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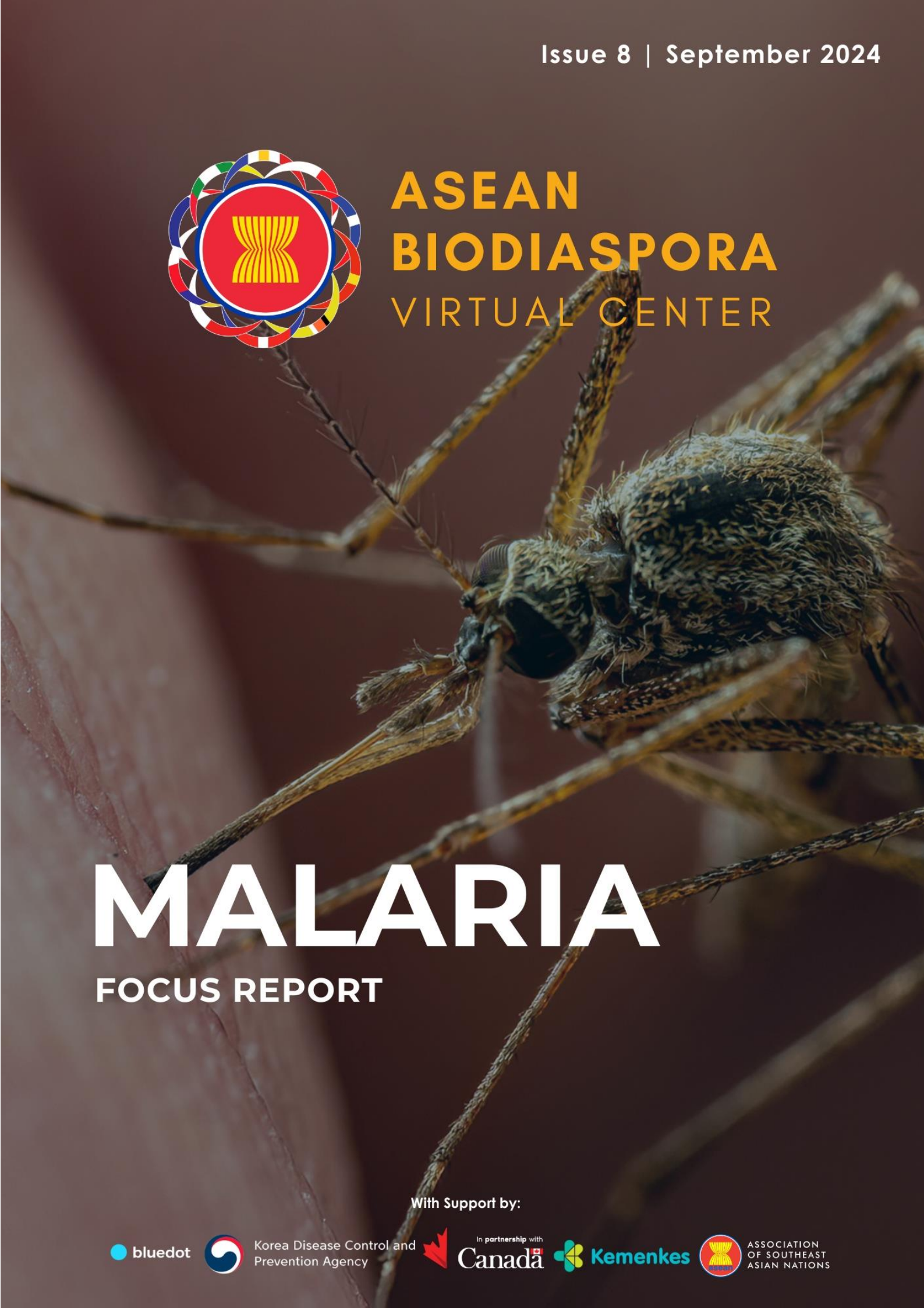
ASEAN BIODIASPORA VIRTUAL CENTER



MALARIA

FOCUS REPORT

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Korea Disease Control and Prevention Agency

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ASSOCIATION OF SOUTHEAST ASIAN NATIONS

ASEAN BIODIASPORA VIRTUAL CENTER

Editorial

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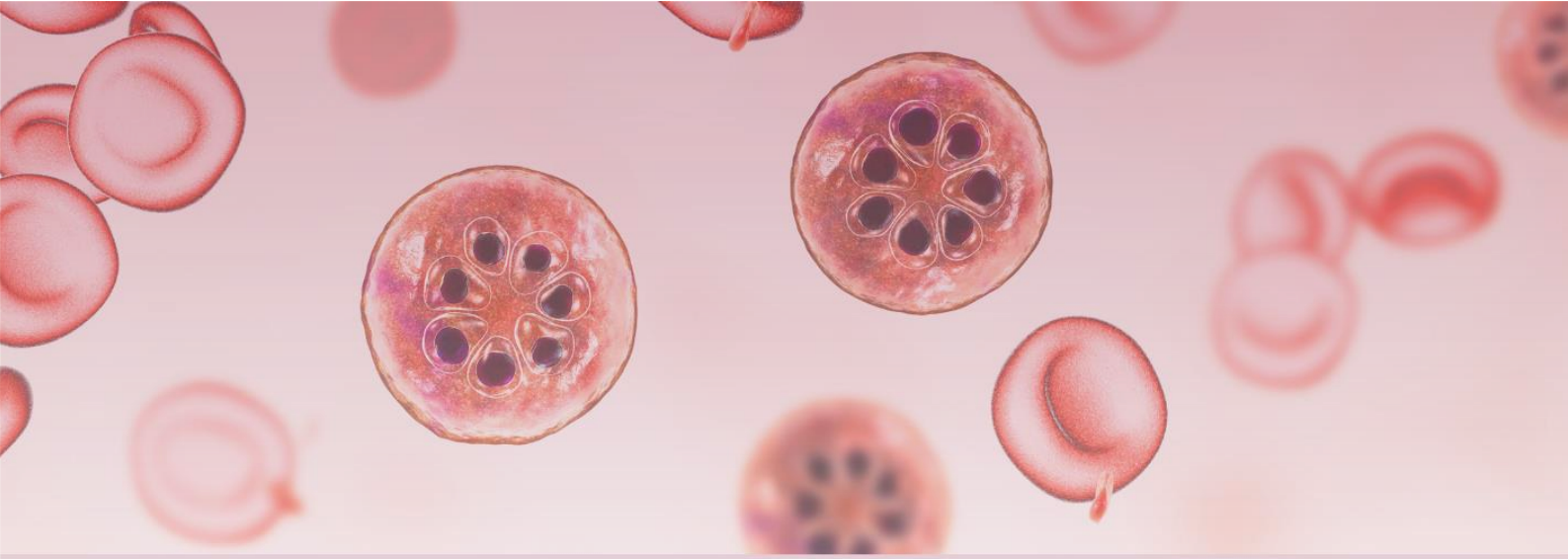


1 Introduction

Malaria, a vector-borne disease caused by ***Plasmodium*** **parasites**, has been a persistent threat to global public health for centuries. While primarily transmitted by ***Anopheles*** **mosquitoes**, the disease has demonstrated significant variability in its epidemiology, resulting in sporadic outbreaks and persistent endemicity in various regions.

This report aims to provide a comprehensive overview of malaria, focusing on its parasitology, epidemiology, pathogenesis, clinical manifestations, diagnostic challenges, and control strategies. It also explores the implications of malaria outbreaks, including the potential risks to human health and public health systems. By integrating current knowledge and highlighting key research gaps, this study seeks to inform ongoing efforts to mitigate the impact of malaria and enhance preparedness for future outbreaks.

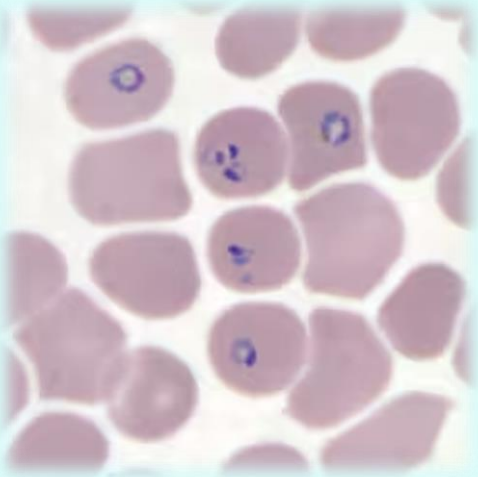
2 Methods

This report employed a comprehensive literature review methodology to investigate the landscape of malaria in the ASEAN region. Relevant data was sourced from established databases including PubMed, Embase, and Scopus, using a combination of keywords related to malaria and the ASEAN region. In addition, real-time information on disease burden, case definitions, preventive measures, and policy strategies was gathered from official reports and news articles detailing cases of malaria. This multipronged approach facilitated a thorough examination of current trends, patterns, and challenges in malaria management within the ASEAN region.

3 Case Definition and Clinical Features

Case Definition

Malaria is a life-threatening disease caused by the infection of red blood cells with protozoan parasites of the genus *Plasmodium* that are transmitted to people through the bites of infected female *Anopheles* mosquitoes (WHO, 2023). This infectious disease predominantly affects tropical and subtropical regions, where the environmental conditions favour the breeding of these mosquitoes. Malaria is caused by a parasite and is not spread from person-to-person, presenting a unique public health challenge. However, blood transfusion and contaminated needles may also transmit malaria.



There are five known Plasmodium parasite species causing malaria: *P. falciparum*, *P. vivax*, *P. malariae*, *P. ovale*, and *P. knowlesi*. According to the World Health Organization (WHO), *P. falciparum* and *P. vivax* pose the greatest threat. *P. falciparum* is the deadliest malaria parasite and the most prevalent on the African continent. *P. vivax* is the dominant malaria parasite in most countries outside of sub-Saharan Africa.

Figure 1 Rings of *P. falciparum* in a thin blood smear.
Source : https://www.cdc.gov/dpdx/malaria/index.html

Malaria presents with non-specific signs and symptoms, primarily indicated by fever or a history of fever. These symptoms can range from mild to life-threatening. Mild symptoms include fever, chills, and headache, while severe symptoms encompass fatigue, confusion, seizures, and difficulty breathing. Infants, children under 5 years, pregnant women, travellers, and people with HIV or AIDS are at higher risk of severe infection. No combination of signs or symptoms reliably distinguishes malaria from other causes of fever, making clinical diagnosis alone unreliable and often leading to overtreatment. Therefore, it is crucial to consider other possible causes of fever to determine if alternative or additional treatment is needed.

Vector and Transmission

Malaria is transmitted to humans through the bite of an infected female *Anopheles* mosquito (WHO, 2024b). The disease is not contagious and cannot spread from person-to-person. The risk of infection varies depending on the location and is affected by seasonality and mosquito species in the area; in tropical places, the risk is higher during the rainy season. About 40 of the 400 species of *Anopheles* mosquitoes known to carry malaria virus.

Most *Anopheles* mosquitoes are active at dusk, dawn, or night, making bed nets effective in preventing malaria (WHO, 2024b). Some mosquitoes prefer to feed and rest indoors, while others do so outdoors. Evidence suggests that the widespread use of bed nets and indoor residual spraying has led to changes in the biting and resting behaviour of the major malaria vectors (Ferreira, et al., 2017).

Clinical Diagnostic

Malaria diagnosis aims to accurately identify true cases, to ensure the rational use of antimalarial medicines. All suspected cases of malaria should be confirmed by parasite detection methods such as high-quality microscopy or rapid diagnostic tests (WHO, 2021). Both public and private health services should have the capacity to confirm diagnoses before initiating antimalarial treatment. Ensuring proper diagnostic testing helps treat non-malarial febrile diseases more successfully, decreases the improper use of first-line artemisinin-based medications, and enhances case tracking for surveillance. Although improvements in vector management have not kept along with diagnostic tests, improving diagnosis and treatment could reduce malaria morbidity and mortality. For *P. vivax,* safe and efficient therapy needs both glucose-6-phosphate dehydrogenase (G6PD) testing and parasite detection; point-of-care G6PD testing will soon be integrated into medical treatment.

In endemic areas, malaria should be suspected in patients with a history of fever or a temperature ≥ 37.5 °C with no other noticeable causes. In high-transmission settings, such as many parts of sub-Saharan Africa and Oceania, malaria should also be suspected in children with palmar pallor or haemoglobin concentration <8 g/dL. In areas with very low malaria incidence, parasitological diagnosis of all fever cases can be costly. Prior to testing medical personnel should identify individuals who may have been exposed to malaria, such as those who have recently travelled unprotected to endemic areas. In all settings, suspected malaria should be confirmed with a parasitological test, which is easy to interpret and does not require special equipment. WHO recommends selecting rapid diagnostic tests (RDTs) based on criteria from the WHO Malaria RDT Product Testing programme.

Clinical Presentation

After a person is bitten by a female *Anopheles* mosquito carrying malaria parasites, there is a waiting period before they become sick. This waiting period, called the incubation period, can last from 7 to 30 days. People infected with *P. falciparum* usually experience symptoms sooner than those infected with *P. malariae* (CDC, 2024). Malaria parasite infection can cause a wide range of symptoms, ranging from absent or very mild symptoms to severe forms and even death. The disease can be classified as uncomplicated and severe (complicated) (Bartoloni, et.al., 2012; CDC, 2024). With early detection and appropriate treatment, malaria is generally curable.

1. **Uncomplicated Malaria**

   Uncomplicated malaria is defined as having a symptomatic infection with malaria parasites but no signs of vital organs being affected (Taylor-Robinson, et al, 2007). Initially, patients commonly present with mild combinations of fever, chills, sweats, headaches, nausea or vomiting, body aches, and general malaise (CDC, 2024).

   In regions where malaria cases are rare, symptoms might be mistaken for influenza, a cold, or other common infections (CDC, 2024). Contrary, in malaria-endemic areas, residents often self-diagnose based on recognized symptoms and may treat themselves without seeking formal diagnosis. Physical findings may include elevated temperatures, perspiration, weakness, enlarged spleen, mild jaundice, enlargement of liver, and increased respiratory rate.

   Uncomplicated malaria may progress to severe malaria, become chronic, or resolve with effective treatment or the development of improved immunity. Thus, the result depends on the immune system and timely provision of an effective treatment. In the absence of effective treatment, people with no or low immunity are at increased risk of developing severe malaria resulting in high morbidity and mortality.

2. **Severe Malaria**

   Malaria progresses to severe condition when infections are followed by serious organ failures or abnormalities in the patient's blood or metabolism, commonly as a result of diagnostic and treatment delays. Severe malaria is primarily caused by *P. falciparum*, although *P. vivax* and *P. knowlesi* can also cause severe cases (Cox Singh et al, 2008; Kantele and Jokiranta, 2011). Delayed treatment of uncomplicated malaria caused by these parasites increases the risk of severe disease (CDC, 2024). Prompt recognition and treatment of uncomplicated malaria is essential. However, in some cases, particularly in children, severe *P. falciparum* malaria can progress so rapidly that early treatment is not always possible.

Table 1 - Signs and Symptoms of Severe Malaria

Signs and symptoms of severe malaria	*Falciparum*	*vivax*	*knowlesi*
1. Impaired consciousness: A Glasgow coma score <11 in adults or a Blantyre coma score <3 in children	✓	✓	✓
2. Prostration: Generalized weakness so that the person is unable to sit, stand or walk without assistance	✓	✓	✓
3. Multiple convulsions: More than two episodes within 24 hours	✓	✓	✓
4. Acidosis: A base deficit of >8 mEq/L or, if not available, a plasma bicarbonate level of <15 mmol/L or venous plasma lactate ≥5 mmol/L. Severe acidosis manifests clinically as respiratory distress (rapid, deep, laboured breathing).	✓	✓	✓
5. Hypoglycaemia: Blood or plasma glucose <2.2 mmol/L (<40 mg/dL)	✓	✓	✓
6. Severe malarial anaemia: Haemoglobin concentration ≤5 g/dL or a haematocrit of ≤15% in children <12 years of age (<7 g/dL and <20%, respectively, in adults) with a parasite count >10,000/µL.	✓	✓	✓
7. Renal impairment: Plasma or serum creatinine >265 µmol/L (3 mg/dL) or blood urea >20 mmol/L	✓	✓	✓
8. Pulmonary oedema: Radiologically confirmed or oxygen saturation < 92% on room air with a respiratory rate >30/min, often with chest indrawing and crepitations on auscultation.	✓	✓	✓
9. Significant bleeding: Including recurrent or prolonged bleeding from the nose, gums or venepuncture sites; haematemesis or melaena	✓	✓	✓
10. Shock a. Compensated shock: capillary refill ≥3 seconds or temperature gradient on leg (mid to proximal limb) without hypotension. b. Decompensated shock: systolic blood pressure <70 mmHg in children or <80 mmHg in adults with impaired perfusion (cool peripheries or prolonged capillary refill).	✓	✓	✓
11. Hyperparasitaemia: parasite density >400,000/µL	✓		
12. hyperparasitaemia: parasite density >100,000/µL			✓
13. Jaundice: Plasma or serum bilirubin >50 µmol/L (3 mg/dL) with a parasite count >100,000/µL	✓	✓	
14. Jaundice with a parasite count > 20,000/µL.			✓

P. vivax and *P. ovale* infections can cause relapses months or years after recovery due to dormant liver-stage parasites (hypnozoites) reactivating and causing new malaria episodes (CDC, 2024). Treatment to prevent relapses should follow the initial illness.

4 Epidemiology

Global Situation of Malaria

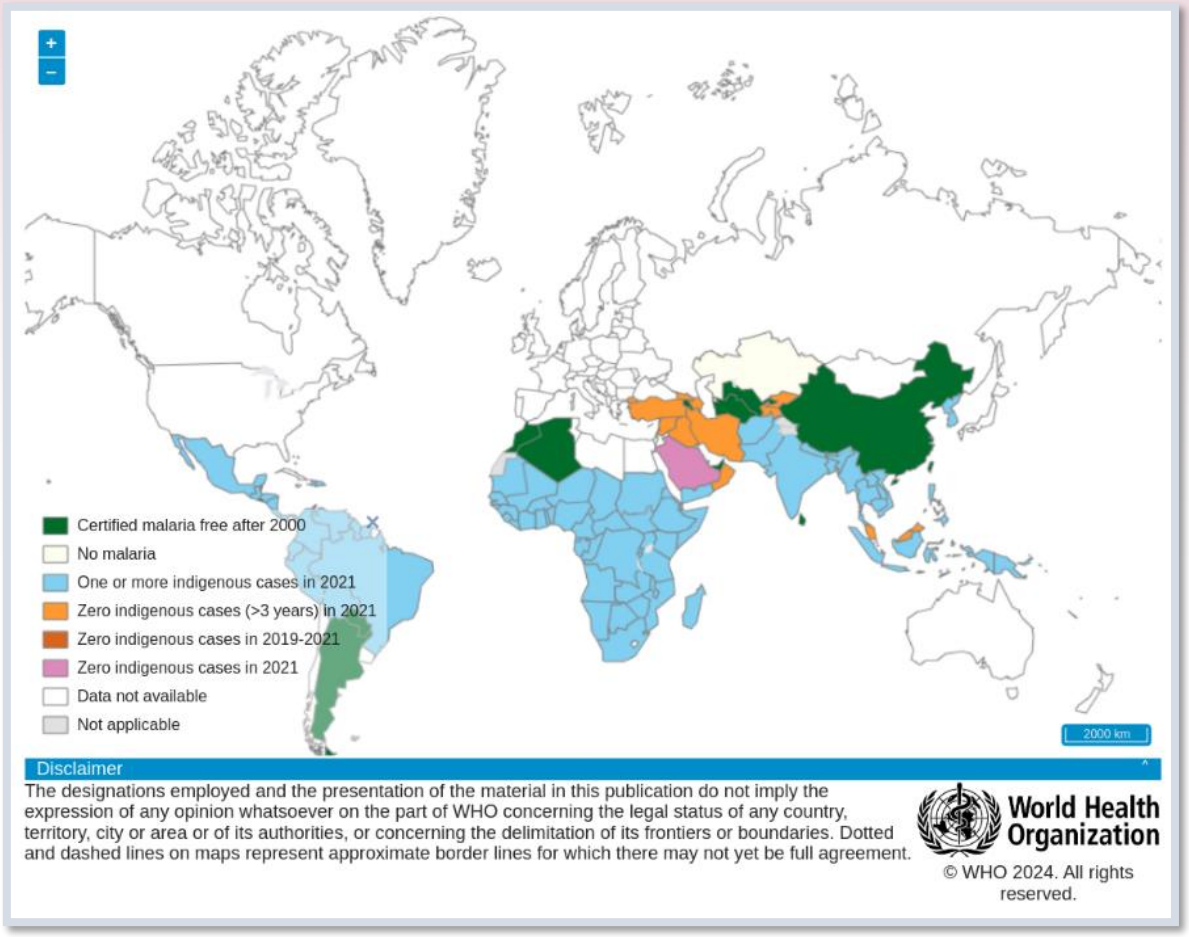


Figure 2. Status of Indigenous Malaria Cases
(Source: WHO (https://www.who.int/data/gho/data/indicators/indicator-details/GHO/number-of-indigenous-malaria-cases), last accessed August 2, 2024)

Between 2000 to 2010, malaria cases decreased from 243 million to 116 million across 108 endemic countries (WHO, 2023). However, cases have been rising since 2015, with the largest annual increase of 16 million occurring between 2021 and 2022 (WHO, 2023). Most of the recent increase happened in the WHO African Region. From 2021 to 2022, notable increases occurred in Pakistan (+2.1 million), Ethiopia (+1.3 million), Nigeria (+1.3 million), Uganda (+597,000), and Papua New Guinea (+423,000). In Nigeria, the increase was due to population growth, while incidence rates rose in the other four countries: fivefold in Pakistan, 32% in Ethiopia and Papua New Guinea, and 2% in Uganda. In 2022, the World Health Organization (WHO) reported over 200 million cases globally in 85 malaria-endemic countries, an increase of 7.6 million compared to 2021.

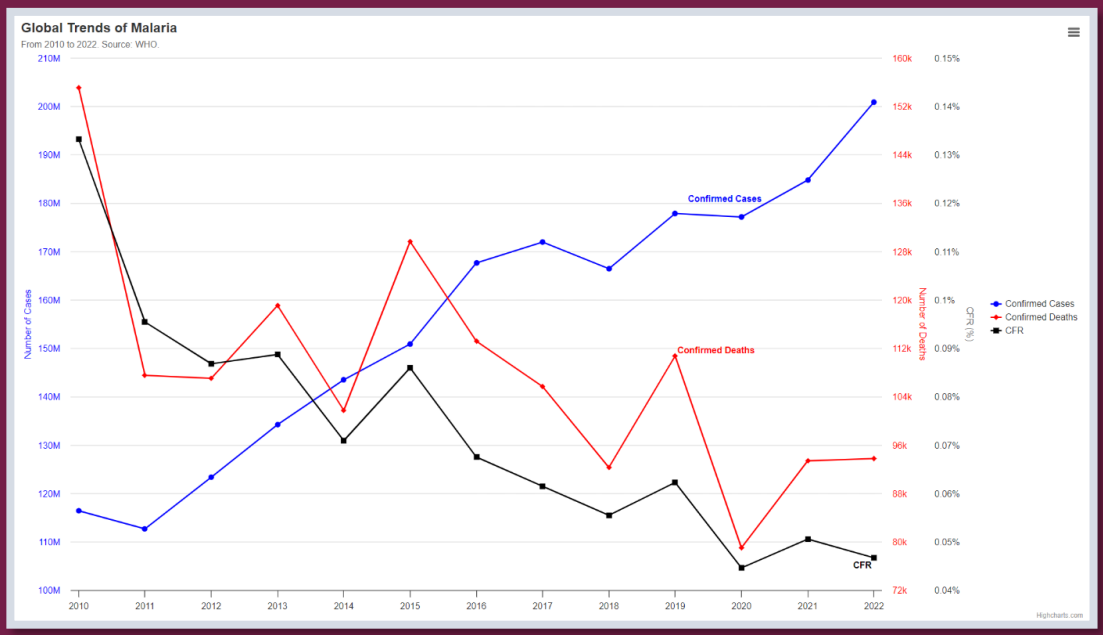


Figure 3. Global Trends of Malaria from 2010 to 2022
(Source: WHO (https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023)

The WHO recorded more than 116 million cases of malaria worldwide in 2010 (WHO, 2023). After a decline in 2011, the number of cases continues to rise, reaching 200,834,692 cases in 2022. With improved medical services, the number of deaths declined from over 115 thousand in 2010 to 93,750 in 2022, *with some variations.* As a result, the case fatality rate continues to decline, from 0.12% in 2010 to only 0.05% in 2022.

Situation of Malaria in the ASEAN Region

As published in the World Malaria Report 2023, the WHO recorded a total of 1,081,662 malaria cases in the ASEAN region in 2010 (WHO, 2023). After reaching at 1,094,071 cases in 2012, the region reported a continuous decline as low as 340,674 cases in 2020. However, it returned following that year, reaching 624,122 cases by 2022. The number of deaths decreased sharply from 1,539 in 2010 (CFR=0.14%) to only 53 in 2020 (CFR=0.02%), then increased slightly to 102 in 2022 (CFR=0.02%).

Figure 4. Regional situation of Malaria from 2010 to 2022
(Source: WHO (https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023)

Malaria-free countries in the ASEAN Region

WHO certifies malaria elimination when a country interrupts local transmission of all human malaria parasites for at least three years and has a surveillance system in place to prevent re-establishment. Singapore achieved this status in 1982, followed by Brunei Darussalam in 1987. (WHO, 2024a).

Brunei Darussalam

Brunei Darussalam continues its efforts to prevent the reintroduction of malaria despite its malaria-free status (Brunei Darussalam MoH, 2024). Vector Control, Entomology, and Malaria Vigilant Units conduct epidemiological surveillance, spraying, and chemoprophylaxis for travelers and military personnel. All foreign workers are required to undergo malaria screening before departure and upon arrival. The Malaria Vigilance Unit is responsible for preventing the reintroduction of the disease throughout the country. The preventive measures carried out are:

1. Malaria blood sampling for people in vulnerable areas and border regions;
2. Regular ultra-low volume (ULV) aerial spraying for chemical control in indigenous villages along the border;
3. Thorough investigation of all reported malaria cases; and
4. Malaria prophylaxis and health education for international travelers and those venturing into deep jungle areas.

Singapore

Malaria was the leading vector-borne disease in Singapore until the early 20th century, causing high morbidity and mortality (Goh, 1983). However, through improved epidemiological measures and vector control strategies, Singapore achieved WHO-certified malaria-free status in November 1982. From 2013 to 2017, Singapore reported 290 malaria cases, 99.7% of which were imported, with 49% involving work permit or employment pass holders (Zhang, et al, 2019).

Malaria endemic countries in ASEAN

Despite efforts to eliminate malaria, several ASEAN countries - Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand, and Vietnam - continue to struggle with ongoing indigenous transmission.

Cambodia

Malaria control in Cambodia began in the 1950s with indoor residual spraying and case management, reducing prevalence from 60% to 1% by the early 1960s. However, civil war halted the efforts (MoH Cambodia, 2021). In 1984, the Ministry of Health established the National Center for Parasitology, Entomology, and Malaria Control.

In 2011, the National Strategy for Malaria Elimination aimed to eliminate malaria by 2025, with strategies outlined in the Cambodia Malaria Elimination Action Framework 2016-2020 (MoH Cambodia, 2021). Three objectives to achieve the target of malaria elimination in 2025 are:

1. Early detection and effective and safe treatment of 100% of cases and effective personal protection for at least 90% of the high-risk population;
2. Intensify focal interventions to interrupt transmission in endemic areas at highest risk (including mobile populations/forest dwellers) to achieve API <0.1 for *P. falciparum* by 2020 and all species by 2025; and
   Investigate, address, document and follow up on 100% of cases and transmission hotspots to halt the spread and prevent resurgence.

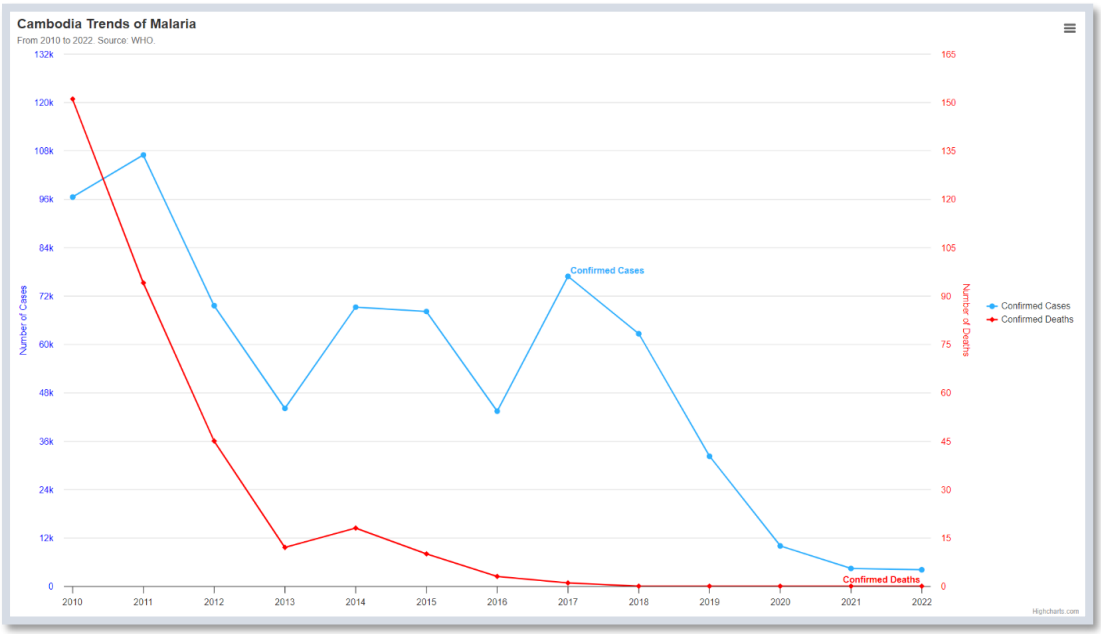


Figure 5. Trend of Malaria in Cambodia (2010-2022)

As shown in Figure 5, confirmed cases of malaria have decreased from 2011 to 2022, although there were fluctuations from 2013 to 2017 (WHO, 2023).

Indonesia

Under the National Action Plan for Malaria Elimination 2020-2024, Indonesia aims to achieve malaria-free status in 75% of the country by the end of 2024 (Indonesian MoH, 2023). Key strategies include:

1. Ensuring universal access to malaria case management and prevention
2. Transforming malaria surveillance for elimination
3. Improving enabling environment through behavior change communication (BCC) and community engagement.
4. Strengthening health system to ensure malaria elimination.

Indonesia's malaria control efforts focus on distributing long-lasting insecticide-treated nets (LLINs) and indoor residual spraying (IRS) in high-risk.

Cross-border cooperation with Timor-Leste is also critical. Indonesia and Timor-Leste have signed a Memorandum of Understanding for 2022-2026 and a Cross-Border Action Plan to eliminate malaria in border areas, including all six Timorese regencies. The MoU will enable the exchange of epidemiological, entomological, and surveillance data between the two countries.

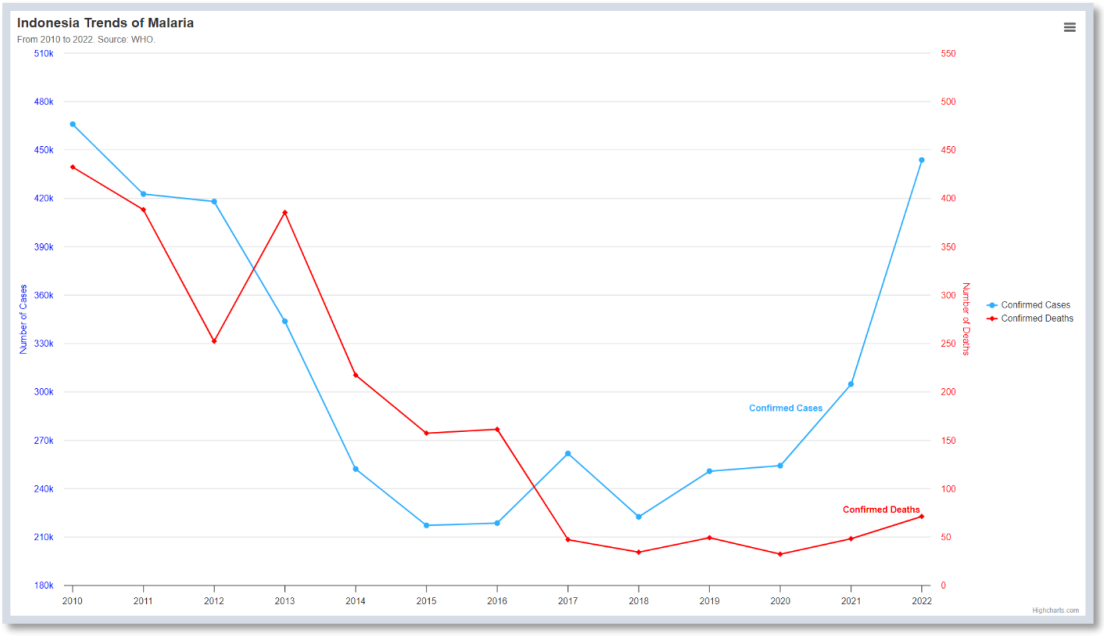


Figure 6. Trend of Malaria in Indonesia (2010-2022)

Figure 6 shows that confirmed malaria cases in Indonesia decreased steadily from 2010 to 2015 but saw an increase from 2016 to 2022 (WHO, 2023).

Lao People's Democratic Republic

Malaria control in Lao PDR began in 1953 with DDT use and a formal program established in 1954 (Lao PDR MoH, 2020). Insecticide-treated nets (ITNs) were introduced in 1988 and expanded nationwide with international support. Early 2000s efforts focused on ITNs and artemisinin-based combination therapies (ACTs), resulting in reduction of malaria burden in the northern and central provinces. However, high malaria rates persisted in the southern provinces due to forest-dwelling, agricultural practices, and migrant populations.

To achieve a malaria-free country by 2030, the country is committed to working with all relevant line ministries, neighboring countries, and partners to empower the health system and communities to eliminate malaria and prevent its resurgence (Lao PDR MOH, 2020). The strategic goals are:

1. Eliminate *Plasmodium falciparum* malaria throughout the country and eliminate all types of malaria in the 13 northern provinces in 2025
2. Eliminate malaria throughout the country by 2030

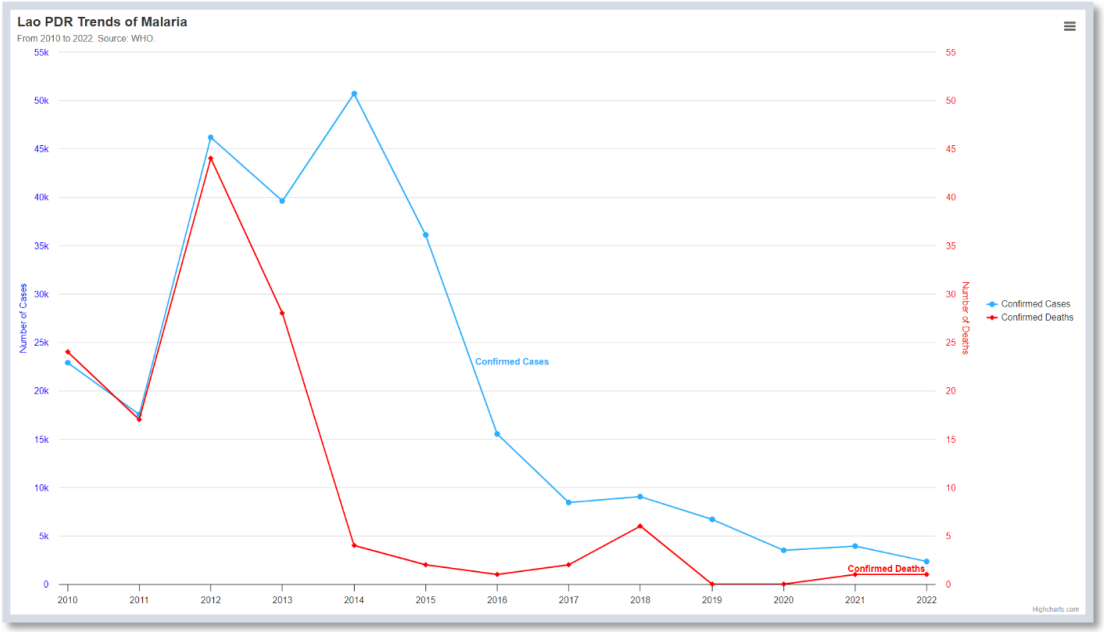


Figure 7. Trend of Malaria in Lao PDR (2010-2022)

As shown in Figure 7, the number of malaria cases in Lao PDR decreased significantly from 2014 to 2022, as did the number of deaths, indicating an overall improvement in malaria control (WHO, 2023).

Malaysia

Malaria vector control in Malaysia is carried out by health workers from the MOH to ensure optimal coverage and effectiveness (MoH Malaysia, 2022). MOH provides insecticides and ITNs/LLINs, while private companies and non-MOH agencies can purchase MOH-approved insecticides, spraying equipment, and ITNs/LLINs. Health volunteers help disseminate information on vector control to increase public acceptance. Larval source management and space spraying are also used as complementary interventions.

Space spraying is the release of fast-acting insecticides into the air as a fog or fine droplets as a method of reducing the number of adult mosquitoes indoors and outdoors. The goal of indoor residual spraying is to kill all infective adult *Anopheles* mosquitoes immediately to prevent further local transmission.

Figure 8. Trend of Malaria in Malaysia (2010-2022)

Malaysia experienced a notable decline in malaria cases from 2010 to 2016, followed by an increase and peak in 2018, then a decline through 2020. (WHO, 2023). Mortality cases decreased from 2010 to 2016 and fluctuated, trending upward until 2022 (Figure 8).

Myanmar

Following an increase in malaria cases in 2021, the National Malaria Control Program (NMCP) initiated discussions with partners in January 2022 to develop a strategy and action plan (U.S. President's Malaria Initiative, 2023). The goal was to intensify efforts in high-burden townships and accelerate malaria elimination activities within the country's operational context. The Malaria Intensification and Acceleration Plan aimed to:

1. strengthen coordination and ensure universal coverage of malaria interventions;
2. enable flexible decision-making for a more agile and aggressive response to changing epidemiology; and
3. implement targeted, responsive interventions to reduce risk and deplete parasite reservoirs in high-risk populations.

Myanmar recorded 420,808 malaria cases in 2010, which peaked in 2012 before declining significantly through 2019. However, cases increased again, reaching 157,538 in 2022, highlighting ongoing challenges in malaria control (WHO, 2023).

Figure 9. Trend of Malaria in Myanmar (2010-2022)

Philippines

To achieve malaria-free status by 2030, the Philippines developed a Malaria Transition, Elimination, and Sustainability Plan (MTESP) from 2023 to 2028 (Philippines DOH, 2023). To meet the MTESP 2023-2028 goal, all 82 provinces must be declared malaria-free by 2030. The three goals of the plan are: (1) eliminate malaria in Palawan by 2026; (2) declare 81 provinces malaria-free by 2027 and Palawan by 2029; and (3) maintain malaria-free status in all provinces. Four strategic pillars to achieve the goals are:

1. **Strategic Pillar 1: Universal Access to Services:** Ensure reliable diagnosis, highly effective and appropriate treatment, and preventive measures.
2. **Strategic Pillar 2: Governance and Leadership:** Strengthen the capacity at all levels to manage and implement Malaria interventions in all provinces.
3. **Strategic Pillar 3: Financing:** Secure government and non-government financing to sustain Malaria elimination efforts at all levels in all provinces.
4. **Strategic Pillar 4: Quality Assurance of Services:** Ensure quality services, timely detection, and evidence-based malaria elimination.

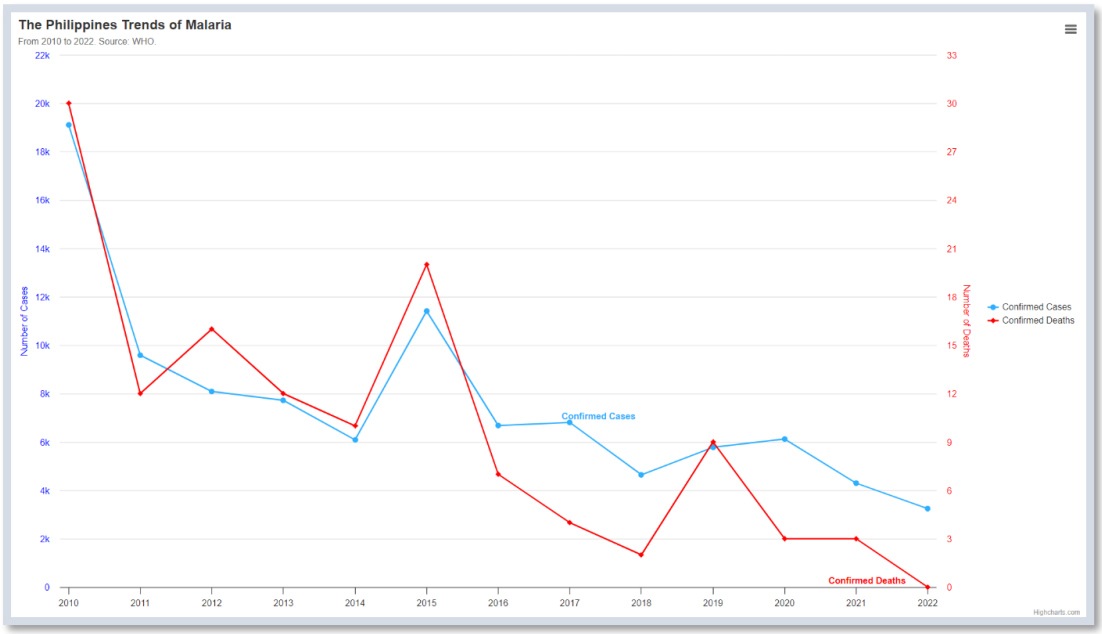


Figure 10. Trend of Malaria in the Philippines (2010-2022)

The Philippines has consistently reported fewer malaria cases than other countries in the region (WHO, 2023). From 19,102 cases in 2010, the number of cases decreased over the years, reaching 3,245 cases in 2022. This trend demonstrates successful efforts to reduce malaria incidence over the decade.

Thailand

Thailand's National Malaria Elimination Strategy (2017–2026) aims to eliminate all indigenous malaria cases by 2024 and includes the following objectives (U.S. President's Malaria Initiative, 2023a):

1. Reduce malaria morbidity to 0.009/1,000 population by 2024
2. Reduce malaria mortality to 0.003/100,000 population by 2024
3. Eliminate malaria transmission in all districts by 2024
4. Prevent reintroduction of transmission in malaria-free areas

Four strategies are used to achieve the elimination goal and objectives:

1. Scale-up malaria elimination activities in Thailand;
2. Develop technologies, innovations, interventions, and models appropriate for malaria elimination;
3. Develop partnerships among national and international stakeholders to enable malaria elimination; and
4. Empower communities to take an active role in malaria prevention.

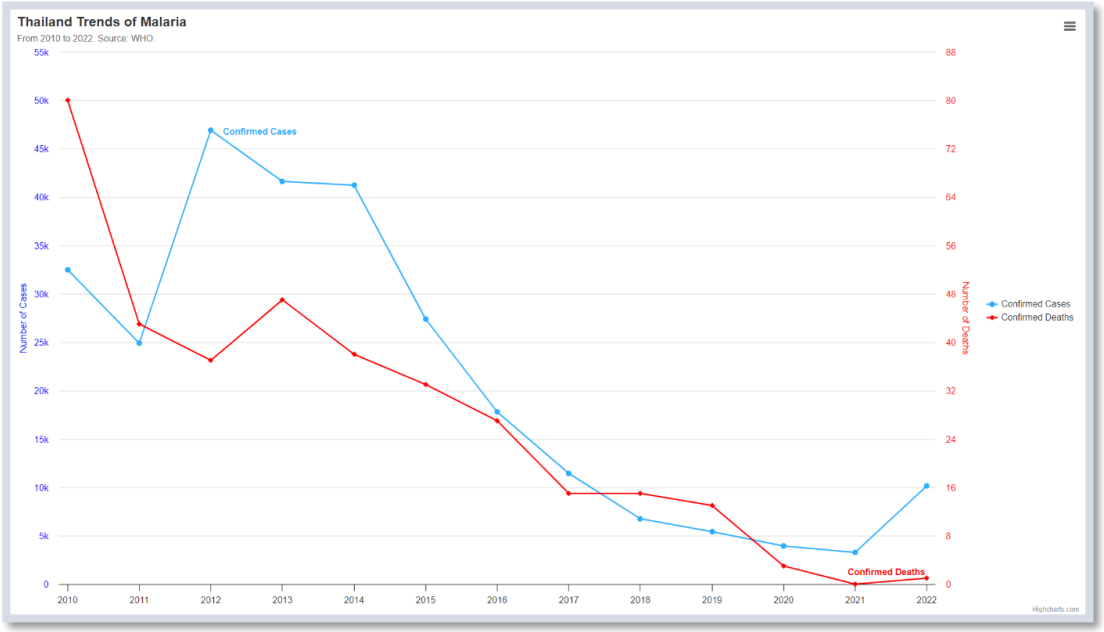


Figure 11. Trend of Malaria in Thailand (2010-2022)

Thailand has seen a fluctuating but generally declining trend in malaria cases since 2012. There was a slight increase in 2022 to 10,154 cases. However, the overall trend suggests improved malaria control (WHO, 2023)

Viet Nam

Through the National Strategic Plan for Malaria 2021-2025, Vietnam aims to build on past successes of the National Institute of Malariology, Parasitology and Entomology (NIMPE), address current challenges in the southern and central provinces, and initiate elimination efforts in remaining transmission areas. The 2025 targets are:

1. Reduce malaria morbidity rate to below 0.015/1,000 population
2. Reduce malaria mortality rate to below 0.002/100,000 population
3. Eliminate malaria from 55 provinces
4. Ensure no malaria outbreaks

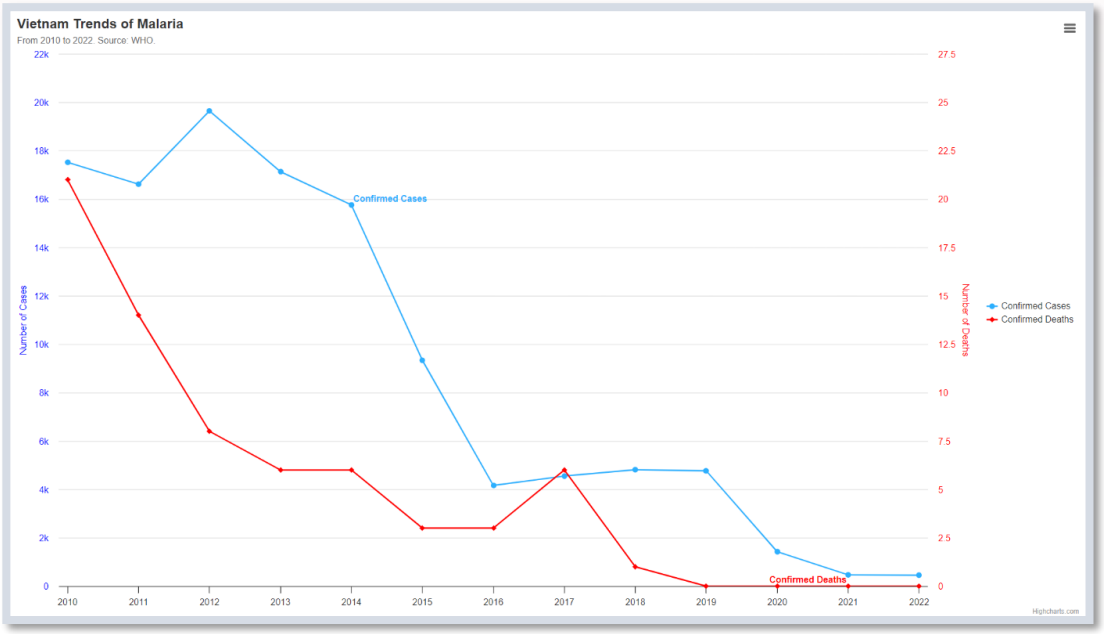


Figure 12. Trend of Malaria in Viet Nam (2010-2022)

Malaria cases in Viet Nam decreased gradually from 19,636 in 2012 to 455 in 2022 (WHO, 2023). The steady decline over the years indicates effective malaria control strategies, although vigilance is needed to maintain these gains.

5 Case Management and Prevention

Case Management

In the event of a suspected zoonotic influenza case, the relevant health authorities should be promptly notified and appropriately initiated clinical case management. This should include but not be limited to, testing, triage system, a clinical assessment for disease severity classification, an assessment of risk factors for severe disease, and isolation and treatment (for example, with antivirals and supportive care). Proper management of influenza patients is crucial to prevent severe illness and fatalities (WHO, 2007).

Treatment

Universal access to WHO-recommended antimalarials is essential to prevent uncomplicated malaria from progressing to severe illness and death. After diagnostic confirmation, all patients with uncomplicated or severe malaria should receive the recommended treatment (WHO, 2021).

1. **Uncomplicated malaria**

   The clinical objectives of treating uncomplicated malaria are to rapidly cure the infection and prevent its progression to severe disease and encompassing the complete elimination of all parasites from the body. The public health objectives of treatment are to prevent the transmission of infection and the spread of antimalarial drug resistance. These are the most common medicines for malaria (WHO, 2023a):

   a. Artemisinin-based combination therapy medicines are the most effective treatment for *P. falciparum* malaria.
   b. Chloroquine is recommended for treatment of infection with the *P. vivax* parasite only in places where it is still sensitive to this medicine.
   c. Primaquine should be added to the main treatment to prevent relapses of infection with the *P. vivax* and *P. ovale* parasites.

   Most of medications are taken as pill, For injectable medications, some people may need to visit a hospital or health center.

2. **Severe malaria**

   Severe malaria is defined by clinical or laboratory evidence of vital organ dysfunction. Severe malaria is most commonly caused by infection with *Plasmodium falciparum*, although *P. vivax* and *P. knowlesi* can also cause severe disease (WHO, 2021).

   a. Give artesunate intravenously for at least 24 hours in the treatment of severe malaria, even if the patient is able to tolerate oral drugs earlier. Then give a full course

of the oral artemisinin-based combination therapy that is effective in the area where the infection was acquired.

b. If artesunate is not available give intramuscular artemether or intravenous quinine. If intravenous administration is not possible, administer intramuscularly into the anterior thigh.
c. Suppository formulations of artemisinin and its derivatives should be given as pre-referral treatment where parenteral therapy with artesunate or quinine is not possible or feasible.

Prevention

Malaria poses a threat to about half of the world's population. Pregnant women and small children are especially susceptible to contracting malaria and dying from the disease in locations with high malaria transmission rates. Global malaria burden has significantly decreased since 2000 as a result of increased availability to WHO-recommended malaria prevention methods and techniques, such as efficient vector control and the use of preventive chemotherapy (WHO, 2021).

Figure 13. An officer conducts fogging, a preventive measures to eradicate mosquito larvae

1. Vector control

WHO published recommendations to cover two new classes of dual ingredient insecticide-treated mosquito nets (ITNs) with different modes of action (WHO, 2023):

a. pyrethroid-chlorfenapyr nets, which combine a pyrethroid and a pyrrole insecticide to enhance the killing effect of the net; and
b. pyrethroid-pyriproxyfen nets, which combine a pyrethroid with an insect growth regulator that disrupts mosquito growth and reproduction.

WHO strongly recommends using pyrethroid-chlorfenapyr ITNs over pyrethroid-only nets in areas with pyrethroid-resistant mosquitoes due to their increased effectiveness in killing malaria vectors. The recommendation highlights that pyrethroid-chlorfenapyr ITNs, compared to pyrethroid-only or pyrethroid- piperonyl butoxide (PBO) nets, have a stronger killing effect on pyrethroid-resistant malaria vectors and are expected to have a greater impact on malaria control.

WHO issued conditional recommendations for using pyrethroid-chlorfenapyr ITNs over pyrethroid-PBO nets and pyrethroid-pyriproxyfen nets over pyrethroid-only nets in areas with pyrethroid resistance. The recommendation for pyrethroid-chlorfenapyr ITNs is based on a single trial in the WHO African Region, showing a better balance of effects compared to pyrethroid-PBO nets. The recommendation for pyrethroid-pyriproxyfen nets considers cost-effectiveness concerns, as higher costs may limit coverage and equity. The following are the conditional recommendations:

a. Interventions recommended for large-scale deployment
b. Co-deploying ITNs and IRS
c. Supplementary interventions

Figure 14. Insecticide-Treated nets (ITNs) and Indoor Residual Spraying (IRS)
Source: https://www.who.int/multi-media/details/control-of-disease-vectors-with-indoor-residual-spraying

2. Chemoprophylactic and Chemoprevention

Chemoprophylaxis and chemoprevention are strategies that use antimalarial medications to prevent malaria infections. **Chemoprevention** involves administering full doses of antimalarials at scheduled intervals to treat existing infections and prevent new ones, while **chemoprophylaxis** typically uses sub-therapeutic doses to prevent infections, mainly for non-immune travellers to endemic regions.

The WHO recommends several chemoprevention strategies, including:

a. Intermittent Preventive Treatment in Pregnancy (IPTp): Pregnant women in endemic areas should receive antimalarial treatment at specific intervals, ideally starting in the second trimester with sulfadoxine-pyrimethamine (SP) to improve pregnancy outcomes.
b. Perennial Malaria Chemoprevention (PMC): In areas with moderate to high malaria transmission, children at risk can receive antimalarials at defined intervals. SP is commonly used, and new data support its use in children aged 12 to 24 months.

c. Seasonal Malaria Chemoprevention (SMC): Children in seasonal transmission areas should receive antimalarials during peak seasons. Monthly doses of SP combined with amodiaquine are effective and cost-efficient.
d. Intermittent Preventive Treatment in School-aged Children (IPTsc): School-aged children in endemic settings can receive preventive treatment at scheduled times, although evidence on its effectiveness is limited.
e. Post-discharge Malaria Chemoprevention (PDMC): Children discharged from hospitals after severe anemia should receive antimalarial treatment to reduce readmission rates.

Each of these strategies is based on the premise that effective treatment can clear existing infections and prevent new ones, tailored to local epidemiology and healthcare delivery capabilities.

6 Policy and Recommendation

WHO Strategy to Eliminate Malaria

To accelerate progress towards malaria elimination, WHO urges affected countries and the global community to maximize the use of current life-saving interventions (WHO, 2021). Until new interventions become available, it is essential to adopt and scale up the strategies recommended by WHO to increase their effectiveness and prevent deaths. The strategy is based on three main pillars and two supporting elements to guide the global effort.

Table 2 - WHO malaria elimination strategic framework

Pillar 1. Ensure access to malaria prevention, diagnosis and treatment as part of universal health coverage
The WHO-recommended package of interventions: vector control, chemoprevention, diagnostic testing and treatment. The goal is equitable access without financial hardship and a reduction in case incidence and mortality. Implement prevention and treatment strategies based on local malaria data, transmission intensity and vulnerability.
Pillar 2. Accelerate efforts towards elimination and attainment of malaria-free status
This includes interruption of transmission, active case detection and, where appropriate, use of drugs to reduce the infectious reservoir. Address insecticide resistance and P. vivax hypnozoite reservoirs with innovative solutions.
Pillar 3. Transform malaria surveillance into a key intervention
Effective health management information systems should be in place to direct resources, detect outbreaks and evaluate interventions. Tailor interventions to local transmission levels and link them to detected infections, especially at very low transmission levels.
Supporting element 1. Harnessing innovation and expanding research
This includes understanding parasites and vectors and developing better diagnostics, drugs, vector control methods and vaccines. Implementation research and addressing contextual vulnerabilities are critical to optimize impact and ensure equitable distribution of resources.
Supporting element 2. Strengthening the enabling environment for more sustainable and equitable results
Political commitment and resources are essential to ensure access to interventions without financial hardship. Services should be safe, effective and equitably delivered. Collaboration with other sectors and a holistic approach, aligned with the SDGs, are needed to address the broader determinants of malaria.

Through the global technical strategy (GTS) for malaria, WHO provides high-level guidance and vision for the malaria response. The GTS sets ambitious targets for 2030, along with interim milestones to track progress. The WHO Global Malaria Programme is responsible for coordinating the Organization's global efforts to control and eliminate malaria and supporting Member States in implementing the GTS (WHO, 2023).

Table 3 - Goals, Milestones and Targets for the Global technical strategy for malaria 2016-2030

Goals	Milestones		Targets
	2020	2025	2030
1. Reduce malaria mortality rates globally compared with 2015	At least 40%	At least 75%	At least 90%
2. Reduce malaria case incidence globally compared with 2015	At least 40%	At least 75%	At least 90%
3. Eliminate malaria from countries in which malaria was transmitted in 2025	At least 10 countries	At least 20 countries	At least 35 countries
4. Prevent re-establishment of malaria in all countries that are malaria-free	Re-establishment prevented	Re-establishment prevented	Re-establishment prevented

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