



# Malaria Risk and Control

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Malaria is a vector-borne infectious disease caused by infection with plasmodium. It is a life-threatening infectious disease in many tropical and subtropical countries. There are four types of malaria parasites: *Plasmodium vivax*, *Plasmodium falciparum*, *Plasmodium malariae*, and *Plasmodium ovale*. *Plasmodium falciparum* is the most harmful to human, followed by *Plasmodium vivax*. It has been found that human beings can be infected by *Plasmodium knowlesi*, which causes malaria in monkeys. Malaria is one of the Class B infectious diseases listed in the “Infectious Diseases Control Law of the People’s Republic of China.”

## 9.1 Epidemic Situation in “Belt and Road” Countries

According to WHO statistics, there were 219 million malaria cases in the world in 2017 [1]. It was 217 million in 2016 and 239 million in 2010. Most malaria cases (200 million, or 92%) were reported in the WHO Africa region, 5% in the WHO Southeast Asia region, and 2% in the WHO Eastern Mediterranean Region. The malaria burden of 15 sub-Saharan African countries and India accounted for nearly 80% of the global total. Almost half of the malaria cases in the world were reported from five countries: Nigeria (25%), the Democratic Republic of Congo (11%), Mozambique (5%), India (4%), and Uganda (4%). From 2010 to 2017, the incidence rate of malaria worldwide dropped by 18%, from 72 cases per 1000 people to 59 per 1000 people, and in Southeast Asia, it was 59%, from 17 cases per 1000 people in 2010 to 7 per 1000 people in 2017. *Plasmodium falciparum* is the predominant malaria parasite in the WHO African Region, responsible for 99.7% of the

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total estimated malaria cases in 2017. It is estimated that 435,000 people died of malaria in 2017. By comparison, the number of malaria deaths was 607,000 in 2010 and 451,000 in 2016. The deaths due to malaria in the WHO Africa region accounted for 93% of all malaria deaths in 2017. Globally, elimination networks are expanding and more and more countries are moving toward zero cases of indigenous malaria. A total of 46 countries reported less than 10,000 cases of malaria in 2017, up from 37 countries in 2010 and 44 countries in 2016. The number of countries with less than 100 cases of indigenous malaria increased from 15 in 2010 to 24 in 2016 and 26 in 2017 [1].

Global malaria response faces many challenges. The immediate obstacle to achieving the 2020 and 2025 milestones of the global malaria technology strategy is the continued increase of malaria cases in countries with the highest disease burden and inadequate international and domestic funding. At the same time, parasite resistance to antimalarial drugs and the continued emergence of mosquito resistance to insecticides also pose a threat to progress.

Malaria prevalence varies widely in “Belt and Road” countries. Despite the continuous decline in reported cases in Ethiopia in recent years, the epidemic is still severe in countries with high malaria burden. According to WHO, Ethiopia reported 7,701,107 malaria cases and 14,514 deaths in 2010 and 2,666,954 malaria cases and 5369 deaths in 2017. The malaria epidemic in Kenya is serious. From 2010 to 2017, 2,845,913; 2,930,265; 3,252,855; 3,754,660; 3,916,556; 3,455,175; 345,217; and 3,520,384 malaria cases were reported respectively, with 11,375; 11,834; 11,990; 12,111; 12,242; 12,331; 12,419; and 12,467 deaths reported respectively. There are countries with no risk of malaria, such as Israel (eliminated), the United Arab Emirates (eliminated), Sri Lanka (eliminated), Kazakhstan, Turkmenistan, etc. Although Malaria burden still exists in many countries in Asia and Oceania, the goal of eliminating malaria by 2030 has been set along with the decline of incidence of malaria in recent years. Malaria is still prevalent in Afghanistan, Pakistan, and India in South Asia.

Malaria was recorded as early as 3000 years ago in China. Before the establishment of the People’s Republic of China, malaria was widespread and seriously threatened people’s life in China. When new China was first founded, malaria was prevalent in its 1829 (70–80% of the total then) counties. The number of malaria cases was the highest among all kinds of reported infectious diseases [2]. After years of large-scale control, the incidence rate of malaria in China has dropped dramatically. The geographical distribution of four species of *Plasmodium* has also changed greatly. *Plasmodium ovale* has not been found. Since 1970, only cases of *Plasmodium falciparum* and *Plasmodium vivax* have been reported. Since 1995, indigenous cases of *Plasmodium falciparum* have only been reported in some areas of Yunnan Province and Hainan Province. From 2011 to 2017, 22,305 malaria cases were reported in China, including 105 deaths and 1334 indigenous cases. Most of malaria cases were falciparum malaria (13,377 cases) and vivax malaria (6850 cases) (90.7%). It was the first time that zero indigenous malaria case was reported in 2017 in China, with only 7 cases of deaths reported. The importation from 75 origin countries showed an increasing annual trend from Africa but a decreasing trend from Southeast Asia from 2011 to 2017 [5–12].

## 9.2 Malaria Risk and Control Principles

### 9.2.1 Malaria Risk

Despite the progress of global malaria control, the achievements are still fragile and unevenly distributed. Malaria is still prevalent in all six WHO regions. The malaria burden in the African region is the heaviest, accounting for an estimated 90% of global malaria deaths. Millions of malaria patients around the world are still unable to benefit from malaria prevention and treatment, and most cases and deaths from malaria are not registered or reported. Considering the growth of the world population size by 2030, it is expected that more people will live in countries at risk of malaria. Moreover, it is important to keep vigilance and ensure timely detection of disease transmission areas and rapid control, experience learned from malaria-free countries and those having made significant progress in reducing malaria incidence rate and mortality in the past 10 years [3].

### 9.2.2 Prevention and Control Principles and Measures

WHO proposed three core principles and two supporting elements in the global malaria technology strategy 2016–2030 [3].

The core principles are to:

- Ensure universal access to malaria prevention, diagnosis, and treatment.  
The core interventions package, including quality-assured vector control, chemoprevention, and diagnostic testing and treatment, can dramatically reduce morbidity and mortality. Universal access of populations at risk to interventions should be given top priority in national malaria programs. According to the stratification of malaria, prevention strategies should be based on vector control and universal diagnosis, and prompt and effective treatment of malaria should be available at health facilities of community level.
- Accelerate efforts toward the elimination of malaria.  
Reduce further transmission of new infections in defined geographical areas. In addition to core interventions, active case detection and investigation within foci should be part of malaria surveillance and response.
- Transform malaria surveillance into a core intervention.  
Strengthening malaria surveillance is crucial for accelerating progress. Effective health management and information system should be established. Surveillance should trigger locally tailored response to every detected infection at very low levels of malaria transmission.

The supporting elements are:

- Harnessing innovation and expanding research.  
Successful innovation in product development and service delivery will make a major contribution to accelerating progress. Implementation research will be

fundamental to optimize impact and cost-effectiveness and facilitate rapid uptake in populations at risk.

- Strengthening the enabling environment.

Strong political commitment, robust financing, and increased multisectoral collaboration are key factors for further progress. To optimize national malaria responses, an overall strengthening of health systems and improvement in the enabling environment is also crucial.

Malaria case-based surveillance was established to strengthen malaria surveillance after the implementation of malaria elimination in China. The strategy of malaria elimination in China was updated as follows in 2019 [4].

- Continue to implement the strategy of “tracking, counting, and cutting off sources” and the work specification of “1-3-7” focusing on eliminating infectious sources and blocking transmission.
- In Yunnan and other border areas with a high risk of malaria transmission, strengthening grass-roots malaria monitoring capacity, multi-sectoral cooperation, cross-border joint prevention and control, and block cross-border transmission of malaria.
- Further strengthening the capacity of malaria monitoring, early warning, and disposal at all levels, enhancing malaria monitoring at the post-elimination and elimination stages, focusing on preventing the risk of retransmission caused by imported malaria, and consolidating the achievements of malaria elimination.

### 9.3 Case Study

#### Control Experience of Malaria Importation in Shanglin County

##### 1. Summary

In 2013, a large number of malaria cases were reported in Shanglin County, Guangxi Zhuang Autonomous Region due to the expulsion of Chinese golden miners by the Ghana government. In the face of the risk of malaria transmission brought by large-scale overseas returnees, Shanglin County launched active and effective malaria control and quick response [13, 14]. Details are as follows.

Since June 2013, the number of imported malaria cases has increased significantly in Guangxi Zhuang Autonomous Region, and in particular, in Shanglin County (Fig. 9.1). Cases reported in Shanglin County were on the rise. From May 1 to August 31, 998 malaria cases were reported in Guangxi, among whom 868, or 87.0%, were reported in Shanglin County. All of them were imported malaria cases, and most were falciparum malaria. As of August 31, all the malaria cases reported in Shanglin County had been imported from Ghana, Africa, except one from Indonesia. Of the 868 reported cases, 825 were falciparum malaria (95.0%), 36 were vivax malaria (4.1%), 2 were ovale malaria (0.2%), 1 was malariae malaria (0.1%), 3 were mixed infection (0.3%), and 1 was not classified (0.1%).

Under the coordination and linkage of departments at all levels of the nation, provinces, cities, counties, townships, and villages, the epidemic response was made timely. Under the unified command and with the support of prevention and control personnel, prevention and control materials, and other favorable conditions, efforts were continuously made to screen overseas returnees, fully complete the treatment work, and effectively implement other prevention and control measures, so as to ensure there were no death cases or second-generation cases in this epidemic, and success in the fight against the outbreak.

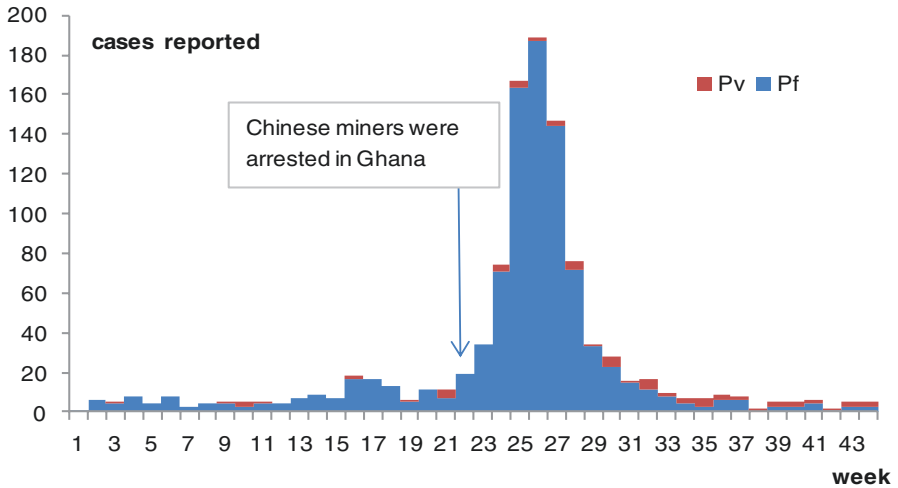
## **2. Prevention and Control Practices**

1. Establish a leading group for malaria control and organize experts to guide and strengthen the leadership. The County's Party Committee and government attached great attention to the establishment of a malaria prevention and control leading group for overall leadership and coordination of the prevention and control work, and to a daily report by each township during the malaria epidemic period. The provincial health department and CDC of the Autonomous Region assigned officers, malaria control experts, and clinician experts for direct handling of the epidemic on the spot and for technical guidance on prevention and control.
2. Set up malaria screening points for timely detection. The County's Party Committee and government mobilized forces from all townships (towns) and villages to carry out a wide range of screening work for overseas workers returning home and strived to achieve 100% malaria screening rate for these people.
3. Establish treatment points for imported malaria and standardize the treatment of cases. Set up a designated treatment unit, and in particular, increase the number of beds and provide a green channel for malaria reception in the outpatient department for the timely in-hospital treatment of malaria patients. Every malaria patient received standard treatment according to the condition.
4. Manage each focus and conduct active case investigation for residents within the foci.
5. Strengthen the monitoring work. Under the guidance of national and provincial experts, continuous mosquito surveillance was carried out. Blood tests and screening of patients with fever were performed in targeted local residents. Meanwhile, promote and mobilize them to screen Plasmodium at local CDCs or hospitals.
6. Carry out extensive publicity activities. Various forms of mass health education were provided.

### 3. Experience

There are many inspirations and references from the management of the epidemic for the treatment of similar imported malaria in the future.

1. Governments at all levels attach great importance to the epidemic, and extensive cooperation within multiple departments and sections is the key. Malaria prevention and control work needs overall organization and mobilization of departments at all levels and requires thorough involvement. Communication and cooperation are required within the Inspection and Quarantine Bureau, Public Security Bureau, and other departments. The investigation of migrant workers and returnees in each village can provide relevant data and information, thus ensuring the orderly and effective handling of the epidemic.
2. The reserve of professional and technical capacity in Guangxi provided the scientific and effective technical guarantee for the response to the epidemic. From 2010 to 2012, more than 4000 malaria prevention professionals and technicians were trained, which improved the sensitivity of medical personnel and related malaria prevention personnel, and ensured timely detection and appropriate treatment of malaria cases. It has reserved sufficient technical capacity for the whole region to deal with the malaria epidemic.
3. Centralized testing, designated hospital treatment, and reference laboratories have ensured high-quality control. In order to ensure the quality of the first-line microscopic examination, the blood examination is required to be carried out at the CDC lab or those above the county level for large-scale epidemics. The technical backbone group of the whole region was transferred to Shanglin County for blood examination, so as to minimize potential infectious sources caused by the false negative.
4. By making full use of various means and methods, for instance, with the support of Women's Federation, Shanglin County improved the awareness of returnees and people in the epidemic area of the harm of malaria and enhanced their compliance in the inspection of Plasmodium. It tried to achieve twice the results with half the effort in the prevention and control of the epidemic.



**Fig. 9.1** Distribution of reported cases of malaria in Shanglin County, Guangxi, from January to November 2013

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