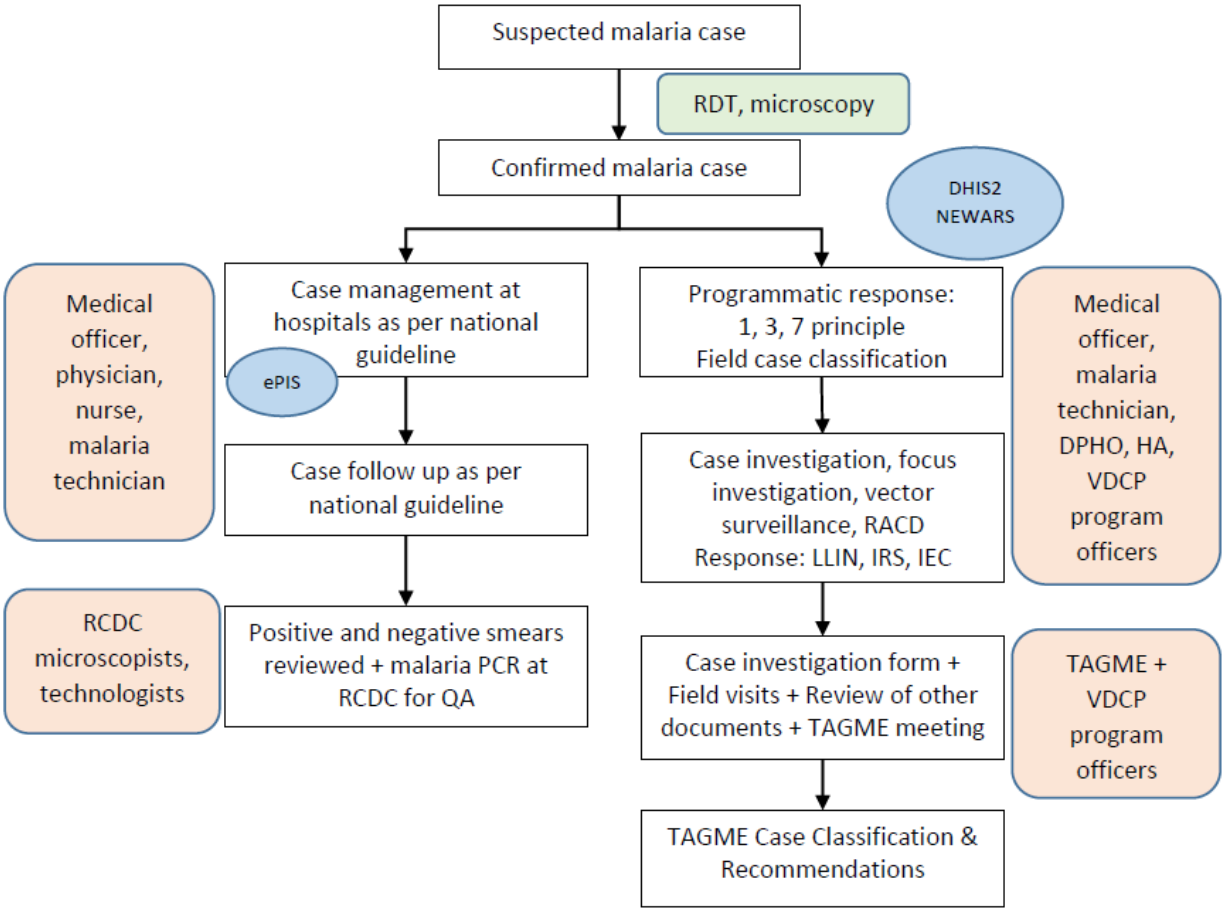


Figure 34. Process of case review and classification and review of programmatic response by Technical Advisory Group for Malaria Elimination (TAGME)

In situations where there are challenges and difficulty in case classification, the TAGME members make field and community visits to selected sites for additional epidemiological investigation and observations (Technical Advisory Group for Malaria Elimination, 2026). Some cases are deliberated exhaustively with consideration of other information and evidences to make the final case classification. After the final case classification, the case investigation form is signed by the VDCP programme officer and the chairperson of TAGME.

The case classification by TAGME is based on the following definitions (Figure 35) (World Health Organization, 2018). An ***indigenous case*** is acquired locally with no evidence of importation or no direct link to transmission from an imported case. An ***imported case*** is one where the infection was acquired outside the country in which it is diagnosed. An ***introduced case*** is acquired locally, with strong epidemiological evidence linking it directly to a known imported case (a first-generation local transmission). An ***induced case*** occurs where the origin can be traced to a blood transfusion or other forms of parenteral inoculation of the parasite but not to transmission by a

natural mosquito-borne inoculation. A ***relapse*** of a case is attributed to activation of hypnozoites acquired previously in the absence of epidemiological link or exposure to risk of infection.

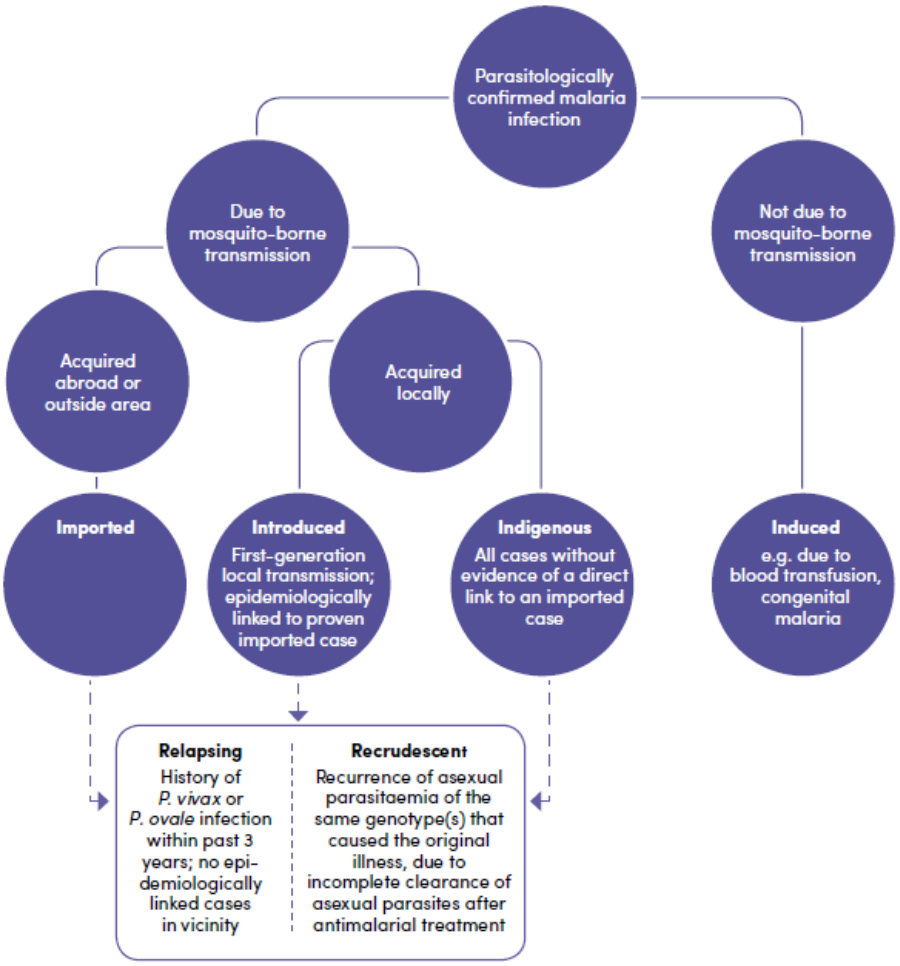


Figure 35. Classification of malaria cases as per World Health Organization framework for malaria elimination (World Health Organization, 2025b)

4.4.8 Focus investigations and monitoring

Once a locally acquired malaria case has been detected in a receptive area, focus investigation is conducted to delineate and characterize the area and at-risk population. For operational purposes, a single case of malaria is considered as a focus. The investigation is more extensive if a new focus is identified; in a known active focus, the detection of a new case will only trigger a new focus investigation if its features (parasite species or location) differ from those of previously detected cases. The focus investigation then identifies the main features of the location (using GPS monitors), including population at risk, identification of actual or potential breeding sites, identification of likely vectors and their densities.

Foci investigation and response activities including RACD are carried out as given below:

- Mapping where transmission occurs, vector breeding locations and risk populations in the focus area;

- Conducting entomological surveillance as per vector surveillance guidelines;
- Evaluating vector control activities and providing supplementary vector control measures if required (LLIN top up);
- Describing the vector species present, their abundance, where they are located and their feeding behaviour; and
- The socioeconomic conditions and access to healthcare in the locality.

4.4.9 Focus response

The findings from focus investigations determine if local transmission is occurring and assists in both the final classification of focus and case. Based on the case investigation, case classification and epidemiological history of locally acquired cases in the foci, a focus is classified as given in Table 25. Focus investigation and responses have to be completed within 7 days from the date of case detection. The following forms and SOPs are used: SOP Focus investigation, Focus investigation form, RACD Form 4, Checklist for household investigation during focus investigation, and Focus follow-up form.

The classification of foci is updated annually in the month of January. The status of a focus is also reviewed as new cases appear and field investigations are undertaken. The results of focus investigations are compiled and maintained at national level in the 'Focus register' and a summary of the status of all national foci is updated annually.

Table 25. Recommended minimum standards for focus investigation response

Focus Definition	Operational Criteria	Activities Recommended
Active: Focus with ongoing transmission	Indigenous case(s) have been detected within the previous 12 months.	Investigation and response within a 0.5 km radius RACD according to guidelines Mapping of vector breeding sites and vector characterization (larvae and adults) Mapping of populations at risk Vector control assessment and response Community mobilization PACD based on risk assessment
Residual Non-active: Transmission interrupted recently (1 –3 years ago)	Transmission interrupted within the last 1–3 years; last indigenous case detected at least 12 months ago.	RACD according to guidelines Mapping of vector breeding sites and vector characterization (larvae and adults) Mapping of populations at risk Vector control assessment and response PACD based on risk assessment
Cleared: No local transmission for more than 3 years and no longer considered residual non-active	No indigenous case(s) for more than 3 years; only imported, relapsing/recrudescent, and/or induced cases may occur in the current calendar year.	Continue case investigation and response

4.4.10 Training and supervision for surveillance

All new recruits to the VDCP are provided with a training on malaria surveillance and case management. This training includes the scope of surveillance activities from case suspicion, to case detection and notification. In addition, all staff are trained on conducting case investigation and its importance in preventing the re-establishment of malaria in the country. Regular supervisory visits are made at different operational levels by designated officers of VDCP.

All in-in-service staff are provided continuing medical education. The guideline on continuing medical education requires all registered practitioners to engage in accredited educational activities, as CME credits serve as a mandatory requirement for renewal of professional registration (Bhutan Medical and Health Council, 2022).

4.5 Monitoring and evaluation of the surveillance system

The programme operates a strong and robust monitoring and evaluation (M&E) plan, as a key component of case-based malaria surveillance and response system to track progress and conduct on-going improvement of malaria surveillance system. Monitoring of surveillance performance at every operational level is conducted to review surveillance performance in detection, reporting and responding to malaria cases. The surveillance M&E indicators is shown in Table 26. The monitoring of surveillance is conducted by the DHO/DMS at district level and surveillance unit from VDCP at the national level. Further, the WHO external expert committee as well as national sub-committee of TAGME conducts independent assessment and evaluation of the surveillance performance annually. The surveillance performance review and recommendation for improvement are presented and discussed during TAGME meetings.

Table 26. Key indicators for M&E of malaria surveillance activities

Indicator	Target	Data source	Measurement	Responsible staff/ agencies
Percent of malaria cases notified within 24 hours	100%	DHIS2 / NEWARS	Within 24 hours (DPHO and VDCP)	DMS/MLT and concerned health facility in-charge
Percent of expected zero malaria report received from health centres	100%	DHIS2	Monthly	DMS/MLT and concerned health facility in-charge
Percent of positive malaria cases referred from private diagnostic centres	100%	Malaria case register of private diagnostic centres / health centres	Within 24 hours to health centre	PDC and health centres
Percent of confirmed malaria cases fully investigated and classified within 72 hours	100%	DHIS2	Within 72 hours	DPHO and VDCP
Percent of confirmed cases with completed investigations and classification information	100%	DHIS2	Case investigation and classification form completed	Health centres / VDCP
% of foci fully investigated (malaria focus investigation form completed including data from entomological investigations) and registered (in register with maps of focus)	100%	DHIS2	Completed investigation form within 7 days from the day of notification	MT / HC in-charge / CMO / DMS / DPHO / VDCP
Percent of health centres with Malaria Technician reporting vector surveillance	100%	DHIS2	Monthly	MT / DMS / VDCP
Percent of sentinel sites monitored for insecticide resistance	100% (4 sites)	DHIS2	2 years	VDCP / health centre
Annual Blood Examination Rate by district and focus (detected passively and actively)	>20% in active and low / high risk districts	DHIS2, district database	Annual	DMS / DPHO / VDCP
Time from first symptom (fever) to first contact with the health system	Within 48 hours	DHIS2 / Malaria case	Annual	DPHO / Hospitals and VDCP

Next page

Continued

Indicator	Target	Data source	Measurement	Responsible staff/ agencies
		investigation database		
Time from first contact to testing	Within 24 hours	DHIS2 / Malaria case investigation database	Annual	DPHO / Hospitals and VDCP
Time from positive test result to start of treatment	Same day	DHIS2 / Malaria case investigation database	Annual	DPHO / Hospitals and VDCP
Percent of health centres provided training / refresher training on malaria microscopy & QA/QC	100%	NMRL, RCDC	Annual	VDCP / NMRL
Percent of malaria testing laboratories participating in blinded re-checking	>80%	NMRL, RCDC	Monthly	NMRL / Health centre
Percent of malaria testing laboratories participating in panel testing	>80%	NMRL, RCDC	Bi-annually	NMRL / Health centre

4.6 Malaria diagnosis

Diagnosis of a malaria infection is the starting point for series of activities which include treatment initiation, case notification and investigation, response measures to prevent further transmission, case classification and recording of event for monitoring and evaluation of the programme. Microscopy, both thick and thin blood smears) and RDTs are the main method of diagnosis used; a positive result to either of the two is considered diagnostic of malaria to initiate treatment as shown in Figure 36 (Ministry of Health, 2024b). Parasite detection and quantification is performed in thick smears to monitor response to treatment. Thin smears are recommended for species identification. Additionally, the severity of malaria infection can be determined by the parasite density per microliter of blood. Ideally, microscopy should only be performed by well-trained microscopists. The accuracy of diagnosis is strongly dependent on the competence of the microscopists supported by a robust quality control system.

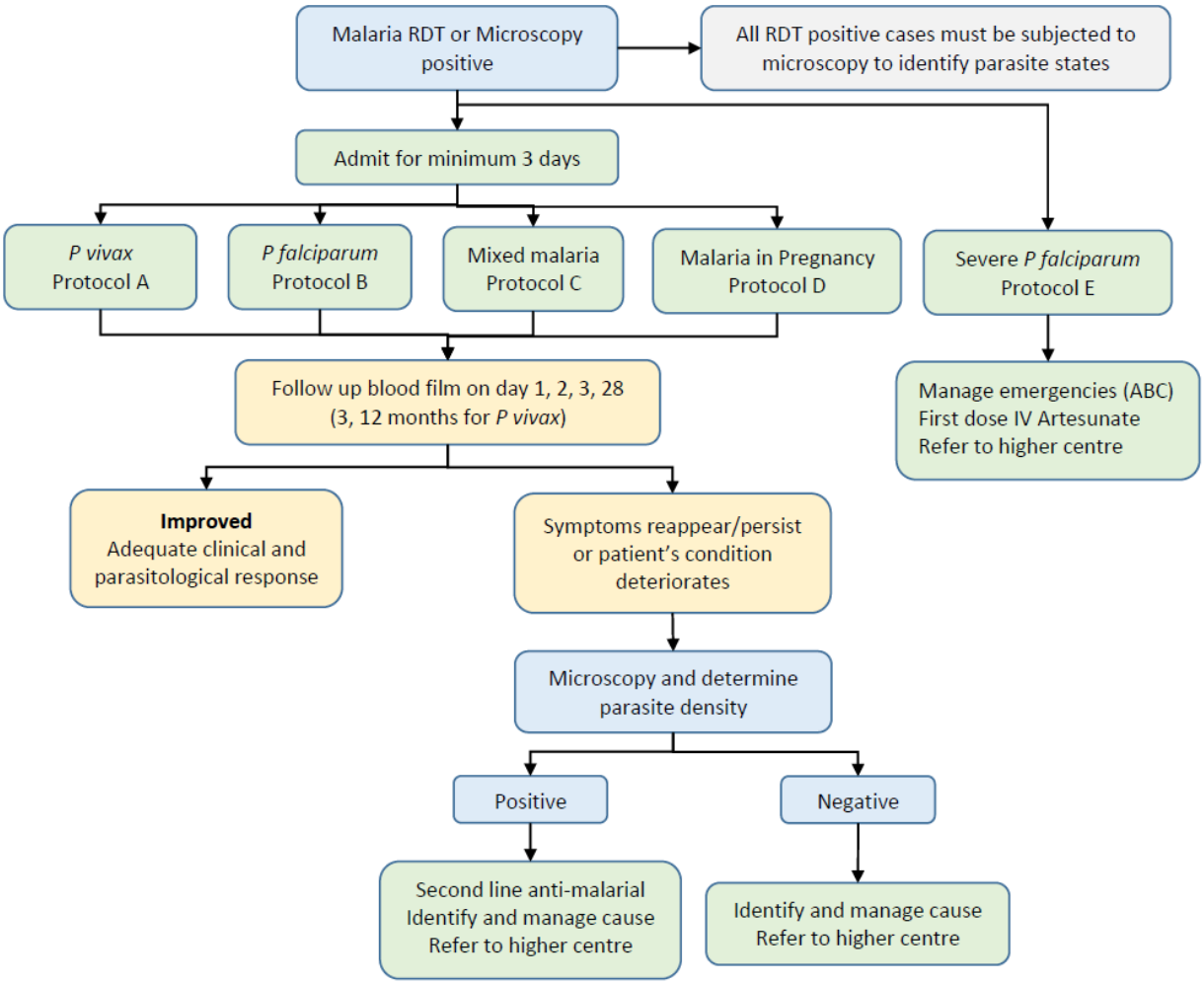


Figure 36. Diagnosis and management algorithm for malaria in Bhutan, 2024 (Ministry of Health, 2024b)

Rapid diagnostic tests are immuno-chromatographic tests which are simple to perform and can be carried out by non-laboratory health staff after training. It detects specific parasite antigens (Histidine-rich protein 2 - HRP2 for *P. falciparum* and Parasite- lactate dehydrogenase pLDH for

P. vivax) in blood but cannot be used for follow-up patients after treatment. Quality of RDTs in both public health facilities and PDC are monitored by the National Malaria Reference Laboratory (NMRL), RCDC through RDTs lot testing assessment and RDT panel testing.

RDTs are used in the following circumstances:

- ACD, RACD, and PACD
- Where microscopy is not available, such as in a facility with no laboratory personnel; and
- During emergencies, in delivering malaria results within 20 minutes.

All RDT positives are subjected to microscopy to determine the species, parasite stages and parasite density. A negative RDT test result does not rule out the possibility of infection with *P. falciparum* and *P. vivax* malaria and false negatives may result due to very low parasitemia i.e. parasite load <200 parasites/µl of blood or in malaria positive individual with HRP2 deletion. False positives may occur, in patients who are positive for rheumatoid factor or other autoimmune markers. Any patient with suspected malaria who initially tests negative and does not improve are re-tested for malaria.

In addition to the above diagnostic tools, molecular diagnostic methods using PCR, a highly sensitive assay in detection of parasite DNA at low parasite density, is carried out on a limited scale at the RCDC, Thimphu. PCR is used in clinical and therapeutic studies in making the distinction between recrudescence and reinfection, as well as in other specialized epidemiological investigations to confirm discrepant results. Whole blood or a dried blood spot (DBS) is prepared for every malaria positive patient and 10% of reactive screening samples are prepared and sent to RCDC within a week.

All health centres and private diagnostic services have RDTs for malaria testing; some institutions have microscopy facilities with trained personnel carrying out diagnosis and treatment for malaria.

4.7 Laboratory diagnosis of malaria

4.7.1 Diagnostic policy

In accordance with the WHO Guidelines for Malaria and the National Guideline for Diagnosis and Treatment of Malaria 2025 (World Health Organization, 2025d), all suspected malaria cases should undergo parasitological testing to confirm the diagnosis (Ministry of Health, 2024b). Diagnostic confirmation is performed using either microscopy or rapid diagnostic tests (RDTs). Both diagnostic methods are supported by a comprehensive quality assurance programme to ensure the accuracy and reliability of test results.

4.7.1.1 Parasitological diagnosis

Parasitological diagnosis of malaria is primarily implemented through the screening of suspected malaria cases in both public and private health laboratories. Microscopy remains the primary diagnostic method used in public health facilities, while RDTs serve as a complementary diagnostic tool. In PDCs, RDTs are the principal method used for malaria diagnosis. Microscopy is predominantly utilized for PCD, whereas RDTs are widely employed during ACD and RACD activities. The total number of blood films examined in 2025 is shown in Table 27.

Table 27. Total number of blood films examined for malaria, 2025 (Source: DHIS2)

District	Microscopy	Passive case detection – RDT	Both microscopy and RDT
Bumthang	0	41	0
Chhukha	1999	157	19
Dagana	352	191	0
Gasa	0	0	0
Haa	0	33	0
Lhuentse	0	0	0
Monggar	0	204	0
Paro	11	101	0
Pemagatshel	256	325	0
Punakha	132	4	0
Samdrup Jongkhar	2695	1040	18
Samtse	2375	839	49
Sarpang	7644	3132	220
Thimphu	135	20	187
Trashi Yangtse	0	6	0
Trashigang	0	64	0
Trongsa	0	16	70
Tsirang	0	163	8
Wangdue	17	304	25
Zhemgang	195	60	0
Total	**15811**	**6700**	**596**

4.7.1.1.1 Malaria microscopy

Microscopic examination of Giemsa-stained blood films remains the gold standard for the diagnosis of malaria. Microscopy provides detailed laboratory information on all five human malaria parasite species, including parasite staging and quantification. As of 2026, microscopy services are available in all three referral hospitals, 54 district hospitals, and seven PHCs located in malaria-endemic areas.

Malaria microscopy involves the preparation and examination of both thick and thin blood smears. Thick blood smears are used for parasite detection and quantification, which are essential for assessing the severity of infection and monitoring treatment response. Thin blood smears are used to identify and differentiate malaria species based on their morphological characteristics.

The accuracy of malaria microscopy is highly dependent on the competence and proficiency of the microscopist. Therefore, microscopy should be performed by adequately trained personnel and supported by a robust quality assurance (QA) system. The QA system ensures adherence to standardized procedures for sample collection, slide preparation, staining, examination, recording, and reporting of results, thereby maintaining the reliability and accuracy of malaria diagnosis.

4.7.1.1.2 Rapid Diagnostic Tests (RDTs)

RDTs are lateral-flow immunochromatographic assays used for the detection of malaria parasite antigens in blood samples. The target antigens, include histidine-rich protein 2 (HRP2) for the

detection of *P. falciparum* and parasite lactate dehydrogenase (pLDH) for the detection of *P vivax*. RDTs are available across all levels of hospitals in Bhutan.

RDTs offer several advantages over microscopy, including ease of use, minimal training requirements, rapid turnaround time, and suitability for use in remote settings and emergency situations. They are also valuable tools for malaria surveillance activities, particularly during community-based screening and active case detection initiatives.

To ensure the quality and reliability of RDT-based diagnosis, regular evaluation of the sensitivity and specificity of RDT kits is essential. Quality assurance measures are implemented to ensure that only high-quality RDTs are procured, distributed, and utilized across both public and private healthcare sectors.

All malaria cases testing positive by RDT are subsequently subjected to microscopic examination for confirmation and to determine the infecting species, parasite stages, and parasite density.

4.5.1.1.3 Polymerase Chain Reaction (PCR)

PCR is a highly sensitive molecular test used to detect Plasmodium DNA. However, its use is limited due to its high cost and the requirement for a well-established molecular laboratory, specialized equipment, and trained personnel. PCR is primarily used for the confirmation of malaria species and mixed infections, as well as for the detection of low parasitaemia and asymptomatic infections. PCR for malaria is available at the RCDC, Thimphu (Table 28).

Table 28. Number of malaria PCR tests done at the National Malaria Reference Laboratory, Royal Centers for Disease Control, 2022 – 2025

Year	Malaria PCR for Pf and Pv			Purpose of testing	
	Positive	Negative	Total	RACD	Confirmation
2022	0	33	33	0	0
2023	1	24	25	0	0
2024	10	25	35	9	5
2025	0	7	7	7	0
Total	**11**	**89**	**100**	16	5

4.7.2 Diagnostic facilities for malaria

4.7.2.1 Private Diagnostic Centres

RDTs are widely used in PDCs for malaria diagnosis. As of 2026, there are nine PDCs located in malaria-endemic areas are staffed with laboratory technicians to conduct malaria screening, particularly among migrant workers. Any malaria-positive cases detected in PDCs are referred to the nearest public health facility for microscopic confirmation and initiation of appropriate treatment.

Table 29. Monthly number of malaria RDTs conducted in private diagnostic centres in Samtse, Phuentsholing, Gelephu and Samdrup Jongkhar, 2021 – May 2026. In 2021 and 2022, there were no tests done during the COVID-19 lockdown period.

Year	Month of testing												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
2021					2000							736	2736
2022	161			4355	6007	4601	5088	5632	4742	6099	4283	2918	43886
2023	5102	8917	12968	6750	9443	5191	9402	7186	5546	5596	5543	4979	86623
2024	4144	6274	8463	6830	7498	5838	7416	6418	5712	5840	6474	5519	76426
2025	4755	5916	7921	8879	6499	8271	6133	7108	5807	7211	5112	6487	80099
2026	5718	6193	8679	7203	10014								37807

4.7.2.2 Diagnostic facilities in the government facilities

In the public sector, malaria diagnosis is conducted using microscopy by malaria technicians and laboratory technicians, in addition to the use of RDTs. In non-endemic areas where laboratory technicians are unavailable, HAs are trained to perform RDTs and refer patients for microscopy confirmation.

4.7.3 Laboratory network

There is a tiered system of facilities, ranging from primary health centres to national referral hospitals that function in a coordinated manner to ensure quality assurance of microscopy and RDTs, thereby strengthening malaria diagnosis and surveillance. The NMRL was established at the RCDC in 2019 to support malaria elimination and the prevention of re-establishment of malaria, with specialized oversight.

The test facilities available as per the level of the health centres are as follows:

Primary healthcare centres (PHCs):

- Rapid Diagnostic: RDTs are widely used as first line of test method in PDCs and few selected PHCs without malaria and technician for screening of malaria at primary level.
- Microscopy: In selected regions where malaria is reported, malaria technicians have been stationed at PHCs to conduct diagnoses utilizing microscopy or RDTs.

District/Referral Hospitals:

- RDT and Microscopy are performed by Malaria and laboratory technicians stationed in the hospitals / referral hospital.

Reference laboratory (RCDC):

- In addition to microscopy and RDTs, NMRL is equipped to perform PCR tests for malaria diagnosis.

4.7.4 Supply of RDTs and laboratory consumables

WHO-prequalified antimalarial commodities are procured to ensure the quality of malaria diagnostic services. These products, including RDTs, undergo batch testing to verify their performance and efficacy prior to use. All commodities are stored and transported in accordance with the manufacturers' guidelines to maintain their integrity and effectiveness.

The eBMSIS links all health facilities with the central warehouse, facilitating inventory management and the submission of procurement requests. However, distribution from the central warehouse is often delayed due to understaffing and suboptimal warehouse management practices. Procurement of commodities required in small quantities is facilitated through a pharmacist stationed at the Royal Bhutan Consulate in Kolkata, India as well as through WHO procurement mechanisms.

To prevent stock outs, commodities are redistributed internally between health facilities as needed. Inventory levels are routinely monitored through the DHIS2 system, enabling timely procurement and replenishment of essential malaria diagnostic commodities.

4.7.5 Quality Assurance for microscopy and RDTs

Quality assurance (QA) and quality control (QC) in malaria diagnosis are essential to ensure that both public and private laboratories deliver accurate, reliable, and timely results (Bhutan Standards Bureau, 2018; Ministry of Health, 2022). QA establishes the overall system, including training and standard operating procedures, while QC involves specific procedures to verify that individual tests and equipment are functioning correctly.

The NMRL, located within the RCDC, serves as the reference laboratory for quality assurance of malaria diagnosis. It is responsible for overseeing the National External Quality Assessment Scheme (NEQAS) for malaria diagnosis (Figure 37). NEQAS is a standardized programme that evaluates the accuracy of laboratory testing methods, including microscopy and RDTs, and incorporates internal quality control (IQC) monitoring to ensure the effectiveness of the quality assurance system.

4.7.5.1 Malaria Blinded Rechecking

Malaria blinded rechecking involves a structured and periodic review of malaria slides from participating laboratories to ensure diagnostic accuracy. All malaria-positive slides and 10% of malaria-negative slides examined by participating laboratories are submitted monthly to the NMRL for cross-verification (Ministry of Health, 2022).

During blinded rechecking, the following parameters are evaluated, and feedback for quality improvement is provided in the report (Table 30):

- For positive slides: malaria detection, species identification, stage identification, and parasite density.
- For negative slides: malaria detection.
- Quality of staining and quality of blood film preparation.

Detailed blinded rechecking reports are available in the mNEQAS system (Figure 38).

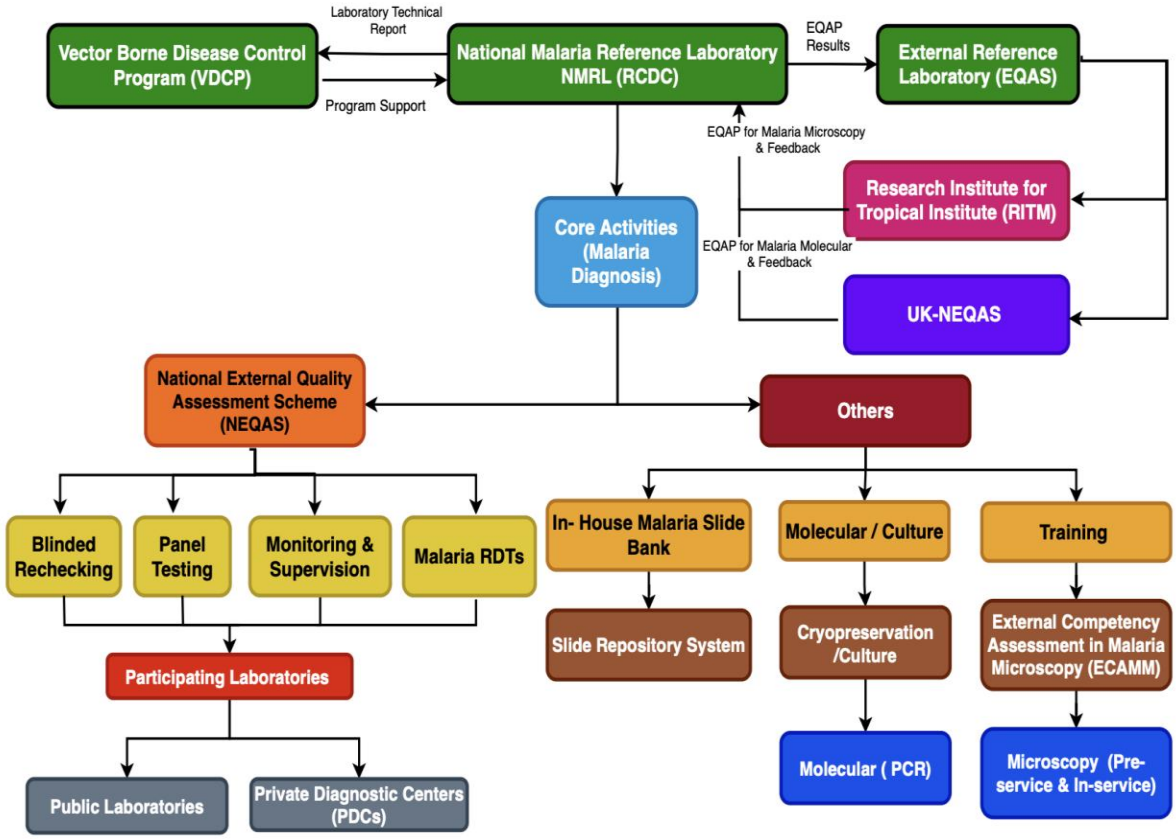
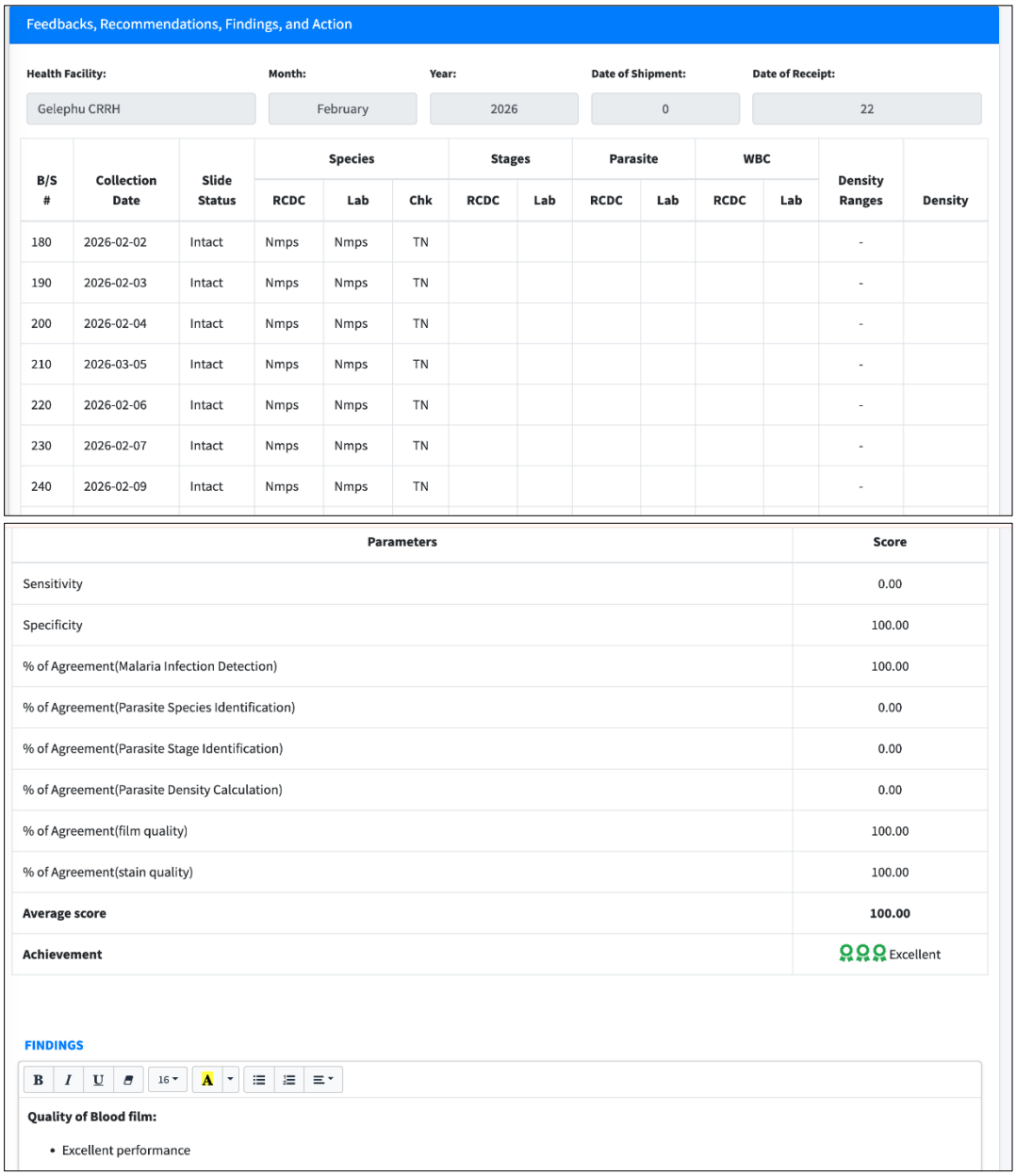


Figure 37. Framework for quality assurance system for malaria diagnostics in Bhutan

Table 30. Number of malaria slides blindly rechecked by NMRL at Royal Centers for Disease Control, Thimphu, 2021 – May 2026

Year	Blinded slides re-checked	
	Positive	Negative
2021	23	1995
2022	11	2705
2023	24	3572
2024	144	3087
2025	43	3557
2026 till May	12	1108



Feedbacks, Recommendations, Findings, and Action

Health Facility:	Month:	Year:	Date of Shipment:	Date of Receipt:
Gelephu CRRH	February	2026	0	22

B/S #	Collection Date	Slide Status	Species			Stages		Parasite		WBC		Density Ranges	Density
			RCDC	Lab	Chk	RCDC	Lab	RCDC	Lab	RCDC	Lab		
180	2026-02-02	Intact	Nmps	Nmps	TN							-	
190	2026-02-03	Intact	Nmps	Nmps	TN							-	
200	2026-02-04	Intact	Nmps	Nmps	TN							-	
210	2026-03-05	Intact	Nmps	Nmps	TN							-	
220	2026-02-06	Intact	Nmps	Nmps	TN							-	
230	2026-02-07	Intact	Nmps	Nmps	TN							-	
240	2026-02-09	Intact	Nmps	Nmps	TN							-	

Parameters	Score
Sensitivity	0.00
Specificity	100.00
% of Agreement(Malaria Infection Detection)	100.00
% of Agreement(Parasite Species Identification)	0.00
% of Agreement(Parasite Stage Identification)	0.00
% of Agreement(Parasite Density Calculation)	0.00
% of Agreement(film quality)	100.00
% of Agreement(stain quality)	100.00
Average score	**100.00**
Achievement	Excellent

FINDINGS

Quality of Blood film:

- Excellent performance

Figure 38. Blinded re-checking of the malaria slides through the Malaria National External Quality Assessment Scheme (mNEQAS). Blinded smears are sent from the hospitals to the NMRL and the details are entered into mNEQAS. The agreement between slide readings by the field technician and two evaluators at the NMRL are recorded. Feedback is given to the participating hospital after reading each slide.

4.7.5.2 Malaria Panel Testing

All public laboratories performing malaria microscopy are enrolled as participating laboratories for the malaria panel testing (Figure 39). Their competencies in malaria parasite detection, species identification, stage identification, and parasite quantification are assessed through panel testing where standard blinded slides are sent from the slide bank at the NMRL. Feedback and recommendations are provided to improve malaria microscopy skills and diagnostic performance.

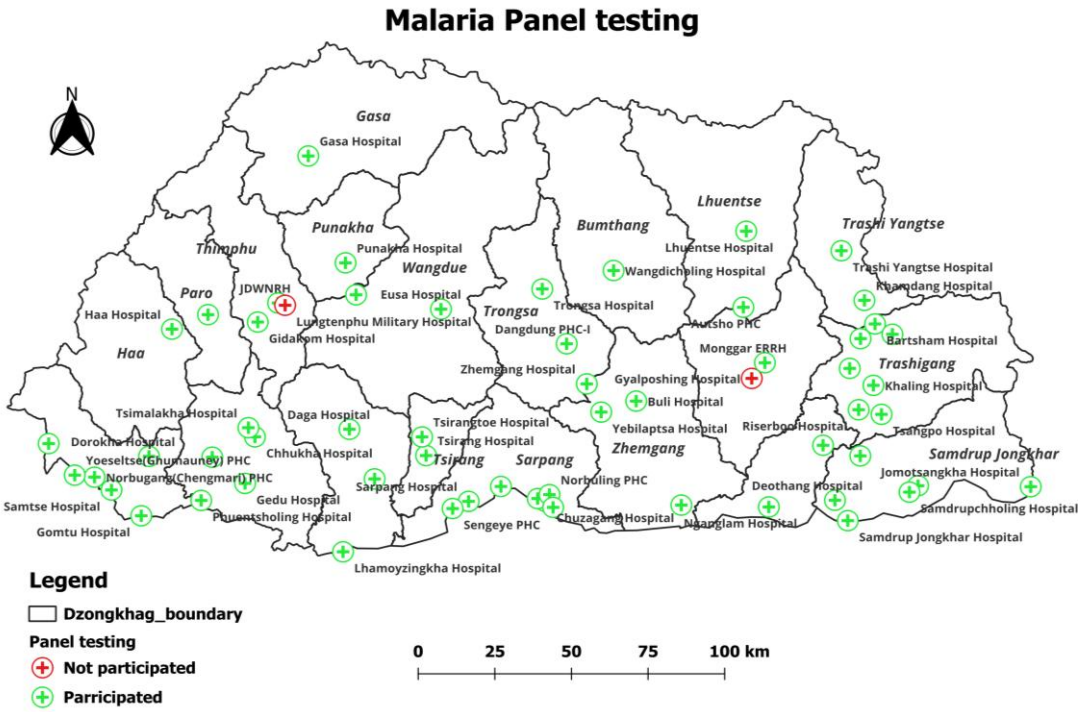


Figure 39. Hospitals from all 20 *dzongkhags* participate in the annual malaria panel testing, 2026

Panel testing is conducted annually, and all data are reported through the RCDC surveillance system platform. To date, the NMRL has conducted seven rounds of panel testing. Detailed reports of the panel testing are available in the mNEQAS system (Ministry of Health, 2022) and is summarized in Table 31.

4.7.5.3 On-site monitoring and supervision

On-site supervision, using a standardized supervisory checklist, provides a comprehensive assessment of malaria microscopy diagnostic services. This process helps identify and address deficiencies detected through blinded slide rechecking, panel testing, and IQC system. It also facilitates the immediate implementation of corrective actions and problem-solving measures, including the resolution of technical errors and issues related to equipment, reagent quality, and IQC practices.

The NMRL conducts on-site quality assurance supervision of malaria laboratories using a standard QA checklist in accordance with WHO standards. The checklist covers laboratory organization and management, internal and external quality assurance systems (including documentation), infection prevention and control, and waste management. Detailed reports of on-site monitoring and supervision are available in the mNEQAS system.

Table 31. Summary of panel testing for malaria conducted across 62 health centres in January 2026 (Source: NMRL, RCDC)

Dzongkhag	Slides Received	False positive	False negative
Bumthang	5	0	0
Chhukha	25	1	1
Dagana	15	0	0
Gasa	5	0	0
Haa	5	1	0
Lhuentse	10	0	0
Mongar	10	1	0
Paro	5	0	1
Pemagatshel	10	0	1
Punakha	5	1	0
Samdrupjongkhar	30	1	1
Samtse	30	0	2
Sarpang	30	0	1
Thimphu	20	1	4
Trashigang	35	1	0
Trashiyangtse	10	1	1
Trongsa	10	0	0
Tsirang	10	0	1
Wangduephodrang	10	0	0
Zhemgang	20	0	1
Total	**300**	**8**	**14**

4.7.5.4 Quality Assurance of malaria RDTs

The quality of malaria RDTs used in public health facilities and PDCs is monitored by the NMRL, RCDC, through RDT lot testing and RDT panel testing (Table 32).

To ensure the quality of RDTs used in both public and private diagnostic facilities, NMRL conducts quality assessments using in-house positive and negative quality control samples to monitor the performance of RDT kits.

Table 32. Indicators for the evaluation of the quality of malaria rapid diagnostic kits

RDT quality indicator	Checklist for evaluation
Procurement of RDTs	Selection and procurement of malaria RDTs is of WHO pre-qualification list
Quality checking	Kit verification: expiry date, lot number, packaging quality and content checking
	Storage and environment condition: checking of temperature and humidity control in place
	Documentation record
Good practices	SOPs for microscopy and RDTs is available in laboratory
	Internal quality control performed to ensure the RDTs quality

The NMRL is planning to implement a National External Quality Assessment Scheme for malaria RDTs. Under this programme, panels consisting of lyophilized blood pellets containing *P. falciparum*, *P. vivax*, and negative samples will be distributed to participating laboratories, including PDCs, to assess and monitor the quality of RDT testing.

The programme aims to collect comprehensive information on the RDTs in use, including kit expiry dates and the performance of participating laboratories in detecting the provided panel samples.

4.7.6 External Quality Assurance for malaria microscopy

4.7.6.1 External Quality Assessment (EQA) for Malaria Diagnosis

The NMRL participates in two External Quality Assessment (EQA) programmes: the WHO EQA Programme for Malaria Microscopy, organized by the Research Institute for Tropical Medicine in the Philippines, and the WHO Malaria Nucleic Acid Amplification Tests (NAAT) and Molecular Markers of Antimalarial Drug Resistance EQA Scheme, conducted by the United Kingdom National External Quality Assessment Service (UK NEQAS). Certificates of participation and detailed reports, including recommendations and feedback, are provided to support the implementation of corrective actions and continuous quality improvement.

4.7.6.2 External Competency Assessment for Malaria Microscopy (ECAMM)

With financial and technical support from WHO (SEARO and Collaborating Centres) and the Global Fund (GFATM), the fifth round of the ECAMM was successfully conducted. ECAMM is facilitated by an external WHO Level 1-certified microscopist over a one-week period (Table 33).

Participants are assessed on malaria parasite detection, species identification, and parasite quantification. Certification is awarded based on performance in these three competency areas (World Health Organization, 2025c). Participants completed a theory assessment consisting of 25 malaria microscopy and diagnostic questions, followed by a practical assessment. These baseline assessments were used to evaluate theoretical knowledge and practical skills but were not included in the final competency certification.

The assessment utilized PCR-confirmed and quantification-validated malaria blood films from the WHO Malaria Slide Bank in Manila, Philippines. The slide set included negative slides, low-density positive slides for parasite detection and species identification, and positive slides for parasite quantification, in addition to slides used for the pre-assessment. Participants were assessed under examination conditions with 10 minutes allocated per slide. Competency was evaluated in three areas: parasite detection, species identification, and parasite quantification. The assessment included *P. falciparum*, *P. vivax*, *P. malariae*, *P. ovale*, mixed-species infections, and slides with varying parasite densities. Feedback and review sessions are conducted throughout the assessment period to reinforce learning and improve performance (World Health Organization, 2025c).

Table 33. Number of L1- and L2-certified microscopists through the WHO External Competency Assessment for Malaria Microscopy, 2017 – 2025

Year	Number of participants	Number of microscopists certified	
		L 1	L2
2017	12	2	1
2018	12	2	4
2022	24	8	5
2024	24	8	8
2025	12	1	3

4.7.7 Refresher training in malaria microscopy

4.7.7.1 Pre-service training

Annual pre-service training in malaria microscopy is conducted for final-year medical laboratory trainees in collaboration with KGUMSB, VDCP, and the NMRL. The 10-day training programme aims to enhance participants' skills in malaria parasite detection, species identification, and parasite quantification, as well as quality control procedures for malaria diagnosis and reporting through the mNEQAS and surveillance systems. The training also includes field visits to hospitals and PHCs to provide practical exposure to malaria diagnostic services.

4.7.7.2 In-service training

Training and retraining of malaria technicians and laboratory technicians are essential for maintaining and improving competency in malaria microscopy and quality assurance practices. The five-day refresher training programme covers malaria microscopy, species identification, parasite quantification, and internal quality control procedures for malaria diagnosis (Table X).

Table 34. Training programme on malaria microscopy given to in-service laboratory and malaria technicians, 2018 – 2026

Year	Duration of training	Training capacity	No of malaria technician trained	No of lab technician trained
2018	5 days	Refresher Training on malaria microscopy	20	50
2020	10 days	Training on malaria microscopy	31	-
2021	5 days	Refresher Training on malaria microscopy		34
2022	5 days	Training on malaria microscopy	20	-
2024	5 days	Refresher Training on malaria microscopy	23	-
2025	6 days	Refresher Training on malaria microscopy	5	7
2026	6 days	Refresher training on malaria microscopy and Quality Assurance	8+	11

4.7.8 Malaria Slide Bank at NMRL

The NMRL is in the process of establishing an in-house Malaria Slide Bank. The primary objective of the slide bank is to provide a customized repository of quality-controlled and validated thick and thin blood films. The repository will include both negative and positive slides representing different *Plasmodium* species and a range of parasite densities. These slides will be used for training, proficiency testing, and internal quality control activities in malaria diagnostics.

Standard Operating Procedures (SOPs) for the slide bank have been developed to guide all processes, including donor recruitment, sample collection, preparation of batch blood smears, staining procedures, and slide validation (Figure 40). The SOPs ensure standardization and quality throughout the development and maintenance of the slide bank.

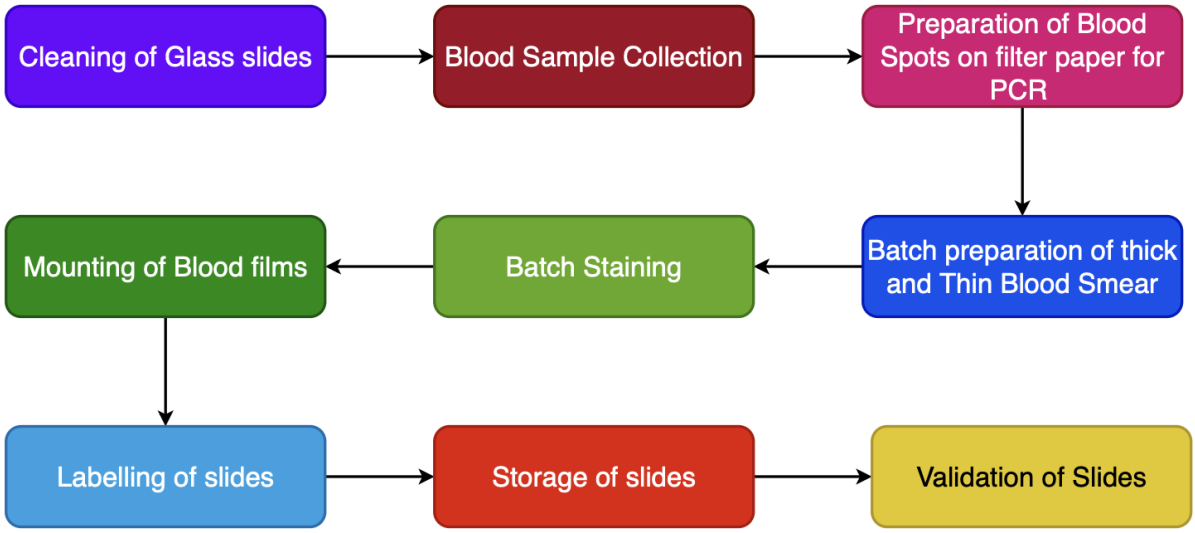


Figure 40. Steps in the preparation of slides for the Malaria Slide Bank at the National Malaria Reference Laboratory, Royal Centers for Disease Control, 2026

4.8 Case management

As soon as the malaria test reports are released through the ePIS, clinicians initiate treatment and management as per the national guideline. The treatment regimens are classified as follows:

- Protocol A: Uncomplicated *P vivax* malaria
- Protocol B: Uncomplicated *P falciparum* malaria
- Protocol C: Mixed malaria
- Protocol D: Malaria infection in pregnancy
- Protocol E: Severe *P falciparum* malaria

Details of the treatment regimens are given in the National Guideline for Diagnosis and Treatment of Malaria in Bhutan, 6th edition, which was updated in 2024 (Ministry of Health, 2024b). All medical records of case management and discharge summary are recorded through the Electronic Patient Information System (except in instances of server down time when medical records may be written on papers).

Malaria diagnosis and treatment is provided free-of-charge to all, including foreigners. Clinical staff in the endemic districts were well aware of the guidelines. Doctors have easy access to a mobile application which contain treatment protocols. Diagnosis is done using microscopy and RDTs. Access to diagnosis in healthcare centres/hospitals is available 24/7 at the Emergency Departments or in the Laboratory. Any RDT positives are complemented with microscopy for confirmation of the diagnosis. Antimalarial medicines are available in all PHC level healthcare centres and above. IV artesunate for treatment of severe cases is available in reference hospitals.

All cases are mandatorily hospitalized for at least three days, except foreigners who choose to go back to their home countries. All diagnosed cases, including all foreigners who stay in Bhutan and those who wish to travel back to their home country, are given the full course of treatment as per national treatment guidelines. All cases are followed up to ensure malaria parasite clearance as per the national guidelines. Compliance for radical cure is ensured through DOTs.

Health Assistants and medical doctors are trained on case management including those stationed in no risk and potential risk areas. Training programmes are and will be conducted annually primarily focusing on new recruits. The training focuses on malaria diagnosis, case management and surveillance. Case management emphasises on national treatment guidelines.

A module on recognizing severe malaria and how to manage a suspected case of severe malaria will be included for medical doctors and specialists such as physicians, paediatricians, obstetricians and gynaecologists, etc.

4.8.1 Review and revision of national treatment guidelines

The national treatment guidelines are periodically reviewed to conform to WHO recommendations; the guidelines are upgraded as necessary; the last update was done in 2024.

4.8.2 Chemoprophylaxis for high-risk travellers

Chemoprophylaxis for high-risk populations is a widely debated subject in malaria elimination and prevention of re-establishment phases. Chemoprophylaxis has benefits in specific contexts as in the case of protecting Bhutanese armed forces personnel serving in UN peace-keeping missions in malaria endemic countries such as in Africa and preventing re-establishment of malaria in the country on their return.

Chemoprophylaxis is not likely to have much of an impact in preventing malaria infections in armed forces personnel stationed in outposts along the Indian border as there is perennial transmission on the Indian side of the border. With contiguous villages along the land border with India and unregulated migration across the border, it is difficult to develop a strategy for chemoprophylaxis; the performance of the health system in preventing onward transmission of malaria in Bhutan even during an outbreak of malaria on the Indian side in 2024 and the high number of imported cases reported in Bhutan in the same year demonstrates the resilience of the Bhutanese health system.

Discussions on developing a policy on chemoprophylaxis for high-risk travellers will be initiated. A suitable policy will be developed depending on the affordability and feasibility of conducting such a programme with the evolving malaria situation in the country and in neighbouring India.

4.8.3 Treatment for malaria

Treatment of malaria is based on the infecting species of malaria parasite, and whether the presentation of the infection is uncomplicated or severe (Ministry of Health, 2024b). The clinical objectives of treating uncomplicated malaria are to cure the infection as rapidly as possible and to prevent progression to severe disease. "Cure" is defined as elimination of all parasites from the body. The objectives of treatment are also to prevent onward transmission of the infection to others and to prevent the emergence and spread of resistance to antimalarial drugs.

The objective of treating malaria caused by *P. vivax* is to cure both blood-stage and liver-stage infections (referred to as radical cure), thereby preventing recrudescence and relapse, respectively. The anti-malaria treatment recommendation for uncomplicated *P. vivax* malaria is a 3-day Chloroquine course and a 7-day Primaquine course; the dosage given depends on the age and body weight of the individual (please refer to national guideline for diagnosis and treatment of malaria in Bhutan). For chloroquine resistant *P. vivax* infections and when chloroquine is not available, malaria cases are treated with ACT.

G6PD testing prior to 7 days primaquine administration in *P. vivax* as recommended by the WHO is strictly followed, where feasible. Where no G6PD test is available, the decision to prescribe primaquine is be based on individual assessment of the risks and benefits. In most cases, patients are sent via ambulance to the neighbouring health facility that has G6PD testing. Patients who are prescribed primaquine receive close medical supervision and patient counselling. Primaquine may cause haemolysis in G6PD deficient patients but it is mild and self-limiting in most cases. Nevertheless, patients are advised to stop medication and come to the hospital if they develop dark coloured urine, pallor, fatigue, shortness of breath and jaundice. For G6PD deficient patients with a *P. vivax* infection, primaquine 0.75 mg/kg body weight is provided once weekly for 8 weeks.

Uncomplicated *P. falciparum* malaria is treated with ACT containing a combination of Artemether 20mg (ART) and Lumefantrine 120 mg. All patients are admitted for 3 days to ensure complete treatment. A single stat dose of primaquine at 0.5 mg/kg body weight is administered on Day 0 as a gametocytocidal agent to stop further transmission of infection. Testing for G6PD is not required. In persons having HIV/AIDS and uncomplicated *P. falciparum malaria*, artesunate + SP is not recommended if they are being treated with co-trimoxazole, efavirenz or zidovudine. Artesunate + amodiaquine is not recommended if they are being treated with efavirenz or zidovudine. Patients co-infected with HIV and tuberculosis are monitored closely as they are at increased risk of severe malaria and malaria deaths. In addition, they are at higher risk of recrudescent infection.

Artemisinin resistance in *P. falciparum* is now prevalent in parts of Cambodia, the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam. Malaria patients with a travel history to those countries and not responding to standard treatment, a longer course (5 – 7 days) of ACT or new fixed combination drugs (eg. artesunate + pyronaridine) is considered.

Mixed malaria infections are treated with ACT and primaquine.

The recommended second line anti-malarial in case of treatment failure to first line ACT is the fixed combination of Dihydroartemisinin + Piperaquine (DHA/PPQ). It is available at the national and regional referral hospitals. It is programmatically suitable for both *P. vivax* and *P. falciparum* malaria. The longer half-life of PPQ has an advantage over Lumefantrine in treatment of *P. vivax* malaria. A second line antimalarial (DHA/PPQ) is used in the following situations where the patient does not tolerate or has adverse reactions to the first line medicine and/or recrudescence (treatment failure), ie, reappearance of symptoms and parasitemia within 28 days following initial antimalarial treatment with first line antimalarial drug.

Dihydroartemisinin (DHA) /Piperaquine (PPQ) is given over three days at a dose of DHA 4 mg/kg per day and PPQ 18 mg /kg per day. PPQ is given once a day for 3 days for adults and children weighting more than 25 kg. Children weighing less than 25 kg should receive 4 mg/kg of DHA and 24 mg/kg of PPQ.

Malaria in pregnancy is associated with low-birth-weight infants, increased anaemia and, in low transmission settings, increased risk for severe malaria, pregnancy loss and death. There is insufficient information on the safety, efficacy and pharmacokinetics of most antimalarial agents in pregnancy, particularly during the first trimester. It is important to exclude pregnancy in all women of child bearing age prior to treatment with antimalarial drugs. *P. vivax* malaria in pregnancy should be treated with Chloroquine. However, use of primaquine is contraindicated throughout the duration of pregnancy and in lactating mothers. The recommended treatment regimen for pregnant women and lactating mothers is given in Protocol D of the National guideline for diagnosis and treatment of malaria in Bhutan.

Severe malaria is defined as having one or more of the following manifestations that occur without any alternative cause and in presence of a positive test, usually for *P. falciparum* malaria. Severe malaria may present with impaired consciousness/coma, seizures, jaundice, severe anaemia (Hb < 7 g/dL), acute respiratory distress, acidosis, acute renal failure, hypoglycaemia, abnormal bleeding or disseminated intravascular coagulation and shock. The most important manifestations of severe malaria are cerebral malaria and severe anaemia. Severe malaria is mainly caused by *P. falciparum* and is a medical emergency. The main objective is to prevent mortality as the case fatality is 100% in untreated cases but falls to 10 – 20% with antimalarial treatment. Patients with severe malaria should be referred to the nearest district hospital as soon as possible.

The overall management of severe malaria is specific antimalarial drugs, adjunctive therapy and supportive care. The antimalarial drug of choice for treatment of severe malaria is IV /IM Artesunate for all ages. If IV artesunate is not available, artemether or quinine can be used in order of preference. The parenteral antimalarial drugs should be given for a minimum of 24 hours once started (irrespective of the patient's ability to tolerate oral medication earlier) or until the patient can tolerate orally. Thereafter, treatment is completed by giving a full course (3 days) of ACT.

Severe malaria is a medical emergency and early management is crucial. Pre-referral treatment should be provided with a single dose of IM/IV artesunate and referred to a higher level health facility. IM artemether or IV quinine can be given if artesunate is not available. Referral of patients

to higher centres are free of cost, and the medical doctor at the receiving hospital is telephonically informed about the incoming patient.

4.8.4 Purchase and supply of antimalarials to health facilities

WHO pre-qualified antimalarial drugs are procured through WHO and the Global Fund to ensure quality. The drugs are stored and transported according to manufacturer's guidelines. Drug inventories are linked to the eBMSIS that connects all health facilities with the central warehouse for inventory management and submission of procurement requests. The stock inventory is managed by the pharmacists or the health workers at the respective hospitals with an overall aim of ensuring no stock out of essential medicines.

4.8.5 Integrated drug efficacy monitoring

As per WHO recommendations in the elimination stage and beyond, monitoring of anti-malarial drug efficacy is integrated into the routine surveillance system (Table 35). Data are collected for all symptomatic and asymptomatic malaria infections for all species detected by both PCD and ACD and used to generate information about drug efficacy. This surveillance system requires: good case detection and reporting on all diagnosed cases of malaria, ensuring that all patients receive supervised treatment using DOTs, and follow- up of all patients to confirm complete cure.

The objectives of the integrated drug efficacy monitoring are to:

- Monitor the efficacy of first- and second-line treatment including any newly registered treatment for which information is necessary;
- DOTs treatment and patient follow-up to ensure treatment adherence and patient cure;
- Assess efficacy of second-line treatment (only for patients with recrudescent infections after first-line treatment); and
- Inform, review of anti-malaria treatment policy and ensure evidence-based recommendations.

The information required for integrated drug efficacy monitoring include diagnosis and patient classification, molecular analysis; responses to treatment, patient follow-up details and data interpretation and policy consideration.

4.8.6 Training and supervision of case management

Health Assistants and medical doctors are trained on case management including those stationed in no risk and potential/low risk areas. Training programmes are conducted annually primarily focusing on new recruits. The training focus on malaria diagnosis, case management and surveillance. Case management emphasises on national treatment guidelines.

A module on recognizing severe malaria and how to manage a suspected case of severe malaria is to be included for medical doctors and specialists such as physicians, paediatricians, obstetricians and gynaecologists, etc.

Table 35. Mandatory and recommended activities for integrated drug efficacy surveillance

Activity	Mandatory	Recommended
Case diagnosis and case classification		
Patient classification	Imported, indigenous, induced, introduced, relapsing or recrudescent	
Diagnosis on day 0	Identification of symptoms (uncomplicated, severe) Species identification by RDT or microscopy	Parasitaemia by microscopy Gametocytemia by microscopy
Diagnosis on follow-up	Microscopy	PCR at NMRL
G6PD testing	G6PD testing for *P. vivax* patients	G6PD status documented and considered before radical cure If no G6PD testing, 14 days PQ regimen with counselling to recognize symptoms and signs of haemolytic anaemia. Advise stopping PQ and seek healthcare immediately
Molecular analysis		
Reinfection or recrudescence		Blood collected on day 0 and day of failure
Markers of drug resistance		Blood collected on day 0 for analysis of drug resistance.
Treatment		
DOT	Ensure all treatments are given under direct supervision	Hospitalization of patients during treatment
Treatment failure	All cases of treatment failure must receive second-line treatment and be followed up for an additional full follow-up period	Hospitalization of patients during treatment.
Treatment outcome classification	All cases should ultimately classified as Adequate clinical and parasitological response (ACPR), Early treatment failure (ETF), late clinical failure (LCF) late parasitological failure (LPF) Recrudescence, Reinfection, Relapse (*P. vivax*) and indeterminate/missing follow-up	Supervised second-line treatment and followed up Hospitalization of patient during treatment

Patient follow up		
Follow-up of *P. falciparum*	Day 2 & 28 days after start of treatment with a drug with a short half-life	Day 1, 2, 28 after start of treatment
Follow-up *P. vivax*	Day 2, 28 and 3rd month (for relapses)	Day 1, 2, 7, 28, 3 month & Up to 1 year
Information collected on days of follow-up	Clinical symptoms, temperature & parasite density microscopy result	Follow-up visits. Alternatively, clinical symptoms only may be collected by telephone and additional follow-up visits made if necessary.

4.9 Entomological surveillance

Entomological surveillance is one of the key strategic components of malaria elimination outlined in the NSP 2020 – 2025 (Royal Government of Bhutan, 2020). The plan emphasized the strengthening of vector surveillance and early warning systems, insecticide resistance monitoring, and assessment of the residual efficacy of IRS and LLINs in the field setting. These routine surveillance and monitoring activities are being carried out in select sentinel sites representing different geographical and ecological settings.

The national programme with two medical entomologists, a supporting Malaria Technician and three insect collectors are responsible for vector surveillance in the country. All malaria technicians in the field are also trained in basic entomological surveillance and mosquito identification, and provide assistance to the national team during spot surveys and in the conduct of resistance monitoring.

The following entomological surveillance are being implemented in the current phase of elimination:

- Sentinel surveillance for monitoring vector population dynamics and insecticide resistance
- Spot surveys in other at-risk areas, including locations undergoing developmental activities
- Monitoring residual efficacy of IRS and LLINs
- Rapid entomological assessments during malaria outbreaks, and
- Case-based entomological investigations

The surveillance activities are being performed in selected sentinel sites and will continue to be strengthened during the POR phase, with particular emphasis on areas identified as having high malariogenic potential. These efforts will support the early detection of changes in vector populations and resistance development; facilitating timely implementation of appropriate vector control measures, and safeguarding the country's malaria-free status.

4.9.1 Vector bionomics (Species composition, distribution, behaviour and ecological habitats)

The programme's surveillance records and preserved specimen collections document a total of 139 mosquito species, comprising 37 Anophelines, 52 Aedes, 36 Culex, and 14 other species belonging to other generas of mosquitoes from 2007 till date. Few newly discovered species, mainly the

highland species, have been formally documented, published, and incorporated into the World Mosquito Inventory in accordance with the International Code of Zoological Nomenclature (ICZN).

Based on these records, *Anopheles pseudowillmori* was found to be the most abundant and widely distributed Anopheline species in Bhutan, occurring from the southern foothills up to elevations of approximately 1,900 m above sea level. It is also the most commonly collected Anopheline species in both human landing catches and cattle-baited collections. In cattle-baited collections, *An. pseudowillmori* exhibited an early biting tendency, with peak activity occurring between 21:00 and 22:00 hours. Limited human landing collection data indicate that biting activity may commence as early as 19:00 hours. The immature stages of this species have been recorded in a wide range of habitats, including stream margins, rice paddies, marshes, ground pools, sand pools, rock pools, and wheel tracks.

An. willmori is another common species found in forested mountainous areas at elevations ranging from 300 to 2,000 m. It was the second most frequently collected species in human landing catches in Chukha Dzongkhag, accounting for 27.8% (5 of 18 specimens collected). *An. maculatus* is relatively uncommon and was rarely collected during human landing catches. Similarly, *An. dravidicus* is rare and predominantly zoophilic. Both the species have been recorded only on few occasions in the southern plains.

Another species commonly encountered during the rainy season in all seven malaria-endemic *dzongkhags* is *An. culicifacies* s.l. Molecular identification have confirmed the presence of sibling species B, C, and D in Bhutan. Its distribution extends from the southern plains to the foothills, with few records from elevations as high as 2 200 metres above sea level. It is among the few species commonly collected during human landing, resting, and cattle-baited collections. Biting activity generally begins towards the end of the first quarter of the night, with no distinct peak observed throughout the night (Naszeerah, 2015). The immature stages have been found breeding in sandy riverbeds, rain pools, river seepages, stream margins, fish ponds, and rice fields.

Although *An. vagus* is not considered a malaria vector in India, it has been recorded resting indoors in relatively high densities in Bhutan compared to other species. It was commonly encountered during outbreak investigations and indoor resting collections. However, it has not been recorded in human landing catches at any of the four sentinel surveillance sites. In cattle-baited collections, *An. vagus* demonstrated an early biting tendency, with peak activity occurring during the first quarter of the night, declining sharply thereafter (Naszeerah, 2015). The species is widely distributed throughout the country and is prevalent in all malaria-endemic *dzongkhags* (Figure 41). Larval habitats include ground pools, wheel tracks, and rice paddy fields.

An. fluviatilis, one of the most efficient malaria vectors in the hilly and foothill regions of India, Nepal, and Pakistan, has been encountered only infrequently and in low numbers during recent surveys conducted across Bhutan. Molecular analysis of *An. fluviatilis* specimens collected from Sarpang Dzongkhag and conducted at Chiang Mai University, Thailand identified sibling species T, which is considered predominantly zoophagic and of limited medical importance (Nanda et al., 1996). Larvae have been found breeding in marshy pools, rice fields, and lakes.

The presence of *An. minimus* in Bhutan was first reported during the national malaria survey conducted by the National Malaria Eradication Programme in 1962. Subsequent years did not confirm the presence of the species until 2017. During a focal malaria outbreak investigation in the foothills of Tenpaling village, located at the border area in Samtse Dzongkhag (Figure 41), *An. minimus* was found to have reappeared and actively biting both indoors and outdoors during human landing collections. It could not be determined whether the species had locally established or had migrated from the adjacent village of India, as no larval breeding sites were found. More recently, *An. minimus* has been reported from Chaskar, Menchuthang, and Singye, all in Sarpang Dzongkhag collected through both adult and larval surveillance activities. The species has been detected in low numbers in both cattle-baited collections and, indoor and outdoor human landing catches. Larvae have been found breeding in marshes and slow-flowing streams.

An. baimaii is considered one of the primary vectors of malaria in the north-eastern states of India, including Assam, contributing at least 50% of all human malaria during warm and wet season. However, In Bhutan, its distribution has been confined to few forested areas of Sarpang and were found breeding in elephant footprints. There are no records of its collection in human landing or indoor resting in Sarpang.

Anopheline species commonly recorded from the high-altitude, non-malarious areas of Bhutan include *An. aberrans*, *An. baileyi*, and *An. lindesayi* (Namgay et al., 2018).

Ecological habitats preferred for breeding for selected Anophelines species are described in the Table 36.

Table 36. Breeding habitats and bionomics of malaria vectors in Bhutan

Vector species	Typical breeding habitats	Adult feeding and host preference	Biting and resting behaviour	Seasonality
An. preudowillmorei	Rain pools on ground and natural rock pools. Shores of slow flowing irrigation channels and paddy fields during early stage of rice plants.	Zoophilic but bite human both indoor and outdoor in absence of IRS and LLINs	Early bitter from 7:00-19:00-22:00), exophilic rarely seen in presence of IRS and LLIN.	Predominant species during Monsoon and density declines by mid-winter seasons.
Anopheles culicifacies s.l.	Pools in foothill villages; prefers sunlit, slow-moving clear water, deforested riverine and canal irrigated areas, sandy/rocky beds of streams and river edges, borrow pits, rainwater pools, paddy fields in early rains.	Primarily zoophilic but may feed on humans in mixed dwellings or in absence of animals.	Bites late night (23:00–03:00); rests indoors (houses, cattle sheds) on hanging objects, walls and ceilings after feeding; may rest in outdoor shelters due to indoor insecticide spraying.	Appears during wet season; declines in dry months.
An. vagus	Paddy-field seepages, shallow vegetated pools, and ground depressions in agricultural plains. Mainly a stagnant water breeder (rice fields, borrow pits, ponds, swamps with emergent vegetation). Often found to breed in outdoor and even indoor water containers.	Predominantly zoophilic; occasionally feeds on humans near cattle sheds.	Outdoor-biting; intense biting mainly during 18:00–21:00; low anthropophily; indoor resting.	Seasonal; post-monsoon periods.
An. fluviatilis	Breeding places are same to that of *An. minimus* and also very difficult to differentiate between *An. minimus* at larval stage. Need adult for identification. They coexist and share same breeding ground.	Collected only from cattle sheds indicating preference to bite animals. Rare species in Bhutan.	Not encountered indoor but from cattle sheds between 18.00-21.00 hours.	Post Monsoon before paddy harvest.
An. maculatus	Located in hilly areas breeding in road side drains, Stream shores with clean water and clean rain pools exposed to sunlight.	Rarely collected from cattle baited collection and not collected from human biting from	Higher altitude or mountain species.	Monsoon season.

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Continued

		malaria prevailing southern belt.		
Anopheles minimus s.l.	In hilly-forested regions, river valleys in mountain ranges, partially shaded, slow-flowing streams, seepage margins, irrigation canals, rice-field edges, and rock pools with clear water and moderate vegetation; occasionally in domestic wells and borrow pits.	Highly anthropophilic; opportunistic feeding on cattle and pigs when humans absent.	Biting mainly between 22:00 – 24:00; both indoor and outdoor activity depending on LLIN/IRS coverage; moderate exophily.	Populations peak with monsoon onset and persist through wet season; lowest in January–March.
Anopheles dirus s.l. (=baimai)	Forested mountains, foothills, forest fringes, shaded forest floor seepages, cultivated forests, tree holes, animal footprints, bamboo stumps, and small temporary puddles in dense evergreen or semi-evergreen forests (>70% canopy cover); occasionally in wells and shaded ground pools near forest villages.	Strongly anthropophilic; prefers humans to domestic animals; major vector of *P. falciparum* in forest and fringe communities.	Primarily outdoor-biting (exophagic) and outdoor-resting in jungles (exophilic); biting starts early evening (~19:00) and peaks at 21:00–23:00; rarely enters houses.	Abundance increases during monsoon; declines sharply in dry months; rainfall and humidity key drivers.
Anopheles annularis s.l.	Permanent or semi-permanent ponds, stagnant waters, slow-moving irrigation channels, rice fields, and seepages; prefers sunlit water with vegetation.	Zoophilic but occasionally feeds on humans; secondary vector in central plains and foothills.	Evening-biting, mostly outdoors; often rests indoors on walls after feeding.	Peak in post-monsoon months (September–November).

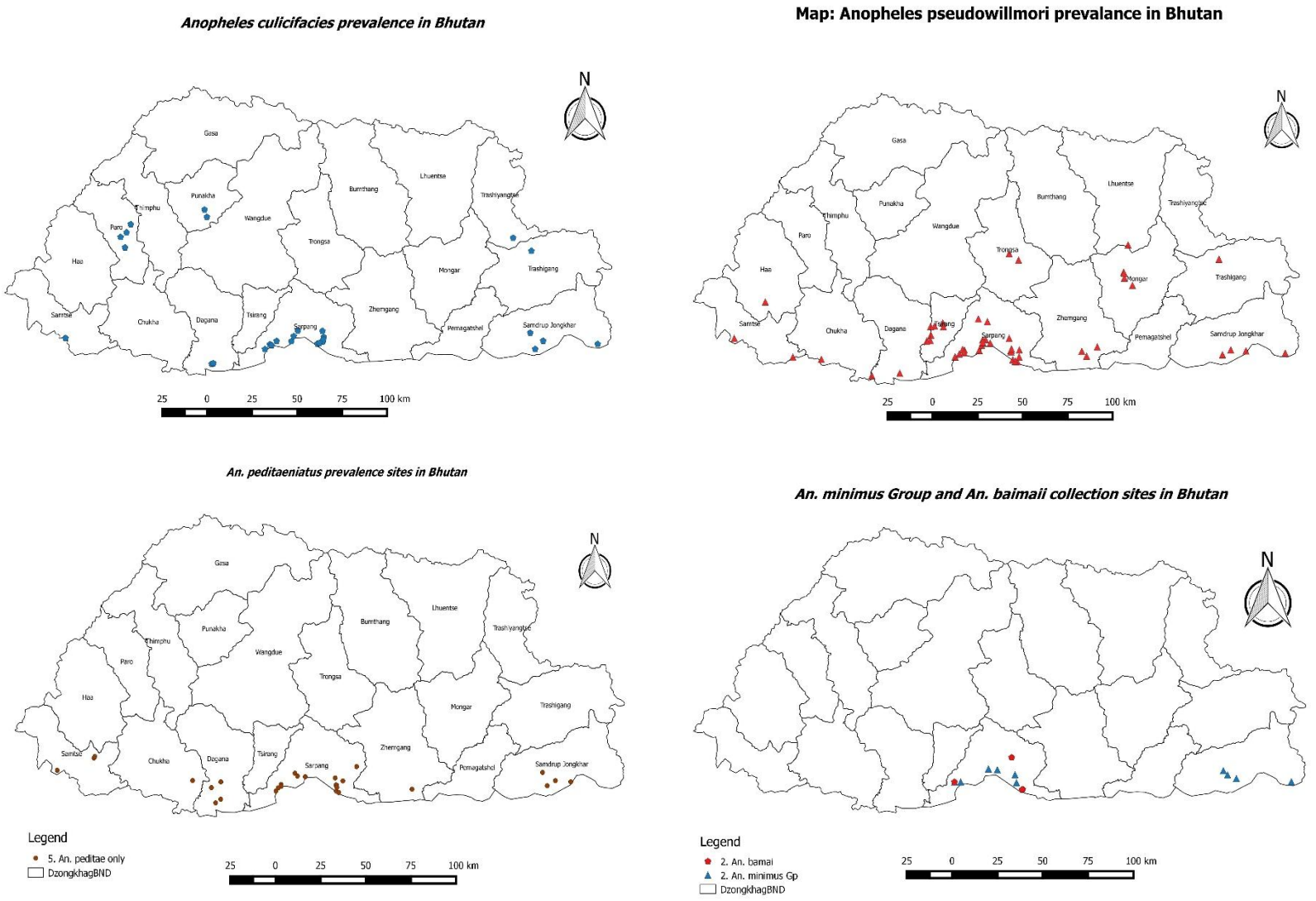

Figure 41. Distribution of malaria vectors *Anopheles culicifacies*, *An. pseudowillmori*, *An. peditaeniatus*, *An. minimus*, *An. baimaii* in Bhutan, 2026

4.9.2 Malaria vectors in Bhutan

There is a mention of *An. minimus* from Samtse being found positive with malarial sporozoites in 1962 (World Health Organization Regional Office for South-East Asia, 2010). Other species recorded as suspected vector in the past were *An. maculatus, An. fluviatilis* and *An. dirus* until 2003 (Yangzom et al., 2012). *An. maculatus* was considered the most probable vector because of its preponderance over other species but no parasites could be isolated. However, in the recent past occurrence of *An. maculatus* and *An. fluviatilis* has been rare and isolated to few areas while molecular confirmation of *An. dirus* proved to be *An. baimaii*. It is highly likely that the species reported as *An. dirus* earlier could have been *An. baimaii*.

In the current situation, where the incidence of malaria is very low, detection of sporozoite-positive mosquitoes may be extremely difficult. Therefore, no definitive incrimination could be made at this stage. However, it is suspected that *An. pseudowillmori, An. culicifacies, and An. vagus* may be playing a role in malaria transmission in Bhutan, based purely on their numerical preponderance and association with cases. Attempts to isolate parasites from these species collected from human landings and indoor restings during outbreak investigations were unsuccessful.

Additionally, *An. minimus,* once a proven vector in Bhutan but which disappeared for some time in the past, saw its reappearance during a focal outbreak in Samtse. It has also been encountered in few areas of Sarpang. They were also the common species occasionally collected from both indoor and outdoor human landing catches. But they are generally collected low in numbers and remain a potential vector. Other important species for Bhutan include *An. fluviatilis, An. maculatus* and *An. baimaii* which are proven vectors in the adjacent Indian state of Assam.

Table 37. Records of vector incrimination attempts

Location	Species	Number	Method	Positive	Year
Samtse	*An. minimus*	--	Salivary gland dissection	1	1962
Sarpang	*An. culicifacies*	32	PCR	0	2018
Sarpang	*An. vagus*	27	PCR	0	2018

4.9.3 Vector surveillance sentinel sites

The selection of sentinel sites for vector surveillance and other entomological monitoring were based on the past transmission history, ecological representation, vector diversity and available human resource capacity.

Vector surveillance are carried out in four sentinel sites in Sarpang, viz. at Chaskar, Chokhorling, Singye and Menchulam. Chasker, with high diversity of Anophelines represent the overall species composition in the country (Figure 42). It sits amidst the vast rice fields and arecanut (*doma*) plantations in the lowland of Chuzargang Gewog, with a slow flowing creek running below the village.

Chokhorling with its mostly alluvial soil, on the other hand is dry during winter months (November – February) and off rainy seasons. It sits on a gentle slope that extends to the foothills on the north. A fast flowing stream run on either side of the village.

To the extreme west of Sarpang Dzongkhag, Singye shares a similar ecological characteristics to Chokhorling, with Phibsoo National Park laying adjacent to its west. All the above three sites extends to the vast plains of Assam in India to the south.

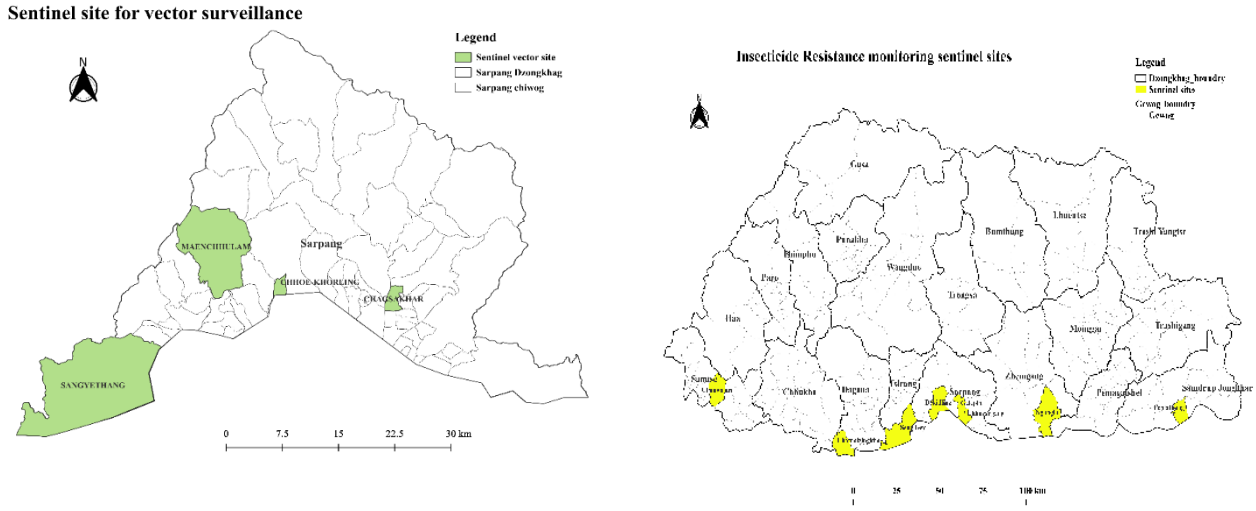

Figure 42. Sentinel sites for entomological surveillance

Quite different to the above sites, nestled in a valley amidst the rising Himalayas, Menchulam sits on the banks of Sarpangchu. It experiences the hot and humid sub-tropical climate from March to September and cold winter. All the three sites were once considered hyperendemic for malaria.

4.9.4 Surveillance methods

Despite the limited human resource, various entomological methods are deployed to gather sufficient information on species composition, their behaviour, temporal distribution and resistance status. Additionally, residual effigies on sprayed surfaces and distributed LLINs are being monitored. The entomological components and methods adopted by the national programme are summarized in Table 38.

Table 38. Entomological surveillance techniques for malaria vectors in Bhutan

Component	Entomological Techniques
Prevalence	Cattle Baited Net Collections
	Larval surveys
Resting behaviour	Indoor Resting Hand Collections
Biting behaviour	Human Landing Collections indoor (partial night)
	Human Landing Collections outdoor (partial night)
Breeding behaviour	Larval surveys
Insecticide resistance monitoring	Insecticide susceptibility tests on wild caught Anophelines
Efficacy of currently used vector control tools	Bioassay tests for IRS and LLINs on wild caught Anophelines

Vector surveillance activities include quarterly monitoring of adult mosquito occurrence and distribution, vector density, human biting and landing rates, biting time, biting location, and morphological species identification. Molecular species identification is conducted periodically in collaboration with regional institutions, while vector incrimination and xenomonitoring using molecular techniques are planned. Insecticide susceptibility testing is carried out annually at sentinel sites using wild-caught Anopheles mosquitoes, and resting location surveys are conducted during outbreak investigations and spot checks. Larval ecology is assessed through random larval habitat surveys and spot-check inspections (Table 39).

Table 39. Frequency of vector surveillance activities

Surveillance indicator	**Frequency**
Adult occurrence and distribution	Quarterly
Vector identification (morphological)	Quarterly
Vector identification (molecular characterisation)	Periodically in collaboration with institutes in the region
Vector density	Quarterly
Human biting/landing rate	Quarterly
Biting time	Quarterly
Biting location	Quarterly
Host preference	No
Resting location (indoor/outdoor)	During outbreak investigations and spot checks
Vector incrimination/xenomonitoring (DNA PCR, molecular test)	Planned
Insecticide susceptibility testing	Once a year at sentinel sites with the wild caught Anophelines available during survey time
Larval ecology study	Random larval habitats surveys and spot checks

The reports of routine surveillance form the four sentinel sites have been reported here as mean densities, calculated as number of mosquitoes per collector per unit time.

Cattle-baited net collections conducted in Chaskar during 2024 – 2026 identified *An. pseudowillmori* as the predominant species throughout the collection period, with the highest mean densities recorded between 19:00 – 20:00 (2.92 mosquitoes/collector/hour) and 20:00 – 21:00 (2.86 mosquitoes/collector/hour). Other recognized malaria vector species, including *An. culicifacies*, *An. minimus, An. aconitus, and An. vagus*, were detected at comparatively low densities. Notably, *An. culicifacies* showed increasing activity later in the evening, reaching its highest density during 21:00–22:00 (1.67 mosquitoes/collector/hour). Peak mosquito activity generally occurred between 19:00 and 21:00 hours, after which densities declined (Table 40).

Table 40. Cattle-baited net collection of malaria vectors at Chaskar, Sarpang Dzongkhag, 2024 – 2026

Species	Mean Density			
	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00
Cattle-baited collection (mosquitoes/collector/hour)				
An. pseudowillmori	2.52	2.92	2.86	1.08
An. culicifacies	0.19	0.78	0.97	1.67
An. vagus	0.04	0.17	0.31	0.08
An. splendidus	0.15	0.28	0.39	0
An. karwari	0	0.03	0	0
An. minimus	0.04	0.14	0.06	0
An. jamesi	1.00	1.33	0.56	0.56
An. annularis	0.11	0.31	0.22	0.33
An. pseudojamesi	0.33	0.83	0.19	0
An. aconitus	0.04	0.06	0.03	0
An. varuna	0.00	0.03	0	0
Outdoor human landing collection (mosquitoes/man/hour)				
An. pseudowillmori	0	0.38	0	0
An. culicifaciess	0	0.08	0.18	0.25
An. minimus	0.22	0.31	0	0
Indoor human landing collection (mosquitoes/man/hour)				
An. pseudowillmori	0	0.08	0	0
An. culicifaciess	0.56	0.33	0	0
An. minimus	0	0	0.09	0

Human landing collections conducted in Chaskar during 2024 – 2026 detected low densities of malaria vector species both outdoors and indoors. In outdoor collections, *An. minimus* was the most frequently encountered species, with peak activity observed between 19:00 – 20:00 (0.31 mosquitoes/person/hour), followed by *An. pseudowillmori* (0.38 mosquitoes/person/hour) during the same period. *An. culicifacies* was recorded at low densities but showed increasing activity later in the evening, reaching its highest density between 21:00 – 22:00 (0.25 mosquitoes/person/hour). Indoor collections similarly demonstrated low vector densities, with *An. culicifacies* predominating and exhibiting its highest activity during 18:00 – 19:00 (0.56 mosquitoes/person/hour), while *An. pseudowillmori* and *An. minimus* were detected only sporadically. Overall, the low human landing rates indicate limited human-vector contact; however, the presence of primary and secondary malaria vector species in both indoor and outdoor settings highlights the continued need for entomological surveillance to monitor residual malaria transmission risk in the area.

The monthly distribution of *Anopheles* species collected through cattle-baited net collections in Chaskar during 2024 – 2026 demonstrated the predominance of *An. pseudowillmori* throughout

the surveillance period, with consistently high mean densities in February (9.00 mosquitoes/collector/night), March (9.28), and June (6.17). *An. jamesii* was abundant in February (5.83) but declined markedly in subsequent months, while *An. pseudojamesii* showed increased densities in March (1.61) and June (4.00). The primary malaria vector *An. culicifacies* was present in all three months, with densities increasing from February (0.17) to June (3.22). Other malaria vector species, including *An. minimus*, *An. aconitus*, *An. annularis*, and *An. vagus*, were detected at lower densities. Species diversity was greatest in June, when several secondary vector species such as *An. vagus*, *An. splendidus*, and *An. annularis* showed increased abundance (Table 41).

Table 41. Monthly distribution of Anophelines from Cattle Baited Collection in Chaskar, Sarpang Dzongkhag, 2024 – 2026

Species	Mean monthly density		
	Feb	March	June
An. pseudowillmori	9	9.28	6.17
An. culicifaces	0.17	1.39	3.22
An. vagus	0	0	0.94
An. splendidus	0	0.11	1.06
An. peditaeniatus	0.5	0	0.06
An. jemsii	5.83	0.56	0.22
An. minimus	0.17	0.33	0.06
An. aconitus	0.33	0	0.11
An. varuna	0.17	0.33	0
An. annularis	0.33	0.17	1.22
An. abrberostirus	0.17	0	0.06
An. jemsii	0	1.61	4
An. fluviatilis	0	0.06	0
An. karwari	0	0	0.06

Cattle-baited net collections conducted in Chokhorling during 2024 – 2026 revealed that *Anopheles pseudowillmori* was the predominant species, with peak activity occurring between 19:00 – 20:00 hours (1.54 mosquitoes/collector/hour). *An. culicifacies*, an important malaria vector, was the second most abundant species and was detected primarily during the early evening, with densities ranging from 0.31 to 0.54 mosquitoes/collector/hour. *An. vagus* was also commonly encountered, showing its highest density between 19:00 – 20:00 hours (0.49 mosquitoes/collector/hour). Other species, including *An. annularis*, *An. pseudojamesii*, *An. maculatus*, and *An. baimaii*, were recorded only at low densities, while *An. aconitus* and *An. varuna* were not detected during the survey period (Table 42).

Table 42. Mean densities from Cattle-baited Net collections in Chokhorling, Sarpang Dzongkhag, 2024 – 2026

Species	Mean Density			
	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00
Cattle-baited collection (mosquitoes/collector/hour)				
An. pseudowillmori	0.55	1.54	0.77	0.22
An. culicifacies	0.48	0.54	0.31	0
An. vagus	0.09	0.49	0.10	0.11
An. annularis	0.03	0	0	0
An. pseudojamesi	0.03	0.03	0.05	0
An. aconitus	0	0	0	0
An. varuna	0	0	0	0
An. maculatus	0.06	0	0	0
An. baimaii	0	0	0.03	0
Outdoor human landing collection (mosquitoes/man/hour)				
An. pseudowillmori	0	0	0	0
An. culicifaciess	0	0	0	0
An. Minimus	0	0	0	0
Indoor human landing collection (mosquitoes/man/hour)				
An. pseudowillmori	0	0	0	0
An. culicifaciess	0	0	0	0
An. minimus	0	0	0	0

Human landing collections conducted both outdoors and indoors in Chokhorling during 2024 – 2026 did not capture any Anopheles mosquitoes. No specimens of the malaria vector species *An. pseudowillmori, An. culicifacies*, or *An. minimus* were recorded during any of the collection periods between 18:00 and 22:00 hours.

The monthly distribution of *Anopheles* species collected through cattle-baited net collections in Chokhorling during 2024–2026 showed that *An. pseudowillmori* was the predominant species, with densities increasing from March (2.17 mosquitoes/collector/night) to June (3.70) and reaching a peak in July (4.22). *An. culicifacies*, an important malaria vector, was detected mainly in March (2.67) and April (1.33), with a lower density recorded in July (0.56). *An. vagus* was present at low densities in March (0.33) but increased substantially in July (2.44). Other species, including *An. maculatus*, *An. annularis*, *An. pseudojamesii*, and *An. baimaii*, were recorded only sporadically and at very low densities (Table 43).

Table 43. Mean monthly density distribution of Anophelines from Cattle Baited Collection in Chokhorling, Sarpang Dzongkhag, 2024 – 2026

Species	Mean monthly density				
	Feb	March	April	June	July
An. p.willmori	0	2.17	1.78	3.7	4.22
An. maculatus	0.33	0.08	0	0	0
An. culicifacies	0	2.67	1.33	0	0.56
An. annularis	0	0.08	0	0	0
An. vagus	0	0.33	0	0.11	2.44
An. p.jamesii	0	0.33	0	0	0
An. baimaii	0	0	0	0	0.11

Cattle-baited collections conducted in Singye during 2024 – 2026 identified *Anopheles pseudowillmori* as the predominant species throughout the collection period, with mean densities ranging from 0.67 to 1.00 mosquitoes/collector/hour and the highest activity recorded between 18:00 – 19:00 hours. *An. culicifacies*, a primary malaria vector, was present at lower densities but showed a gradual increase in activity during the evening, reaching its highest density between 20:00 – 21:00 hours (0.24 mosquitoes/collector/hour). *An. vagus* was detected consistently at low densities, while *An. aconitus* was recorded only sporadically (Table 44).

Table 44. Mean density from cattle baited collection in Singye, Sarpang Dzongkhag, 2024 – 2026

Species	Mean Density			
	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00
Cattle-baited collection				
An. pseudowillmori	1	0.67	0.75	
An. culicifacies	0.12	0.18	0.24	
An. vagus	0.12	0.09	0.05	
An. aconitus	0	0.03	0	
Outdoor human landing collection (mosquitoes/man/hour)				
An. pseudowillmori	0	0	0	0
An. culicifaciess	0	0	0	0
An. minimus	0	0	0	0
Indoor human landing collection (mosquitoes/man/hour)				
An. pseudowillmori	0	0	0	0
An. culicifaciess	0	0	0	0
An. minimus	0	0	0	0

Human landing collections conducted both outdoors and indoors in Singye during 2024 – 2026 did not capture any Anopheles mosquitoes. No specimens of *Anopheles pseudowillmori*, *An. culicifacies*, or *An. minimus* were recorded during any collection period between 18:00 and 21:00 hours (Table 45).

The monthly distribution of Anopheles species collected through cattle-baited collections in Singye during 2024 – 2026 showed that *An. pseudowillmori* was the predominant species, with densities peaking in March (2.89 mosquitoes/collector/night) and declining in June (0.75). *An. culicifacies*, a primary malaria vector, was detected in all survey months, with the highest density also recorded in March (0.89). *An. vagus* was present at low densities, increasing to 0.44 in March before declining to 0.08 in June, while *An. aconitus* was detected only at very low densities in June (0.08).

Table 45. Monthly distribution of Anophelines density from Cattle Baited Collection in Singye, Sarpang Dzongkhag, 2024 – 2026

Species	Mean Density (mosquitoes/collector/hour)		
	Feb	March	June
An. culicifaces	0.22	0.89	0.33
An. pseduwillmori	0.56	2.89	0.75
An. Vagus	0	0.44	0.08
An. aconitus	0	0	0.08

Entomological surveillance conducted in Menchulam during 2024 – 2026 demonstrated that *An. pseudowillmori* was the dominant species in cattle-baited collections, with high mean densities throughout the evening and peak activity observed between 20:00 – 21:00 hours (8.3 mosquitoes/collector/hour). *An. willmori* was present at substantially lower densities, showing its highest activity during 18:00 – 19:00 hours (1.3 mosquitoes/collector/hour), while *An. vagus* was detected only sporadically at low densities. Indoor human landing collections recorded only a single low-density capture of *An. pseudowillmori* during 18:00 – 19:00 hours (0.2 mosquitoes/person/hour), with no mosquitoes collected during later time periods. These findings indicate a predominance of zoophilic *Anopheles* activity, particularly *An. pseudowillmori*, with limited evidence of indoor human-biting behaviour (Table 46).

Table 46. Mean density from cattle baited and indoor human landing collection form Menchulam, Sarpang Dzongkhag, 2024 – 2026

Species	Mean Density (mosquitoes/collector/hour)		
	18:00-19:00	19:00-20:00	20:00-21:00
Cattle baited collection			
An. pseudowillmori	4.5	8.1	8.3
An. willmori	1.3	0.2	0.3
An. vagus	0.2	0.3	0.1
Indoor human landing collection			
An. pseudowillmori	0.2	0	0

4.9.5 Insecticide resistance monitoring

Bhutan ventured into malaria eradication in 1964 with the use of DDT for indoor residual spraying. In 1995, after about three decades of its use it was replaced with deltamethrin 10% WP following suspicion of resistance development. LLINs impregnated with deltamethrin came into use from

2006. The use of deltamethrin in both IRS and LLINs led to further replacement with cyfluthrin 10% WP for IRS in 2008. With concern for development of resistance to pyrethriod among malaria vectors, bendiocarb was introduced on trial basis in 2019 and 2020 along with cyfluthrin. It had to abandoned following poor acceptance from communities and spray persons, and cyfluthrin is still being used for IRS.

IRS and LLINs remained the core vector control interventions towards achievement of malaria control and elimination. The national programme, taking cognizance of the threat from insecticide resistance development, national insecticide resistance monitoring plan was developed in 2021 with support from GFATM.

The monitoring plan came into effect from 2022 with susceptibility tests carried out in eight sentinel sites selected across the southern malaria *dzongkhags* (Table 47).

For the test 3 – 5 days old adult female non-blood-fed vector mosquitoes were subjected for susceptibility tests. The type of breeding site (e.g., rice field, rainwater collection, irrigation channel, well or others) and the global positioning system (GPS) coordinates from which the larval collection was made was recorded. The standard procedure as per WHO was followed using WHO adult susceptibility test kit, insecticide-impregnated papers and control papers impregnated with the appropriate carrier oil only (without insecticide). A total number of 120 – 150 adult female mosquitoes of a given species were used to conduct a single set of WHO insecticide susceptibility tests (100 for exposure to the insecticide and 50 for control).

In each sentinel site, a team comprising an entomologist assisted by 1 – 2 technicians and two insect collectors are assigned for a week to carry out entomological surveillance in each sentinel site. From 18.00 – 22.00 hrs every night, cattle-bated catches are done; 20 – 25 healthy females fed on sugar solution are used in 4 test replicates and 2 control replicates for each set of tests. Knockdown after every 10 minutes during exposure period (1 hour) and mortality after 24 hours in holding tubes were counted. Test sets in which control mortality exceeding 20% were discarded. Corrected mortality was calculated using Abbot's formula.

Currently, *An. culicifacies, An. vagus* and An. *peditaeniatus* show varying degrees of resistance to pyrethroids currently used in Bhutan. To address the issue of resistance, mass distribution of pyrethroid-LLINs impregnated with synergist (PBO) has already been completed in the first quarter of 2026; IRS with the pyrethroid group is to be replaced with another suitable insecticide class, and will eventually be phased out.

Table 47. Resistance status of *Anopheline* spp in eight sentinel sites

Sentinel site (place, dzongkhag)	Mosquito species tested	PYRETHROIDS					CARBAMATES			OP[1]	OC[2]
		Permethrin	Cyfluthrin	Deltamethrin	L/cyhalothrin	Alphamethrin	Bendiocarb	Propoxure	Etofenprox	Malathion	DDT
Pemathang, Samdrup Jongkhar	*An, pseudowillmori*										
	An. culicifacies										
	An. vagus										
	An. peditaniatus										
	An. jamesii										
Pantang, Zhemgang	*An, pseudowillmori*										
Norbugang, Samtse	*An, pseudowillmori*										
	An. peditaniatus										
	An. jamesii										
Lhamoizingkha, Dagana	*An, pseudowillmori*										
	An. jamesii										
	An. peditaniatus										
Senggey, Sarpang	*An, pseudowillmori*										
	An. vagus										
	An. peditaniatus										
	An. kochi										
	An. jamesii										
Chokhorling, Sarpang	*An, pseudowillmori*										
Gelephu, Sarpang	*An, pseudowillmori*										
	An. vagus										
	An. peditaniatus										
Chaskar, Sarpang	*An, pseudowillmori*										
	An. vagus										
	An. peditaniatus										
	An jamesii										

YELLOW		SUSCEPTIBLE
RED		HIGH INTENSITY RESISTANCE
LIGHT RED		LOW INTENSITY RESISTANCE

4.9.6 Data management system and use of data

Entomological surveillance and vector control data are reported through a web-based DHIS2 system. Data on vector prevalence, their density and temporal dynamics are entered quarterly into the system. Bioefficacy test on LLINs and IRS are reported biannually and susceptibility report annually from the sentinel sites. Additionally, there is a provision to report LLINs and IRS campaign into the same system.

Though, there is no focal person at the central level for entomological data management, findings from the entomological data are used on-spot for preventative and control operations; such as, informing communities and local health officials if the mosquito densities increased, larviciding, improving LLINs and IRS coverage and support decision making in selection of pesticides for IRS and LLINs.

4.9.7 Vector control tools and approaches

4.9.7.1 Integrated Vector Management (IVM)

Integrated Vector Management (IVM) is the principal strategy adopted by the Royal Government of Bhutan for the prevention and control of vector-borne diseases, particularly malaria, dengue, Japanese encephalitis, leishmaniasis, and other emerging vector-borne threats. IVM is a rational decision-making process that promotes the optimal use of resources for vector control through evidence-based, integrated, and environmentally sound interventions.

Bhutan's policy on IVM strategy was formally emphasized in the Bhutan National Malaria Control Strategy 2008 – 2013 which is guided by national health policies, vector-borne disease control strategies, and environmental protection regulations (Vector-borne Disease Control Program, 2008). Its implementation aligns with the recommendations of the World Health Organization and supports the country's goals of sustaining malaria elimination while strengthening preparedness for other vector-borne diseases.

The key policy principles for IVM include:

1. Evidence-based decision making through entomological and epidemiological surveillance.
2. Integrated use of vector control methods rather than reliance on a single intervention.
3. Inter-sectoral collaboration involving the health, agriculture, local government, education, and environmental sectors.
4. Community participation in vector control activities.
5. Capacity building of health workers and entomology personnel.
6. Environmental sustainability and the judicious use of insecticides.

Vector surveillance forms the foundation of IVM in Bhutan. Routine surveillance activities include:

- Monitoring vector species distribution and abundance.
- Identification of malaria vectors such as *An. pseudowillmori*, *An. culicifacies*, and other local vectors.
- Monitoring seasonal vector dynamics.
- Detection of invasive and emerging vector species.
- Insecticide resistance surveillance.

- Surveillance data are used to guide vector control decisions and resource allocation.

4.9.7.2 Environmental management

Environmental management is widely promoted as a sustainable vector control measure. Activities include:

- Source reduction through elimination of mosquito breeding sites.
- Improved drainage systems.
- Water management around human settlements.
- Solid waste management.
- Community clean-up campaigns.

These interventions are particularly important in urban and peri-urban settings where dengue vectors may breed.

4.9.7.3 Indoor Residual Spraying (IRS)

IRS has historically been one of the most important malaria control interventions in southern Bhutan. The programme involves:

- Application of WHO-recommended insecticides on indoor walls.
- Targeted spraying in high-risk and receptive areas.
- Monitoring of spray quality and insecticide effectiveness.
- Regular training of spray operators.

IRS remains a preparedness tool to prevent the re-establishment of malaria transmission.

4.9.7.4 Long-Lasting Insecticidal Nets (LLINs)

Bhutan has extensively used LLINs in malaria-risk areas. The programme includes:

- Distribution of LLINs to at-risk populations.
- Replacement campaigns based on net durability.
- Community education on proper net use and maintenance.
- Monitoring of ownership, access, and utilization rates.

4.9.7.5 Larval Source Management

Where breeding habitats are identifiable and manageable, larval control measures are applied through:

- Environmental modification.
- Environmental manipulation.
- Biological control methods.
- Targeted larviciding when appropriate.

4.9.7.6 Insecticide Resistance Management

Bhutan conducts periodic susceptibility testing of vector populations to monitor resistance trends. The programme emphasizes:

- Rotation of insecticides where feasible.

- Selection of appropriate insecticide classes.
- Monitoring resistance mechanisms.
- Evidence-based insecticide procurement.

4.9.7.7 Community Engagement and Health Education

Community participation is considered essential for successful IVM. Activities include:

- Health education campaigns.
- School-based awareness programmes.
- Community-led source reduction activities.
- Promotion of personal protective measures.

Implementation of IVM has contributed significantly to Bhutan's progress toward malaria elimination and the prevention of vector-borne disease outbreaks. Major achievements include:

- Sustained interruption of indigenous malaria transmission.
- Strengthened entomological surveillance systems.
- Improved community awareness and participation.
- Enhanced capacity for outbreak preparedness and response.

Despite substantial progress, several challenges remain:

- Risk of imported malaria cases from neighbouring countries.
- Emergence and expansion of dengue transmission.
- Climate and environmental changes affecting vector ecology.
- Limited specialized entomological workforce.
- Need for continuous insecticide resistance monitoring.
- Sustaining political and financial commitment after malaria elimination.

4.9.8 Core and supplementary vector control interventions

LLINs and IRS remain the main vector control interventions for elimination of malaria in Bhutan. Mass distribution of LLINs after every three years and two rounds of targeted routine IRS are carried out based on the micro stratification at the *Chiwog* level. This geographical unit is considered for classification of active, residual non-active and cleared foci to plan and implement prevention and control activities.

LLINs were was introduced in 2006 and continues to date with mass distribution every three years in all previous malarious areas. IRS is now limited to stratified areas with high vulnerability and receptivity close to the international border. Though discouraged by the WHO, the combination of the two vector control tools with the same insecticide class had to be maintained as withdrawal of IRS in foci where malaria was declared free saw reemergence of focal outbreaks. Entomological investigation found appearance of indoor resting and biting Anophelines that are suspected to be malaria vector in Bhutan. Additionally, the suspected vectors are found to bite early rendering LLINs less effective. This led to the decision on continuing combined intervention in the areas described above. In 2025, 59 214 people living in the risk areas were covered by both LLINs and IRS out of the 168 861 populations living in those areas.

Other vector control measures adopted are source reduction and environmental management. Larval source reduction and management is done in communities through CAG formed in every foci. Environmental management is promoted in communities across transmission areas through CAGs with emphasis on the prevention of mosquito breeding near human settlements.

Supplimentary anti-larval measures with chemical (mainly temephos) are also being implemented. Additionally, pyriproxyfen and diflubenzuron are used in select anopheline breeding sites.

A total of 108 650 LLINs were distributed across six malaria-risk districts during the mass distribution campaigns conducted in 2020 and 2023. In 2020, 98 550 individuals at risk received 84 450 LLINs, while in 2023, 80 575 individuals received 75 773 LLINs. Net coverage remained generally high across districts, ranging from 1.2 to 1.5 persons per net, with most districts maintaining similar coverage levels between the two campaigns. Chukha, Samtse, and Sarpang accounted for the largest at-risk populations and the highest numbers of LLINs distributed in both years, while Zhemgang recorded the smallest at-risk population and LLIN distribution (Table 48).

Table 48. LLINs distribution and coverage from mass distribution in 2020 and 2023

Dzongkhag	2020			2023		
	Risk population	Total LLINs distributed	Net coverage (persons/ net)	Risk population	Total LLINs distributed	Net coverage (persons/ net)
Chukha	32482	22998	1.4	29336	20957	1.4
Dagana	6602	5593	1.2	5391	4514	1.2
Pemagatshel	9835	6528	1.5	8267	5614	1.5
Samtse	39155	27048	1.4	31973	28327	1.1
Samdrup Jongkahr	19928	15129	1.3	18343	14011	1.3
Sarpang	42081	32207	1.3	36033	28327	1.3
Zhemgang	3890	4145	0.9	3405	2344	1.5

IRS was implemented across malaria-risk districts during 2023 – 2025 through two annual spray rounds, with household coverage generally remaining high in most districts. Sarpang consistently recorded the highest number of households targeted and covered, followed by Samtse and Samdrup Jongkhar, while no IRS activities were conducted in Zhemgang and Pemagatshel. Coverage rates exceeded 90% in most districts and rounds, with Dagana consistently achieving nearly complete coverage (99.5 – 100.0%). In several instances, including Samtse, Chhukha, and Samdrup Jongkhar, the number of households covered exceeded the initial targets, resulting in coverage rates above 100% (Table 49). The inventory of functional spray pump available in Bhutan is shown in Table 50. The quantity of pesticides used in the country for vector control is shown in Table 51.

Table 49. Number of household in malaria risk district covered by IRS from 2023 – 2025

Year	Dzongkhag	HH Targeted	HH Covered	% Covered	HH Targeted	HH Covered	% Covered
2023	Chhukha	503	420	83.5	533	502	94.2
	Dagana	1087	1083	99.6	1087	1083	99.6
	Pemagatshel	0	0	—	0	0	—
	Samdrup Jongkhar	3196	3084	96.5	1568	1602	102.2
	Samtse	1608	1446	89.9	1446	1719	118.9
	Sarpang	6728	6279	93.3	6372	6194	97.2
	Zhemgang	0	0	—	0	0	—
2024	Chhukha	356	333	93.5	1901	2175	114.4
	Dagana	925	923	99.8	1003	1038	103.5
	Samdrup Jongkhar	3536	3343	94.5	6838	6676	97.6
	Samtse	1724	1828	106			
	Sarpang	6324	6014	95.1	1109	1108	99.9
	Pemagatshel	0	0	—	0	0	—
	Zhemgang	0	0	—	3768	3500	92.9
2025	Chhukha	1946	1073	55.1	2137	1174	54.9
	Dagana	925	920	99.5	899	899	100
	Samdrup Jongkhar	3813	3514	92.2	3748	3539	94.4
	Samtse	2137	2015	94.3	2058	2187	106.3
	Sarpang	7002	6658	95.1	6518	6290	96.5
	Pemagatshel	0	0	—	0	0	—
	Zhemgang	0	0	—	0	0	—

Table 50. Inventory of functional spray equipment by brand for application of vector control, 2026

District	Gloria	Spray-Matic 12S	Thermal Fogger
Samtse	4	5	2
Chukha	4	3	3
Dagana	3	2	0
Sarpang	15	21	0
Zhemgang	0	2	0
Pemagatshel	0	2	0
Samdrup Jongkhar	8	5	2
VDCP		10	5
Total	**34**	**50**	**12**

Table 51. Quantity of pesticides (larvicides, space spray, etc) used in the country, 2023 – 2025

Active ingredient	Year		
	2023	2024	2025
Cyfluthrin 10% WP (kg)	1082	1100	1125
Temephos (kg)	125	200	225
Diflubenzuron (bottle of 10 Tabs)	400	200	400
Pyrethrum (litre)	100	75	75

4.9.9 Procurement of vector control products

The procurement of all pesticides that are used in public health are guided by the Pesticide Act of Bhutan 2000. No pesticide can be imported, sold, or used unless it is registered and approved by the competent authority in the Ministry of Agriculture. Registration is based on efficacy, safety, environmental impact, and quality standards.

The insecticidal products that are procured for the national programme are all from the WHO prequalified list.

4.10 Operational research

Bhutan is a unique landlocked country bordered by the north-eastern states of India and Tibet and China. It is featured by the presence of high-altitude mountains in the north and plains in south along the Indian border where malaria has been and continues to be problem. Some of its unique country-specific features, as related to the PoR of malaria, has not been characterised as yet and need to be done for optimal use of control and response activities. Although very little operational research have been conducted as yet, the country plans to conduct operations research activities to find solutions to its unique problems. Some of activities that require attention include the following:

- Validating a method to define imported and introduced malaria cases along the India-Bhutan land border given its unique socio-cultural and geographic context. Although, criteria have been reviewed, validating such classifications will be important for maintaining PoR of malaria status in Bhutan.
- Characterising the Anopheline fauna in potential/low and high-risk settings and incriminating malaria vectors. Although the Anopheline fauna in the country has been characterized in different settings in the country, vector incrimination studies have not been conducted as yet. The data generated will have direct implications on choice of insecticides for routine control and response activities.
- Pilot studies to follow up foreign nationals who acquire malaria and go back to India. Following up such individuals who are likely to return to Bhutan for work are a threat to PoR of malaria. This activity will have to done collaboratively with malaria officers from the border districts of India.
- Conduct pilot studies to maintain awareness about malaria during the PoR of malaria phase. Other expertise from the social sciences and academia will be useful guides to conduct such research studies.

- Any other challenge encountered during implementation that needs urgent investigation.
- It is proposed that a dedicated budget be allocated for this purpose; funding should be provided based on scientific merit of the proposal and the priority or importance of the findings for PoR of malaria in Bhutan.

4.11 Public health education and community engagement

Similar to the experiences of other countries in the malaria elimination and prevention of re-establishment phases, there is a general waning of awareness regarding malaria and its impact on the livelihoods of people among the public and healthcare staff. Among healthcare staff, there is also a waning of skills to diagnose and treat malaria cases.

VDCP has been conducting health education and community engagement activities for the general public focusing on the southern districts bordering India. Such activities are coordinated by VHW and CAG at village level whenever a case is reported and just before and during the transmission season; topics cover the vulnerability and receptivity of the population, where to seek treatment, compliance to treatment and community engagement for prevention of further transmission whenever a case is detected. The VHW and CAG also assist in distribution of LLINs and advocating IRS whenever needed.

Separate programmes are held for healthcare personnel usually in combination with training programmes conducted by VDCP.

4.12 Intersectoral and multisectoral collaboration

VDCP takes the lead in malaria elimination and prevention of re-establishment activities. Coordination with private sector industries is promoted for diagnosis and treatment and LLIN coverage of the labour population. Private sector practitioners are not present; only private diagnostic laboratories are present which reports to the VDCP if a positive case is detected for treatment and further follow up.

4.13 Cross-border coordination and collaboration,

Districts share a long international border with India, approximately 699 kilometre in length, with daily/short to long term population movement at designated points. Although migration across the Indo-Bhutan border took place at multiple sites in an uncontrolled manner previously, currently, it is more regulated, occurring at four crossing points as Bhutanese security personnel are deployed along the border. Cross-border collaboration between Bhutan and India was initiated with support from WHO as well as non-government coordination mechanisms especially at local level, district to district collaboration (Technical Advisory Group for Malaria Elimination, 2026). Information on malaria positive cases and response are shared through social media platforms (WhatsApp) so as to synchronize actions, as locally feasible. In 2025, a site visit by Bhutanese officials was carried out in some localities in India along the border to observe anti-malaria activities first hand and to look at ways of synchronized actions. Periodic consultation meetings and exposure visits are held. Although a formal system exists, its functionality is questionable especially in relation to sharing of real time data from Assam to Bhutan for setting up organized and harmonized antimalarial activities. This mechanism needs to be strengthened and further facilitated.

Fever cases from India (labour/travellers) are provided diagnosis and treatment free-of-charge (those without work permit/travellers return after diagnosis and treatment).

4.14 Multi-sectoral and private sector engagement

Community engagement has played a pivotal role in the progress toward malaria elimination. Village health workers, local leaders, and community volunteers support health promotion, distribution and utilization of long-lasting insecticidal nets, early referral of febrile patients, and reactive case detection activities around confirmed malaria cases. Community members and community leaders are supportive of all public health intervention implemented in their villages.
Private diagnostic centres, construction companies, and other employers contribute by promoting awareness among workers, facilitating access to healthcare services for migrant populations, and referring suspected malaria cases to government health facilities for confirmation, treatment, and reporting.

In the GMC, the employers ensure cleanliness of the worker's dormitory, coordinate with the VDCP for IRS, and coordinate with the local hospitals in providing health education for the signs and symptoms of dengue and malaria. Vector surveillance is conducted in and around major construction areas and appropriate interventions carried out where required.

5 Prevention of re-establishment of malaria transmission

Bhutan achieved zero indigenous cases in 2023 and beyond based on implementing the national strategic plan for malaria elimination 2020 – 2025. The National Malaria Strategy 2020 – 2025 was based on the following key guiding principles (Royal Government of Bhutan, 2020):

- Using evidence-based strategies conforming to WHO recommendations and adapted to local conditions and needs;
- Universal access to quality malaria diagnosis, treatment and prevention with emphasis on coverage of vulnerable populations;
- Forging national ownership and leadership for malaria elimination through establishment of a Malaria Elimination Commission;
- Developing mechanisms to pursue effective partnerships with line ministries and agencies, local leaders and private organizations for multi-sector approach to malaria elimination;
- Strengthening decentralized malaria elimination with district health taking the onus of malaria elimination and promoting community empowerment for malaria elimination activities;
- Collaborating and networking with local institutions and leaders, neighbouring countries, international organizations and agencies; and
- Utilizing of modern technology and available tools to strengthen malaria elimination strategies and programme.

The strategic plan comprised the following eight strategic objectives:

1. Strengthen targeted and focused preventive malaria interventions;
2. Establish rigorous quality assurance program for laboratory diagnosis and ensure prompt and effective treatment and follow up;
3. Strengthen services for surveillance for malaria case detection and rapid outbreak response system;
4. Strengthen effective collaboration and partnerships to support malaria elimination program;
5. Improve programme management and performance;
6. Intensify advocacy and pursue effective IEC approaches for malaria elimination;
7. Conduct operational research on malaria elimination; and
8. Strengthen monitoring and evaluation of malaria elimination programme.

The above strategic activities were conducted in partnership with collaborating partners including WHO, the Global Fund, other international and bilateral agencies and local agencies. As this approach led to successful outcomes, VDCP proposes to strengthen and use similar strategies for the prevention of re-establishment of malaria in the country in the future after review and modification of the activities to suit the local setting.

5.1 Overview

Bhutan plans to obtain WHO malaria-free certification and preventing re-establishment of malaria in Bhutan from 2026 to 2030 and beyond as part of achieving the national vision of ‘a nation with the best health’. Bhutan is eligible for consideration for malaria-free certification given that no indigenous cases of malaria have been reported since the beginning of 2023 coupled with a resilient

and responsive health system that has negotiated and successfully prevented re-establishment of malaria since 2023 onwards even though the country shares a porous land border with Assam state of India where malaria is endemic.

The National Strategic Plan (NSP) for the prevention of re-establishment of malaria in Bhutan from 2026 – 2030 has been developed through a comprehensive, evidence-based, and highly consultative process led by the VDCP under the Ministry of Health, with technical support from WHO building on the successful achievements gained over several years. Relevant reports and documents were reviewed and the findings of the external review of the malaria programme conducted in 2025 laid the foundation for the development of the strategic plan.

This national strategic plan builds on past achievements and presents a roadmap to obtain WHO malaria-free certification and to prevent re-establishment of malaria in Bhutan in the future. It focuses on strengthening surveillance, epidemic preparedness and response, case management, targeted implementation of preventive interventions, maintaining technical expertise within the country, improved cross border collaboration and sustained political and financial commitment. Enhanced surveillance, including both parasitological and entomological surveillance, and effective response in collaboration with currently expedited developmental activities in the country will be the backbone of the prevention of re-establishment programme. Bhutan has already developed guidelines and standard operating procedures for surveillance and response activities. The currently implemented 1-3-7 strategy for notification and investigation of cases and response has been in operation for some time and well implemented; generated data are tracked real time through a web-based online system which ensures timely actions that are monitored regularly as part of the M&E plan.

National treatment guidelines for Bhutanese and non-Bhutanese nationals have been revised recently and are used for case management; all detected malaria cases in the country will have access to quality assured diagnosis and treatment services. These guidelines will be reviewed and revised as necessary. Training of health personnel will be done regularly to ensure that their skills are up to date.

Based on findings of entomological surveillance and of case investigations, appropriate evidence-based preventative strategies including vector control will be implemented. Vector susceptibility testing will be carried out routinely and adequate stocks of WHO-prequalified insecticides for IRS and LLINs, based on findings of susceptibility studies, will be procured and used as necessary. In addition, vulnerable populations in high-risk areas in close proximity to the border with Assam State of India where malaria is endemic will be protected using LLINs. IRS will primarily be used as part of response.

The VDCP will ensure quality assurance of all prevention of re-establishment of malaria activities ranging from diagnosis, treatment and implementation of preventive activities. The skills of microscopists will be assessed annually through internal and external competency testing programmes; in addition, there will be regular in-service training programmes for microscopists. Further, all positive blood smears and 10% of negative blood smears will be cross checked by Level 1 and Level 2 microscopists. Regular training of all healthcare providers will be carried out routinely in various areas such as surveillance, case management case investigation, response etc.

All these are carried out to ensure that the necessary skills of healthcare personnel required for prevention of re-establishment of malaria are maintained.

All guidelines and standard operating procedures will be reviewed and revised as necessary. Although the supply chain management system is upgraded and computerized, a few gaps have been identified which will be rectified with strengthening of the system. As part of quality assurance, only WHO-prequalified products will be procured for prevention of re-establishment of malaria activities.

Cross-border collaboration will comprise a major component of this strategic plan as imported cases acquired in neighbouring India where malaria is prevalent is the greatest threat to prevention of re-establishment of malaria in Bhutan. Although links have been established with agencies in the Indian side, actual sharing of data and implementation of joint programmes do not occur on a regular basis. It is proposed that cross-border collaboration will be strengthened and that regular meetings along with field visits will take place at least twice a year. It is also proposed that international agencies will coordinate this activity and dedicated funding for this be obtained.

With dwindling numbers of malaria cases in the country, both healthcare personnel, and the public, in general, forget the threat posed by malaria. The VDCP will be conducting sensitization sessions for healthcare providers on a regular basis. For the general public, health promotion programmes will be conducted for vulnerable population residing in close proximity to the land border with India at least twice every year; once before the potential transmission season and once during the potential transmission season.

It is proposed that the Technical Advisory Committee for Malaria Elimination (TAGME) be renamed as the Technical Advisory Committee for Prevention of Re-establishment if Malaria (TAGPoR). It is proposed that regular programme reviews be conducted; as currently done, the VDCP personnel engaged in prevention of re-establishment of malaria activities will meet every month. A programme review is proposed to be conducted in 2028; ideally inclusion of external reviewers is preferred, but if funding is limited, even a review by local experts is acceptable.

The success and sustainability of the prevention of re-establishment of the malaria programme rests solely on political and financial commitment. The Royal Government of Bhutan has been very supportive of the PoR programme for malaria. This is evident from the fact that additional sources of funding have been identified for the future through the Bhutan Health Trust Fund to cover gaps that resulted from recent funding restrictions that have been imposed by donor agencies. With malaria-free certification it is likely that the ability of country to attract funding will be further limited; hence there is an urgent need to ensure adequate sources of funding for the future.

The prevention of re-establishment of malaria programme will have to be adopt a high state of vigilance for a long time to mitigate the threat posed by endemic malaria in Assam state, India, along the border with Bhutan. During this period, it is essential to maintain a responsive system that is capable of preventing onward malaria transmission in Bhutan for which adequate funds must be ensured. The integrated activities implemented by the VDCP that have already been implemented will be continued to optimize prevention of re-establishment of malaria activities.

The activities related to the prevention of re-establishment of malaria in Bhutan 2026-2030 have been identified; the estimated budget is to be worked out.

5.2 Stratification by receptivity and risk of importation

Epidemiological risk stratification is an important component of an effective and responsive surveillance system that enables evidence-based, cost-effective targeting of interventions. VDCP initiated geographical reconnaissance for risk stratification throughout the country using malaria case data, vectors and breeding sites distribution for implementation of targeted preventive interventions; in the prevention of re-establishment phase, receptivity and risk of malaria importation is also considered. These variables are uploaded and analysed in customized GIS databases to produce malaria risk stratification maps. Every health facility in a district in malaria prone areas have geo-locations of households which are used to map buffer areas including households around an index case for malaria case-based surveillance. The household geo-coordinates enable the health facility, the districts and the programme in assessing risk stratification of areas and population, intervention coverage, impact assessment and focused interventions for malaria. The households and new settlements are added every year and the database is updated every year in at the respective health facility level. This work will be carried out on an ongoing basis.

With the transition from an elimination to a prevention of re-establishment of malaria phase, an initial epidemiological risk stratification will be conducted taking into consideration importation risk of malaria, receptivity to malaria transmission and future development activities in the country that will attract foreign labour from malaria endemic regions. The risk stratification strategy will be based on mathematical models and GIS technology already developed for this purpose at *gewog/chiwog* levels. This procedure will be carried out every 3 years or as when required depending on the evolving epidemiology of malaria in the country.

Epidemiological risk stratification and mapping exercise will also be used to train personnel (entomologists, epidemiologists, DHOs, MTs etc.) on use of GIS tools and IT technology for surveillance purposes as part of capacity development for sustained prevention of re-establishment of malaria. New modules such as report generation will be incorporated into the system and manuals and guidelines will be updated as necessary. All databases (household data, village-wise data, case data and entomological findings) will be updated at chiwog level. Health volunteers who collect data will also be introduced to the system and the importance of their role will be communicated.

For intervention purposes, epidemiological risk stratification for malaria transmission based on the epidemiology of malaria at the end of 2025 at the sub-district (Gewogs) level is stratified as No Risk, Potential/Low Risk and High Risk areas (Figure 27). The recommended interventions based on the microstratification is shown in Table 52.

Table 52. Interventions based on microstratification of epidemiological risk of malaria transmission, 2026 - 2030

Interventions	No risk areas	Potential/low risk areas	High risk areas	Remarks
Anti-malarial and diagnostic supplies	Yes	Yes	Yes	
Training on case management and diagnosis	Yes	Yes	Yes	
Follow up *P. falciparum*	Day 3 and 28	Day 3 and 28	Day 3 and 28	
Follow up *P. vivax*	Day 3, 28 and month and 1 year	Day 3, 28 and month and 1 year	Day 3, 28 and month and 1 year	As per latest WHO guidelines
iDES (DOT & FU)	Yes	Yes	Yes	
PCD	Yes	Yes	Yes	
ACD	No	Yes	Yes	
Case-based Investigation (RACD)	Yes	Yes	Yes	
Foci investigation	No	Yes	Yes	
Event monitoring	No	Yes	Yes	
Epidemic/Rapid Response Team	Yes	Yes	Yes	Rapid Response Team exists
LLIN distribution	No	No	Yes	
IRS	No	No	Yes	Focal in active foci and during outbreak response
Vector surveillance				
Insecticide resistance monitoring	No	No	Yes	In sentinel sites
IEC/BCC	Yes	Yes	Yes	More frequent and aggressive in high-risk areas and active foci
CAG activity	No	Yes (Selective)	Yes (Selective)	
Malaria Review Meeting	Annual	Annual	Annual	
M&E interval	Annually	Quarterly	Monthly	

5.3 Surveillance and response systems

The malaria case-based surveillance system in Bhutan is part of the National Early Warning Alert and Response (NEWARS) system in the DHIS2 platform implemented by the district with support from VDCP; the report is generated through the DHIS2 system (Ministry of Health, 2018). Standard case notification, and case and foci investigation forms have been developed and

incorporated into electronic formats and reported in the DHIS2 platform. Vector surveillance including insecticide resistance monitoring has been strengthened to make evidence-based decisions. Currently, there are four sentinel sites for monitoring insecticide resistance. Monthly entomological surveillance is conducted in all high transmission risk areas by malaria technicians within their catchment areas irrespective of foci stratification.

Case detection comprising passive case detection and active case detection (including both proactive and reactive case detection will be strengthened in all health centres in districts along the border with India and in districts reporting high incidence of imported malaria cases. All health centres and private diagnostic centres along the border with India will be provided with microscopy facilities and/or RDTs. Diagnostic facilities will be provided free to all patients presenting with fever including foreign nationals.

Where there is a strong suspicion of malaria in travellers from malaria endemic areas, these travellers may be subject to PACD tailored to the local context and targeting high-risk and vulnerable groups such as those in remote areas with poor health access, migrants and refugee groups who may not use or have limited access to routine healthcare and likely harbour a reservoir of asymptomatic infections.

Currently, the TAGME is involved in case and foci classification. It is proposed that TAGME be renamed as Technical Advisory Group for Prevention of Re-establishment (TAGPoR) of malaria and appointed by the Minister of Health.

Each case reported, including imported malaria cases, will be considered a focus. Case investigation and response will be guided by the 1-3-7 model, where notification is carried out within 24 hours by telephone, investigation carried out within 3-days of the case being detected and response completed within 7-days of detection of a case. The case and focus investigation will comprise the following:

- Epidemiological investigation to identify potential sources of infection;
- RACD among residents within 1 km of the residence of the index case;
- Mapping the area of the residence of the index case;
- Entomological survey of the area and identifying potential vector breeding sites;
- Data compilation, data analysis and carrying out a suitable response;
- Case and focus classification based on available evidence; and
- Follow up the community to detect and prevent further transmission as per guidelines of focus investigation and management.

Indicators to assess the performance of the implementation of the 1-3-7 model have been included the M&E framework.

5.3.1 Strengthening epidemic preparedness, forecasting and early warning systems for prevention of re-establishment of malaria

The case-based malaria surveillance system was developed as an important element during the elimination phase. The notification through the NEWARS system and the DHIS2 platform has enabled the VDCP to investigate cases and respond at the district level. To improve surveillance

and data collection, standard case notification, case and foci investigation forms have been developed and incorporated into electronic reporting format in DHIS2 platform. The system was piloted and rolled out in all health centres.

This system will be further improved. Additional personnel will be trained as part of capacity building. New modules will be incorporated as required and an efficient and responsive surveillance system will be in place as part of epidemic preparedness, forecasting and an early warning system.

With time, modules for other diseases will be incorporated to test the applicability of the system for other vector borne diseases as well.

5.3.2 Special events surveillance

Special events surveillance will include monitoring of events such as unexpected population movements, construction of large developmental projects, mass community gatherings, changes in climate data, number and pattern of fever cases in communities and any events with the potential for malaria importation and transmission. This will be done through multi-sectoral collaboration and community monitoring. Entomological surveillance in the developmental projects will inform potential transmission areas and levels of receptivity. Regular meetings will be conducted among multi-sectoral stakeholders to plan and conduct special event surveillance programmes.

5.3.3 Outbreak detection and rapid response systems

VDCP will rely on the web-based surveillance system to provide real time case-based data. These data will be analysed by trained personnel and relevant authorities notified on a timely basis. M&E indicators have been developed and will be used to monitor these activities which will also be reviewed at monthly meetings.

Rapid response teams to handle all diseases targeted by VDCP have been established at district level. At sub-district level, mechanisms have also been established to mobilise community action groups to assist in case finding and implementation of control measures.

Whenever the need arises, the centre assists the districts by providing technical guidance and in implementing response activities. The centre also supervises and monitors activities carried out at district and sub-district level. Assistance provided by the centre includes financial and human resources.

5.4 Malaria diagnosis

Malaria diagnosis is primarily based on quality assured microscopy and RDTs. Quality assurance of microscopy is done on a regular basis. WHO pre-qualified RDTs are procured to ensure quality. There is regular assessment and training of personnel on malaria diagnosis.

Nested PCR is performed on all positive cases for species identification; a dried blood sample is taken from all positive cases for this purpose.

Access to diagnosis in healthcare centres/hospitals is available 24/7. Any RDT positives are complemented with microscopy for confirmation of the diagnosis.

5.5 Case management

Malaria diagnosis and treatment is provided free-of-charge (to all including foreigners) as per the national treatment guidelines (Ministry of Health, 2024b). Clinical staff interviewed in endemic districts are well aware of the guidelines (although not so in non-endemic districts). Doctors had easy access to a mobile application which contained treatment protocols. Antimalarial medicines are available in all PHC level healthcare centres and above. IV artesunate for treatment of severe cases is available in reference hospitals.

All cases are mandatorily hospitalized for treatment completion (except foreigners who choose to go back to their home countries). All diagnosed cases (including foreigners who stay in Bhutan and those who wish to travel back to their home country) are given the full course of treatment as per national treatment guidelines. Compliance for radical cure is ensured through DOTs.

5.6 Antimalarial drug procurement system

WHO-prequalified antimalarial drugs are procured by the programme. All drug procurements are inventorised in the web-based inventory system and procurement (eBMSIS) requirements are generated by the system. Funding for procurement of antimalarial drugs was obtained from the Royal Government of Bhutan and other donor agencies; currently funding is solely provided by the Royal Government of Bhutan. The purchasing, distribution and stock management is done by VDCP.

5.7 Vector control and entomological surveillance

Vector control remains a key strategy in malaria control and response in prevention of re-establishment phase. In Bhutan, LLINs and IRS are the main vector control strategies used depending on the receptivity of the area; in addition, other methods such as environmental modification and larval control are used in limited settings.

Guidelines for use of LLINs and IRS have been established for the elimination setting. As the programme transits into the prevention of re-establishment phase, these guidelines will be reviewed and updated targeting high-risk areas such that vector control activities will be targeted optimally. As malaria transmission prevalent across the border is a major threat to prevention of re-establishment of malaria in Bhutan, routine vector control will remain a main strategy for PoR along the border. In addition, vector control using LLINs and IRS will be used as a major strategy as part of response to imported and introduced malaria cases.

The choice of insecticides used for vector control will be guided by results of insecticide resistance monitoring that will be conducted in 8 ecological settings. Strategies for use of insecticides for vector control will be guided by vector control guidelines that have been developed based on WHO recommendations. Vector control guidelines will be reviewed and updated as necessary.

As there is a dearth of expertise in carrying out insecticide resistance monitoring, training programmes will be conducted for personnel through collaborations with academic institutions such as the KGUMSB.

5.7.1 Strengthening entomological surveillance

Currently, there are eight sentinel sites for monitoring insecticide resistance which will need to be continued and further strengthened to generate evidence on insecticide resistance patterns for informed decision-making by the programme. Entomological knowledge is key to stratification and identification of transmission risk areas; targeting and selecting appropriate vector control interventions; and monitoring their impact on vector populations. Currently, monthly entomological surveillance is conducted in potential/low risk and high-risk areas by malaria technicians within their catchment areas. However, the monitoring site is not specified as such and it is very difficult to monitor the trend of vector density.

A review of entomological surveillance will be undertaken. Robust entomological surveillance will be strategically conducted, particularly in areas identified as having potential/low risk or high-risk for malaria transmission. This surveillance will be conducted at a few sentinel sites (at least 4) in different ecological settings for trend observation and as part of case investigation; vector species, density, behaviour, and insecticide susceptibility profiles using standard techniques will be monitored and all data will be integrated into the MIS to inform adaptive vector control strategies and prevent re-establishment of malaria. In addition, vector susceptibility tests to inform decisions on use of vector control methods in case of an outbreak/epidemic would be carried out. Entomological surveillance will be integrated with other vector borne disease control programmes to optimize services. A plan to conduct integrated vector surveillance will be made at village (*gewog/chewog*) level.

Training on entomology and use of entomological findings in prevention of re-establishment will be provided to Malaria Technicians. The VDCP has already developed a curriculum for such a training programme (this is further expanded under capacity building). The training module will include updating knowledge on vector bionomics through comprehensive vector studies and xenomonitoring, use of the most optimal vector control and surveillance methods according to disease risk, e.g. adult traps, aspirators; aedes pupal productivity surveys, monitoring ITN durability; and combining ITN/IRS with unrelated modes of action. Vector surveillance data will be digitized.

There is a shortage of essential equipment for entomological surveillance activities. For Anopheline surveillance only aspirators are currently used. Integrated entomological surveillance activities require procurement of CDC light traps, cattle-baited traps, mechanical aspirators etc which will be procured. In addition, spray machines, bioassay tests and insecticide susceptibility tests for insecticide resistance monitoring will be procured. WHO pre-qualified pyrethroids for LLINs, temephos for larval control and insecticides for IRS based on susceptibility tests will be procured.

All staff will be trained on how to use new equipment and conduct integrated entomological surveillance.

5.7.2 Insecticide resistance monitoring

Insecticide resistance monitoring will be conducted in 8 sites. VDCP staff will be oriented on sound pesticide management practices. A central repair/maintenance facility will be established. An IVM/IRM plan within the context of the WHO Global Vector Control Response strategy will be developed and implemented (World Health Organization, 2017).

5.8 Traveller's health

Chemoprophylaxis for high-risk populations is a widely debated subject in malaria elimination and prevention of re-establishment phases. Chemoprophylaxis has benefits in specific contexts as in the case of protecting Bhutanese armed forces personnel serving in UN peace-keeping missions in malaria endemic countries such as in Africa and preventing re-establishment of malaria in the country on their return.

Chemoprophylaxis is not likely to have much of an impact in preventing malaria infections in armed forces personnel stationed in outposts along the Indian border as there is perennial transmission on the Indian side of the border. With contiguous villages along the border with unregulated migration across the border, it will be difficult to develop a strategy for chemoprophylaxis; the performance of the health system in preventing onward transmission of malaria in Bhutan even during an outbreak of malaria on the Indian side in 2024 and the high number of imported cases reported in Bhutan in the same year demonstrates the resilience of the Bhutanese health system.

Discussions on developing a policy on chemoprophylaxis for high-risk travellers will be initiated. A suitable policy will be developed depending on the affordability and feasibility of conducting such a programme with the evolving malaria situation in the country and in neighbouring India.

5.9 Public health education

Community awareness has been waning over the years with the reduction in the number of reported malaria cases. As a result, people are less vigilant about malaria and do not follow and comply with advice given to residents in potential/low and high-risk areas. CAGs at local government levels have been trying to motivate communities to be more vigilant.

It is proposed that activities of CAGs in informing communities of the risk of acquiring malaria and its further spread in the country will be strengthened especially in potential/low and high-risk areas especially during the transmission season in the summer months. Areas such as seeking early healthcare if fever develops, revealing travel history to a malaria endemic region, complying with the use of LLINs and other human-vector contact preventive measures, supporting control and response activities and elimination of vector breeding sites. A compendium of country-specific activities to be carried out and a manual including educational material in the local language to be used will be developed within the first 2 years of this planned cycle. It is proposed that this activity will be supported by the Royal Government of Bhutan and other donor agencies.

At points of entry, immigrants are provided with health education material emphasising that there is no indigenous transmission of malaria in Bhutan, actions that should be taken if persons get fever, the importance of seeking healthcare and complying with treatment.

5.10 Intersectoral and multisectoral collaboration

Intersectoral and multisectoral collaboration will be strengthened building on the links already established through the Technical Advisory committee for Malaria Elimination. Malaria elimination and malaria-free certification is a national priority which has full governmental support and backing.

5.11 Cross-border coordination and collaboration

Already established cross-border collaboration efforts will be further strengthened during this NSP cycle with the facilitation of international agencies such as the WHO. In addition to regular exchange of WhatsApp messages between officials across the borders, site visits, similar to the one organized in 2025, will be organized annually. Teams from across the border will meet at least twice a year to discuss the following:

- Malaria situation in the along the border;
- Agreement to provide diagnostic and treatment facilities to citizens of both countries free-of-charge;
- Mechanisms to track malaria cases and investigate cases across the border to prevent onward transmission;
- Ensure regular exchange of real time information;
- Control measures applied;
- Challenges faced;
- Potential areas of collaboration; and
- Synchronized actions.

Funding to formalize this process will be sought from GFATM and other international donors.

5.12 Monitoring and evaluation of the plan to prevent re-establishment of transmission

An M&E framework and plan for prevention of re-establishment of malaria in Bhutan has been developed separately. Indicators and their frequency of reporting have been identified. The M&E plan needs to be costed.

5.13 GMC Preparedness Plan for PoR of Malaria

To mitigate the risk of malaria re-establishment associated with large-scale development activities and increased population movement, a range of preventive and preparedness measures will be implemented. These include strengthened health screening at points of entry and exit, mandatory screening of migrant workers and other incoming populations from malaria-endemic areas, and enhanced surveillance systems for the early detection and rapid response to imported malaria cases.

In addition, efforts will be made to strengthen health insurance coverage and access to healthcare services for migrant populations. A centralized system for monitoring and managing migrant workers will be established to facilitate effective tracking, screening, and follow-up. Operational measures will also be implemented to minimize the risk of importing malaria parasites and vectors through population movement, transportation networks, and development-related activities. These interventions will contribute to sustaining Bhutan's malaria-free status and preventing the re-establishment of local transmission.

6.0 Budget for prevention of re-establishment of malaria

The activities to be included in the national strategic plan for the prevention of re-establishment of malaria in Bhutan 2026 – 2030 have been identified and costed. The estimated budget for the 5-year period (2026 – 2030) is US $ 8 173 055, approximately a little over US $ 1.5 million a year. The estimated budget for the proposed M&E plan is US $ 1 158 910, approximately 14% of the total malaria budget, a substantial proportion, which will ensure that the programme is adequately monitored and the activities will be implemented as envisaged in a timely manner.

Bhutan is currently being funded by a GFATM grant awarded to the Ministry of Health of the Royal Government of Bhutan that was initiated in 2024 and is active till June 2027. The allocated amount for malaria for this period was US $ 1 373 076 under allocation funding request; a sum of US $ 461 705 has been requested under prioritized above allocation request.

In addition to funding from the GFATM, the malaria programme received funding from other donor agencies as well some of which were drastically reduced while others were withdrawn altogether. There were also budget restrictions imposed on funds disbursed by The Global Fund. The RGOB was quick to respond and commit alternate sources of funds through the Bhutan Health Trust Fund which will ensure continuity of PoR activities in the coming years.

The integration of the malaria programme with other vector-borne diseases under the broad umbrella of the VDCP ensures proper coordination of activities, optimizing of services and adding value to money.

Maintaining low indigenous malaria incidence rates for a long time and finally eliminating indigenous malaria transmission, despite having a porous land border with an Indian state in which malaria is prevalent, with dedicated political commitment and providing resources needed for prevention of re-establishment of malaria, Bhutan has demonstrated adequate evidence to be certified as malaria-free by WHO.

7 Conclusions

Bhutan has achieved remarkable success in its journey towards malaria elimination. Guided by the national development philosophy of Gross National Happiness, which emphasizes the well-being, happiness, and best possible health of all citizens, the country has invested consistently in strengthening its public health system and combating malaria. Since the establishment of the National Malaria Eradication Programme in 1964, Bhutan has progressively reduced malaria transmission through sustained investments in surveillance, vector control, diagnosis, treatment, and community engagement. Indigenous malaria transmission was interrupted in 2021, and Bhutan has maintained zero indigenous malaria cases since 2021 despite sharing a porous border with malaria-endemic areas of India. Equally significant, Bhutan has reported zero malaria deaths since 2018, demonstrating the effectiveness of its health services and its commitment to protecting the health and well-being of its people.

A major strength of Bhutan's health system is its comprehensive approach to malaria surveillance, case detection, and case management. Malaria diagnosis is available throughout the primary health-care network through quality-assured microscopy and rapid diagnostic tests, supported by passive, proactive, and reactive case detection in accordance with national guidelines. Every confirmed case receives prompt treatment based on national protocols, while referral hospitals maintain capacity for management of severe malaria. Surveillance remains the cornerstone of prevention of re-establishment activities, with rapid reporting, case investigation, classification, and response mechanisms fully integrated into the health system. Continuous training, competency assessments, and supportive supervision help maintain the skills of malaria workers and clinicians, ensuring readiness despite the rarity of malaria cases.

Quality assurance underpins all aspects of Bhutan's malaria programme. WHO-prequalified diagnostics, medicines, insecticides, and vector-control products are procured and monitored through robust supply-chain systems. Regular proficiency assessments, refresher training, and international microscopy accreditation supported by WHO and regional partners ensure consistently high standards of diagnosis and surveillance. Entomological surveillance and insecticide resistance monitoring guide evidence-based vector-control interventions, including indoor residual spraying and long-lasting insecticidal nets. Community action groups, health education initiatives, and an online inventory management system further strengthen programme performance and help sustain vigilance among communities and health workers alike.

Bhutan has demonstrated both the capacity and commitment required to prevent the re-establishment of malaria following certification. The National Strategic Plan for Prevention of Re-establishment of Malaria 2026 – 2030 provides a clear framework to sustain surveillance, maintain rapid response capacity, strengthen cross-border collaboration, and address remaining challenges. While importation of malaria from neighbouring Indian states will continue to pose a risk, Bhutan has already shown its ability to maintain zero indigenous transmission even during major outbreaks across the border. The development of Gelephu Mindfulness City offers an unprecedented opportunity to strengthen disease prevention through modern urban planning, improved housing and environmental management, enhanced health services, and advanced surveillance systems in the district that reports the highest number of imported and introduced cases. With the overall direction of progress and development in the overall health system and in the country, Bhutan will

be able to maintain its efforts in the prevention of re-establishment of malaria through dedicated funding mechanisms.

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