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PREVENTION OF RE-ESTABLISHMENT OF MALARIA: STRATEGIES, CHALLENGES AND FUTURE DIRECTION

APMEN CASE STUDY

ASIA PACIFIC LEADERS MALARIA ALLIANCE
ASIA PACIFIC MALARIA ELIMINATION NETWORK

Contents

ABBREVIATIONS

AMC	Anti Malaria Campaign
APLMA	Asia Pacific Leaders Malaria Alliance
APMEN	Asia Pacific Malaria Elimination Network
IOM	International Organization for Migration
MMP	Mobile Migrant Population
POR	Prevention of Re-establishment
RMO	Regional Malaria Officers
TSG	Technical Support Group
UNHCR	United Nations High Commissioner for Refugees
WHO	World Health Organization

ABOUT APLMA-APMEN

Asia Pacific Leaders Malaria Alliance (APLMA) is an alliance of heads of government committed to achieving a region free from malaria by 2030. APLMA is a distinctive platform facilitating collective regional leadership for malaria elimination and health security.

Asia Pacific Malaria Elimination Network (APMEN) is a network of 22 countries and 54 partner institutions. APMEN facilitates regional and multi-sectoral collaboration around evidence-based practices and fosters innovation. Jointly, APMEN and APLMA act as an 'evidence-to policy' vehicle that links directly to leadership levels across the region.

Prevention of Re-establishment of Malaria


Photo by LightFieldStudios

Malaria remains a significant global health issue which is caused by Plasmodium parasites spread through bites of infected Anopheles mosquitoes. This disease poses a substantial burden on public health systems and affects millions of people worldwide, particularly in tropical and subtropical regions. Despite significant progress in controlling and eliminating malaria in Asia Pacific, achieving regional elimination remains a challenging task. Two countries in the region, Sri Lanka and China, have successfully eliminated malaria, while eight countries under the World Health Organization's (WHO) E-2025 Initiative – namely Bhutan, DPR Korea, Malaysia, Nepal, Republic of Korea, Thailand, Timor-Leste and Vanuatu – are on the brink of elimination.[i]

Obtaining WHO certification for malaria-free status is a momentous achievement for countries after centuries of suffering and decades of relentless efforts to reduce malaria-related morbidity and mortality. However, this certification does not absolve countries of their responsibilities. The persistent threat of re-invasion necessitates ongoing efforts on prevention of re-establishment (POR) of malaria and to sustain the malaria-free status enjoyed in these countries.

To address this issue, the World Health Assembly adopted the WHO 'Global Technical Strategy for Malaria 2016-2030' in 2015, which was then updated and endorsed in 2021. The strategy outlines goals, milestones, and targets to be achieved by 2020, 2025, and 2030, which includes the prevention of malaria re-establishment in all malaria-free countries. As more countries move towards elimination, the number of nations dealing with or preparing for prevention of malaria re-establishment is increasing.[ii]

GLOBAL TECHNICAL STRATEGY AT A GLANCE

Vision - A World Free of Malaria

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 2015	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

Malaria re-establishment refers to the occurrence of locally acquired malaria infections in an area where transmission had been previously stopped. The level of surveillance needed to maintain a malaria-free status principally depends on the ecosystem for malaria transmission, known as receptivity, and the probability of malaria parasites being imported into a country or region, known as vulnerability. Indeed, re-establishment can occur due to various factors, such as population movement and migration, discontinuation of control measures and surveillance responses, weak vigilance systems and lack of awareness about malaria, inadequate cooperation among countries, existing reservoirs of infection, drug resistance and vector adaptation, as well as changes in the environment and climate factors.

WHO Malaria Terminology (2021 update)[iii]

Transmission, re-establishment of

Renewed presence of a measurable incidence of locally acquired malaria infection due to repeated cycles of mosquito-borne infections in an area in which transmission had been interrupted.

Note: A minimum indication of possible re-establishment of transmission would be the occurrence of three or more indigenous malaria cases of the same species per year in the same focus, for 3 consecutive years.

To effectively manage and prevent the re-establishment of local malaria transmission, a comprehensive approach with multiple components is essential. This approach includes notifiable malaria reporting, early detection of all cases, and prompt effective treatment by both public and private sectors. Additionally, proper investigation of all cases, sustained entomological surveillance systems, strengthened political commitments, a multisectoral approach and improved international cooperation are crucial elements.

By addressing the factors contributing to malaria re-establishment, highlighting successful strategies and best practices of countries, discussing challenges, and providing valuable insights for future directions, this case study aims to contribute to the ongoing efforts of Asia Pacific countries in sustaining malaria-free areas, preparing for prevention of re-establishment, and reducing the overall regional burden of this devastating disease.

Factors Contributing to Re-establishment of Malaria


Photo by Frans Devriese

Following the elimination of malaria, a continuous prevention of re-establishment programme must be in place until malaria eradication – defined as the complete interruption of all forms of human malaria transmission worldwide – is achieved. The risk of re-establishment is influenced by two key issues: receptivity and vulnerability. Receptivity is determined by the presence and abundance of mosquito vectors and the ecological and climatic conditions that can support malaria transmission. Vulnerability, on the other hand, depends on the importation of parasites through significant human movement across borders and oceans in the region. Both factors can undergo changes over time. For instance, vulnerability may increase with the arrival of people and migrants from areas where malaria is still prevalent. Similarly, receptivity may rise due to developmental projects that create favourable conditions for mosquito vectors and increase human-vector contact.[iii]

Evaluating these two major aspects, the risk of malaria transmission re-establishment in a country is contingent upon a multitude of precipitating factors encompassing ecological, environmental, meteorological, socio-demographic, epidemiological, entomological, and health system-related elements.[iv] Those factors need to be considered for implementing effective strategies to prevent the re-establishment of malaria transmission.

Disruptions or instability in healthcare systems: Political instability, conflict, and natural disasters can disrupt healthcare systems, including national malaria programmes. Weak health infrastructure becomes a burden for disease control, limiting access to malaria prevention, treatment, and surveillance services, leading to disease resurgence.

Inconstant vigilance systems and discontinuation of surveillance: Close monitoring of receptive areas is crucial, and prompt implementation of preventive measures is necessary to prevent transmission. Neglecting surveillance efforts or gaps in notification, reporting, and response may lead to unnoticed outbreaks and further transmission.

Reduced political commitment and limited funding: Malaria elimination heavily relies on continuous political commitment and sufficient funding. When a malaria programme loses priority or experiences reduced funding, essential interventions may be compromised, heightening the risk of re-establishment of the disease.[v]

Inadequate vector control and entomological measures: When mosquito populations are not effectively targeted and managed, they can increase in numbers and spread the malaria parasite more widely. Insufficient use of insecticides and larvicides, coupled with ineffective surveillance and monitoring of mosquito populations, can lead to a resurgence of the disease in areas where malaria was previously under control.

Drug and insecticide resistance: Drug-resistant malaria parasites can evade the effects of standard antimalarial medications, making treatment less effective. Similarly, mosquito vectors that develop resistance to insecticides used for vector control can hinder control and elimination measures. When these factors converge, they create a challenging environment for malaria control, allowing the disease to resurge in previously controlled areas.

Population movement and cross-border migration: Human population movements, such as migration and displacement, can contribute to the spread of malaria. People traveling across borders or regions can unknowingly carry the malaria parasite with them and reintroduce it to areas that were previously malaria-free.

Lack of multisectoral collaboration: To effectively combat malaria, it is crucial for stakeholders from different sectors to unite, share knowledge and resources, and develop comprehensive strategies that address the multifaceted challenges posed by malaria. Without a unified approach, resources and expertise are scattered, leading to inefficiencies in malaria interventions, missed opportunities for innovation, and gaps in information sharing.

Inadequate cooperation among countries: If neighbouring countries do not work together to coordinate surveillance, control efforts, and information sharing, malaria cases can spread across borders unchecked. Disparities in control measures and weak cooperation may lead to pockets of transmission that could eventually spark broader outbreaks.

Lack of awareness and misperceptions: Malaria post-elimination tends to become a forgotten disease and a low priority. This complacency can lead to a decrease in public awareness, deterioration in treatment-seeking behaviour for fever, lower levels of treatment compliance and preventive measures, allowing the disease to spread and re-establish in areas where it was previously eliminated.

Presence of reservoirs of infection: The presence of competent mosquito vectors, such as Anopheles mosquitoes, is a critical factor in malaria transmission. Reservoirs enable malaria-carrying mosquitoes to thrive again, posing a significant public health threat and contributing to the re-establishment of malaria transmission in an area.

Changes in vectorial capacity and susceptibility: Vectorial capacity to transmit the malaria parasite depends on factors like their numbers, lifespan, and feeding habits. Susceptibility of the human population to malaria infection is determined by factors like genetics, immunity, and socioeconomic conditions, which affects the potential for disease spread. Moreover, if mosquitoes are competent vectors for a certain *Plasmodium* species, it increases the risk of malaria re-establishment.

Weakening of immunity: In areas where malaria has been eliminated, the immunity of a population to the disease may decrease over time. This weakened immunity can lead to an increase in susceptible individuals, making the population more vulnerable to malaria infection and potentially resulting in a resurgence of the disease.

Environmental and climate changes: Environmental changes, such as deforestation, urbanisation, and changes in land use can create new breeding sites for mosquitoes or alter mosquito behaviour, increasing the risk of malaria transmission. Climate change influencing temperature and precipitation patterns can disturb the distribution and behaviour of malaria vectors, affecting transmission dynamics of the disease.

Successful Efforts in Preventing Malaria Re-establishment

Photo by The Global Fund

Forty-two countries and one territory have been certified as malaria-free by WHO.[vi] In the Asia Pacific region, Sri Lanka obtained its malaria-free certification in September 2016, while China was certified in June 2021.[vii-viii] The primary objective of these countries' national malaria programmes is to sustain their malaria-free status by preventing both introduced and indigenous cases. Sri Lanka and China have demonstrated successful efforts in preventing the re-establishment of malaria transmission and maintaining their hard-earned malaria-free status. Their experiences below serve as valuable examples for other countries striving to eliminate malaria.

SRI LANKA

Sri Lanka has faced the challenges of malaria for over a century, even experiencing near elimination in 1963 only to be followed by resurgence leading to 600,000 annual malaria cases by the early 1990s which took decades to eliminate. Through the dedication of the Anti Malaria Campaign (AMC) and strong in-country collaborations, Sri Lanka successfully stopped malaria transmission in 2012 and maintained zero malaria cases for over three years, earning the WHO's malaria-free certification in 2016.[ix]

Despite eliminating local transmission, Sri Lanka now faces challenges due to an economic crisis with declining domestic funding and the cessation of Global Fund support in 2022. A new case introduced in 2018, a transfusion-induced malaria incident in 2021, and two malaria cases from contact with an imported case of *Plasmodium falciparum* in December 2021 could potentially contribute to the re-establishment of malaria.[x] Furthermore, recent epidemiological changes, including an urban malaria vector, pose a threat to Sri Lanka's malaria-free status.[xi] To tackle these issues, Sri Lanka has been implementing five core interventions: malaria case management, parasitological surveillance, entomological surveillance, monitoring and evaluation of field activities, and capacity building and advocacy.

The country's successful strategies hinge on well-documented approaches, emphasising robust surveillance and response systems and collaboration across sectors. Crucially, Sri Lanka implements early diagnosis and treatment for rising imported malaria cases.[xii] Sri Lanka's achievement of malaria elimination, despite challenges like a 30-year civil war, serves as a model for other counties. Maintaining these gains and averting re-establishment necessitates consistent investment and unwavering political dedication to the POR programme.[xiii]

Whole-of-government approach

Sri Lanka's successful elimination of malaria can be primarily attributed to political leadership and commitment at the highest levels. Central to their prevention strategy is Sri Lanka's proven 'whole-of-government' framework which entails the seamless integration of various governmental agencies and bodies. Notably the army, navy, air force, and police play instrumental roles in safeguarding the country's malaria-free status. The Army Medical Corps received training in diagnosing, treating, and monitoring malaria patients. The Army supported in conducting vector surveillance in the camps while the navy regularly informs the AMC regarding immigration of refugees and asylum seekers. Their cooperation in surveillance, border control, and response activities acts as a bulwark against potential re-establishment of malaria.

The POR programme is supported by the Technical Support Group (TSG), which was established by the Director General of Health Services to offer evidence-based strategic advice and recommendations to the AMC. Under the chairmanship of the Director General of Health Services, 17 members possessing diverse expertise related to malaria control – including parasitology, epidemiology, pharmacology, sociology and vector control – convene bi-monthly with provisions for additional meetings as needed. The TSG subcommittee, Case Review Committee, conducts independent assessments of reported malaria cases monthly.[xiv] The advisory and advocacy functions provided by the TSG is greatly appreciated by the AMC, just as the commitment of essential members who sustain the continuous flow of assistance, guidance, and technical contributions to prevent re-establishment of malaria.

Additionally, partnerships with international entities like the International Organization for Migration (IOM) and United Nations High Commissioner for Refugees (UNHCR) hold immense significance. These collaborations address the unique challenges posed by migrant workers and asylum seekers, who could inadvertently act as carriers of malaria parasites. Extending the reach of preventive measures to these populations is essential.

The AMC collaborates extensively with the private sector as well, with successful public-private partnership models for malaria elimination initiated by necessity back when the health system was in disarray followingthe 30-year separatist war in Sri Lanka. In 2009, the AMC escalated its malaria surveillance efforts in collaboration with a private sector associate, Tropical and Environmental Diseases and Health Associates Private Limited (TEDHA). Companies operating in the Colombo dockyard and private steel companies linked with the AMC to conduct blood screening of foreign labourers, ensuring a high annual blood examination rate and screening of vulnerable people in receptive areas.[xv] The AMC also provides complimentary quality assurance training for private sector entities which is crucial in upholding Sri Lanka's malaria-free status as one-third of malaria cases are diagnosed in private sector hospitals and laboratories.[xvi]

Comprehensive guidelines and updated policies

Malaria control and elimination interventions were supported by policies and strategic plans, standard operation procedures and guidelines endorsed by the Ministry of Health, Nutrition and Indigenous Medicine. These comprehensive guidelines and updated policies have played a critical role in preventing the re-establishment of malaria in Sri Lanka.

In 2016, the guidelines for 'Malaria Chemotherapy and Patient Management' and 'Scope of Work for Reported Malaria Patients' were renewed. Following this, the 'Revised Guidelines for Malaria Entomological Surveillance in POR Phase' were issued in 2017. In 2019, a series of guidelines were released including 'Malaria Prophylaxis for Travelers: Healthcare Worker's Guide', 'Manual for Parasitological Surveillance to Prevent Malaria Reintroduction in Sri Lanka', 'Procurement Procedure for Essential Antimalarial Drugs and Services for Sri Lanka's Anti-Malaria Campaign', and 'Guidelines for Malaria Entomological Surveillance in POR Phase'. These comprehensive guidelines provide unified strategic direction and best practices to guide policymakers, healthcare and malaria professionals, and other stakeholders.

Sri Lanka have continued to update policies and guidelines for timely adjustments in response to emerging challenges, including Covid-19. These included 'Guidelines for Sample Collection for Malaria Diagnosis during the Covid-19 Pandemic', 'Interim Recommendations for Vector Control and Entomological Surveillance during the Covid-19 Pandemic', 'Parasitological Surveillance Guidelines for Malaria during Covid-19', 'Guidelines for Malaria Prevention in Covid-19 Quarantine Centers', 'Vector Control Guidelines for Preventing Malaria Reintroduction in Sri Lanka', and 'Updated Outbreak Management Guidelines to Prevent Malaria Reintroduction', all released in 2020.[xvii]

In 2023, the 'Guidelines for the Management and Treatment of Malaria Patients' was published. These updated guidelines and policies standardised approaches, procedures, and practices across different sectors and regions to ensure all involved parties are on the same page. Comprehensive guidelines provide a roadmap for sustained success by ensuring that strategies are implemented consistently over time, reducing the risk of resurgence.

Vigilant parasitological surveillance system

Since achieving malaria elimination in 2012, Sri Lanka's AMC has diligently maintained a robust POR programme. The containment of an introduced case in 2018 underscores Sri Lanka's successful surveillance mechanisms. Parasitological surveillance within the nation encompasses both screening of individuals seeking medical care as well as village-level screening on selected populations based on assessed risk of vulnerability and receptivity. Sri Lanka screens all suspected fever patients with a travel history to malaria endemic countries. Moreover, individuals donating blood are screened for malaria before transfusion.

Post-elimination, the nation's case surveillance has hinged on a dual approach involving both passive and active case detection. Passive Case Detection (PCD) identifies malaria cases among outpatients with fever. Active Case Detection (ACD) comes in two forms: Reactive Case Detection (RACD) responds to index cases by targeting individuals with similar risk exposure or those vulnerable to contracting the disease from the index case, while Proactive Case Detection (PACD) involves screening high-risk populations independent of an existing malaria case.[xviii]

This multifaceted surveillance strategy has proved pivotal in maintaining Sri Lanka's malaria-free status. By combining passive and active methodologies, Sri Lanka not only detects potential resurgence but also pre-emptively safeguards against re-establishment. This consistent vigilance and adaptability in surveillance shows Sri Lanka's dedication in safeguarding public health.

Entomological surveillance and integrated vector management

Sri Lanka faces a persistent risk of malaria resurgence due to the continued presence of malaria vectors and increased travel to and from malaria-endemic regions. The country's vulnerability is emphasised by the widespread distribution of the primary malaria vector, *Anopheles culicifacies*, across most regions. The discovery of the invasive vector *Anopheles stephensi* in the Northern Province in 2016 has further complicated the situation. To maintain its malaria-free status, Sri Lanka has implemented robust vector control measures with entomological surveillance aimed at eliminating the risk of local malaria transmission.

Entomological surveillance focuses on evaluating the potential for malaria re-establishment by quantifying receptivity in vulnerable regions and enhancing understanding of malaria's epidemiology. It serves as a foundation for informed vector control approaches, encompassing the assessment of insecticide susceptibility and bio-efficacy.

Key components of entomological surveillance in Sri Lanka encompass stratifying risk through receptivity characterisation, monitoring vector abundance and behaviour, gauging insecticide resistance and efficacy, identifying vector species, delineating distribution, quantifying population densities and understanding their behaviour and susceptibility or resistance to insecticides. These insights are pivotal for devising effective vector control strategies and tracking the role potential vectors might play in disease transmission.

AMC has conducted four different types of entomological surveys. Reactive spot surveys are conducted when a malaria case is reported to evaluate receptivity around the location. Proactive spot surveys target vulnerable populations' areas pre-emptively to assess receptivity and respond proactively. Extended sentinel site monitoring occurs in fixed locations, allowing monthly tracking of key entomological parameters. Routine sentinel site monitoring involves quarterly assessments at fixed locations, aiding decision-making.[xix]

In the face of different settings and scenarios — such as urban or rural areas, presence of primary or secondary vectors, and local transmission — the AMC deploys various vector control strategies. These include Indoor Residual Spraying (IRS), Long-Lasting Insecticidal Nets (LLINs), space spraying, larval source management (including larvivores fish and chemical larvicide) with or without follow-up responses like foci investigations.[xx]

The comprehensive vector control and entomological surveillance orchestrated by the AMC employ 22 Regional Malaria Officers (RMO) and about 50 entomological teams. Through these actions, Sri Lanka remains dedicated to effectively preventing the re-establishment of malaria.

Photo by Pacific Air Forces Public Affairs

Cross border malaria management and travellers' health

Imported malaria cases pose a significant concern for Sri Lanka, with the majority of malaria cases contracted in nearby South Asia country like India and Pakistan where malaria is still endemic and extensive travel with Sri Lanka occurs. Africa is another noteworthy source, contributing to a considerable portion of imported malaria cases. The cases consist of Sri Lankan nationals returning from abroad and foreign nationals entering Sri Lanka.

The AMC applies several strategies to prevent malaria re-establishment through imported cases. Implementing these strategies requires maintaining strong partnerships with national and international entities including the private sector, armed forces, police, IOM, and UNHCR. The AMC provides malaria prevention guidance and free chemoprophylaxis for Sri Lankan citizens traveling to malaria-endemic countries through partnerships with travel agencies, hotels and businesses. The Navy consistently communicates with the AMC regarding the arrival of refugee groups and asylum seekers from malaria endemic countries.[xxi] The AMC also engages with refugee agencies and employers to identify and screen foreign workers and travellers from malaria endemic regions. Notably, maintaining close communication with religious leaders of migrant communities is an effective approach in Sri Lanka.

During the pandemic, the Covid-19 programme collaborated with the AMC and shared vital pre-arrival information like departure countries and quarantine sites. For travellers originating from malaria-endemic nations, the AMC and RMO ensured malaria screening during quarantine, using microscopic blood exams alongside Covid-19 testing blood collection, irrespective of symptoms. Measures were also put in place in the post-quarantine period which included scheduled follow-up (every month up to six months, then again on the 9th and 12th months or upon their return), and entomological surveys.[xxii]

The risk of malaria re-introduction remains high due to the influx of infected individuals from endemic countries and the presence of vector mosquitoes across Sri Lanka. Preventive measures include using physical barriers to avoid mosquito bites and taking chemoprophylaxis before traveling to malaria-endemic regions. The AMC has provided guidelines for prophylaxis, listing recommended antimalarial drugs and dosage regimens for both adults and children traveling to prevent malaria. The guidelines specify the appropriate drugs for specific countries with malaria risk, assisting travellers in making informed decisions about their preventive measures. This comprehensive approach aims to curtail the spread of imported malaria in Sri Lanka.[xxiii]

Advocacy, community engagement and awareness

Advocating for political and financial commitment is vital to ensure the sustainability of malaria-free status. The AMC has established a public health service network, including regional malaria offices and links to the curative health sector for treatment services. It is imperative to maintain a high level of malaria awareness and emphasise the risk of re-introduction among politicians, clinicians, and high-risk groups.[xxiv]

In the community, awareness programmes are actively underway to educate that while malaria has been eliminated in the country, the risk of resurgence remains. This necessitates continuous vigilance among the population and preventive measures for travellers visiting endemic countries. The establishment of community-level intervention channels through community mobilisation has significantly enhanced the entire population's participation in malaria elimination and prevention. Besides, Sri Lanka employs community engagement initiatives to bolster the entire population's involvement in malaria elimination and prevention. Additionally, school awareness programmes have also been conducted.

The AMC employs a comprehensive approach that includes both general public awareness and self-awareness, with both playing pivotal roles in effectively disseminating information about preventing malaria re-establishment. General public awareness is achieved through mass media platforms like television, radio, and newspapers. Self-awareness focuses on individuals understanding the personal ramifications of visiting malaria-endemic regions. To promote awareness, strategic events are organised in hospitals, schools, and public spaces which utilise diverse mediums such as leaflets, brochures, posters, documentaries, and websites. These materials cover topics ranging from malaria symptoms to free treatment and prophylaxis, along with offering free blood testing and toll-free hotlines for inquiries. The AMC ensures that information-bearing materials like leaflets and brochures are readily available at key locations such as immigration desks, airports, seaports, and hotels frequented by foreign travellers.[xxv]

Keep Sri Lanka Malaria Free

A Aware of the risk of malaria in the country to be visited

B Avoid mosquito Bites

C Chemoprophylaxis when indicated

D Diagnosis in fever patients

E Early and Effective treatment

F Fatal if diagnosis and treatment delayed

Maintaining knowledge and skills of health staff

The AMC has devoted substantial efforts to enhance the capacity for malaria laboratory diagnosis, disease management, case reporting and investigation, as well as information and reporting systems. Collaboratively with the Sri Lanka Medical Association, the AMC has conducted continuing medical education for doctors by partnering through joint sessions with regional medical associations spanning various parts of the nation. The AMC has done much to strengthen capacity for malaria laboratory diagnosis, disease management, case notification and investigation, and information and reporting systems. Physicians, laboratory staff and other field health personnel have been trained and equipped with the skills necessary for effective malaria surveillance.

Clinician awareness programmes in 25 districts in the country were conducted over the past five years with the support of the Global Fund. Regular training programmes have been systematically organised for all levels of field staff nationwide. These sessions serve to not only keep our staff up to date with recent advancements but also to maintain their motivation. To embed malaria education, dedicated time has been incorporated into all medical undergraduate programmes throughout the country.

As part of their continuous efforts, AMC personnel regularly visit medical facilities, delivering informative presentations on malaria. Through these multifaceted approaches, Sri Lanka is committed to enhancing medical knowledge, skills, and awareness, contributing to the effective management and control of malaria in Sri Lanka.

CHINA

China achieved the remarkable milestone of being certified malaria-free by the WHO in 2021. This achievement is particularly significant as China is the world's most populous country and has the longest land border with numerous neighbouring states. Their success not only reduces the global malaria map but also bolsters international confidence in malaria elimination efforts.

To align with health-related Millennium Development Goals and the overarching global objective of malaria eradication, China initiated the National Malaria Elimination Program (NMEP) in 2010. This included the National Malaria Elimination Action Plan (2010–2020), which resulted in substantial progress. All 24 endemic provinces, encompassing 258 endemic prefectures and 2,158 endemic counties, successfully completed malaria verification as planned. The final case was reported in Yunnan Province in April 2016, and WHO officially granted China the malaria-free certification in 2021.

Despite this certification, guarding against re-establishment in the post-elimination phase remains a challenge. Malaria vectors persist, and the risk of transmission resurgence is particularly notable in areas with high imported malaria cases, such as the China-Myanmar border in Yunnan Province. In addition to the enduring threat of border malaria, there are uncertainties surrounding asymptomatic infections, *Plasmodium falciparum* HRP2/3 gene deletions, and the ongoing spread of antimalarial drug resistance.[xxvi]

Preventing re-establishment in China hinges on consistent government leadership, ongoing efforts, technological innovations, robust surveillance, capacity enhancement, and adaptive strategies. By maintaining continuous political and financial support, fostering multi-sectoral collaboration, and implementing innovative approaches, China's malaria-free status can be sustained over time.[xxvii]

Sustained political commitment and investment

Political commitment and investment are crucial pillars for maintaining China's malaria-free status. The central government of China demonstrated its determination and prioritised malaria elimination in national and provincial health agendas which involved consistent policy development, leadership, and allocation of resources. Governments at all levels in China have continuously incorporated malaria prevention into health and socioeconomic development plans, underlining their continued dedication to the cause.

The central government has formulated comprehensive guidelines, empowering public health personnel to adopt effective technical strategies and responses to malaria. Nationwide, extensive and sustained malaria control and elimination initiatives have been meticulously executed. The presence of skilled professional teams and multi-level full-time personnel, bolstered by sound technical guidance, has propelled the success of these programmes.

China's present focus is on implementing interventions to safeguard its malaria-free status. In 2020, 13 ministries, including the National Health Commission, jointly released the 'Administrative Management for the Prevention of Re-establishment of Malaria Transmission'. This official document reaffirms the nation's political commitment to preserving its malaria-free status.

Adequate funding support underscores the firm political determination to uphold the malaria-free status. Financial backing from both central and local sources, as well as external funds, has provided the robust financial foundation crucial in maintaining China's status.[xxviii]

The political commitment of China reinforces the long-term dedication of governments needed to prevent malaria re-establishment, while the accompanying investment provides the necessary financial resources to implement strategies, sustain capacity-building efforts, and respond effectively to challenges. Together, these factors ensure that China's malaria-free status remains secure, and that the country continues to be a model for successful malaria elimination efforts.

Strengthened health system

China's strengthened health system for preventing malaria re-establishment is characterised by vigilant surveillance, rapid response mechanisms, cross-border collaboration, community engagement, and capacity building. By integrating malaria prevention seamlessly into its broader healthcare framework, China ensures the sustained success of its malaria elimination efforts.

The real-time surveillance and response system established help detect any potential resurgence of malaria cases promptly while the rapid response mechanisms swing into action the moment a malaria case is identified. These systems are equipped to identify and respond to even isolated cases, preventing the spread of the disease.

The health system integrates malaria prevention and control into its broader framework, ensuring that essential services are provided alongside routine healthcare. The Malaria Prevention and Control Station was established with the primary objective of conducting focused investigations and control measures against malaria. Additionally, China's malaria surveillance network is structured around a three-level primary health network spanning counties, towns, and villages. This network serves as the foundation for effective malaria control efforts.

China has significantly advanced its malaria control and elimination efforts through the establishment of a comprehensive nationwide malaria diagnostic reference laboratory network and a robust quality management system. These advancements also form a robust foundation for maintaining a malaria-free status in the country.

Continuous training and capacity-building initiatives are conducted for healthcare professionals at all levels. This ensures that they are well-prepared to diagnose, treat, and prevent malaria, contributing to a robust health system. China's health system integrates research and innovation to stay ahead of potential challenges. This involves developing new tools, technologies, and strategies to enhance surveillance and control measures.

Multisectoral cooperation with other sectors

China’s achievement in malaria elimination can be attributed to a combination of factors including robust political commitment, cross-sectoral collaboration, and effective cooperation both nationally and internationally. The government has implemented a range of measures to prevent re-introduction of malaria, effectively managed drug resistance, and engage neighbouring countries for cross-border control.

China’s success is due to its unwavering commitment and collaboration across different sectors. This includes development of comprehensive guidelines, policies, and plans for malaria elimination through interdepartmental cooperation.

In order to prevent the re-establishment of malaria and maintain the malaria free status of the country, the Administrative Measures for the Prevention of Malaria Re-establishment was issued jointly by 13 government departments including the National Health Commission, Ministry of Education, Ministry of Industry and Information Technology, Ministry of Public Security, Ministry of Justice, Ministry of Finance, Ministry of Commerce, Ministry of Culture and Tourism, General Administration of Customs, National Healthcare Security Administration, National Immigration Administration, National Medical Products Administration, and Logistic Support Department of the Central Military Commission.

Initiatives such as the Southern Three Provinces Malaria Joint Control and Prevention launched in 1992, and the subsequent division of 24 pre-endemic provinces into Joint Regions since 2017, have fostered regional collaboration. This approach enhances the sharing of information and experience, particularly in managing mobile populations. It also improves the capacity of medical staff in case management and response to foci of infection, ultimately contributing to the sustained maintenance of a malaria-free status in China.

Border malaria surveillance

While China has successfully eliminated malaria within its borders, the ongoing movement of people across borders and the absence of effective barriers for malaria vectors contribute to an elevated risk of malaria resurgence. It is imperative to maintain multisectoral collaboration and international cooperation among countries sharing endemic malaria borders to effectively address this risk.[xxix]

To combat the risk of malaria re-establishment, sustained collaboration and cooperation between countries for endemic malaria is crucial. Examples include collaboration between China and Myanmar, where joint control and prevention activities, as well as information sharing, are conducted. China's involvement in malaria control efforts with countries in Africa and Southeast Asia under the Belt and Road initiative highlights global cooperation.

Yunnan Province has developed a defensive 3-pronged strategy and a "3+1" strategy that includes an extended buffer zone in Myanmar to ensure surveillance coverage and rapid response to transmission re-establishment. Effective malaria detection and management systems for migrant populations are crucial in managing imported malaria cases. The achievements in malaria elimination in the Chinese border area showcase the importance of strong surveillance systems, collaborative efforts, innovative approaches, and international cooperation.[xxx]

Anti-malaria policies, guidelines and strategies

China's triumphant response to the disease can be attributed to the formulation and execution of well-founded guidelines and policies on a national scale. In 2010, a 'National Action Plan' was issued with the goal of nationwide malaria elimination by 2020. The 'Technical Guideline for Malaria Elimination (2011 Edition)' provided further clarity on the 1-3-7 approach, emphasising rapid case reporting, epidemiological investigation, and focus disposition. Malaria elimination assessment and verification were carried out at subnational levels. Joint malaria prevention and control mechanisms were established among different provinces to consolidate achievements.

At the end of 2020, the 'Management Measures for Preventing Reestablishment of Malaria Transmission' were jointly issued by 13 government departments to ensure political commitment. They were formulated based on the 'Law of the People's Republic of China on the Prevention and Control of Infectious Diseases' and the 'China Malaria Elimination Action Plan (2010-2020)', as well as the goals of 'Healthy China 2030' and the 'Healthy China Action Plan'.[xxxi] The Chinese Center for Disease Control and Prevention also published the 'Technical Strategy for the Prevention of Re-establishment of Malaria Transmission'. Both documents focus on strengthening surveillance and response to prevent dilution of vigilance, reduced funding, and weakened capacity building. These efforts involve continued training for healthcare personnel at all levels, multi-departmental cooperation, cross-regional and cross-border joint prevention and control, and comprehensive malaria management services. The aim is to detect and treat imported cases promptly, identify and address potential transmission sources, reduce severe malaria and death, and solidify the gains of malaria elimination.[xxxii]

The achievement of malaria elimination and the continued prevention of its resurgence in border regions necessitate comprehensive malaria surveillance coverage and swift responses to potential transmission threats. China's '1-3-7' surveillance and response strategy serves as a cornerstone in this journey. It steers and supervises the reporting, investigation, and response to malaria cases.[xxxiii] The case surveillance system in China has undergone substantial transformation during the post-elimination phase. The '3 + 1' strategy emerges as a distilled lesson from border malaria control and elimination efforts, which has significantly contributed to the success of malaria elimination in China's Yunnan border areas.

Since 2016, a nationwide antimalarial surveillance network has been established. This network's role has progressively gained importance in the post-elimination period. Notably, it plays a pivotal role in genotyping drug resistance genes and in tracking individuals traveling from regions with high malaria prevalence. Integrated drug efficacy surveillance (iDES) within this network ensures timely and complete recovery of individuals.[xxxiv]

China's proactive approach to preventing malaria's re-establishment after elimination involves targeted surveillance, strategic response, and collaboration through an advanced surveillance network. This multifaceted strategy demonstrates the country's dedication to sustaining its malaria-free status.

1 Focal investigation and control (1949-1959)

Key documents: Draft of National Programme for Agricultural Development (1956-1967), the first National Malaria Control Programme.

Strategy & Key Interventions: Establish the professional institutes, carry out baseline survey and field pilots, initiate national malaria control programme, and enroll malaria as one of the notifiable diseases.

Achievements: Incidence declined significantly, dropped to 215.83 per 100,000 in 1958, a decrase of 57.2% from 1956.

2 Control of severe epidemics (1960-1979)

Key documents: National Technical Plan for Malaria Prevention and Control, joint malaria prevention mechanism developed in the five provinces of Jiangsu, Shandong, Henan, Anhui and Hubei, the "523" project.

Strategy & Key interventions: MDA was used for population prophylaxis and radical treatments, and joint malaria prevention mechanism was developed among provinces.

Achievements: Outbreak controlled and the incidence declined significantly, dropped to 257.54 per 100,000 in 1979, a decrease of 91.3% from 1970.

3 Incidence decline (1980-1999)

Key documents: Standards for Malaria Control and Basic Elimination.

Strategy & Key interventions: Comprehensive measures based on the characteristics of malaria vectors in receptive areas.

Achievements: *P.f* transmission was interrupted in the Central, and a total of 1321 counties and cities with incidence under 1 per 10,000.

4 Achievement consolidation/ pre-elimination (2000-2009)

Key documents: National Malaria Control Programme (2006-2016).

Strategy & Key interventions: Extend the integrated measures including foci response and vector control (blood testing, prompt diagnosis and standard treatment, LLINs/ ITNs distribution, health education, and monitoring and evaluation); Establish the web-based reporting system; Apply target MIDA in the central.

Achievements: Malaria resurgence contained in 2008; local transmission of *P. falciparum* blocked in Hainan since 2009; no malaria cases reported for at least 3 consecutive years in 1687 counties.

5 Elimination phase (2010-2020)

Key documents: National Action Plan for Malaria Elimination in China (2010-2020), Technical Guideline for Malaria Elimination.

Strategy & Key interventions: Discover and determine the source of infection based on the reported index case of malaria, followed by counter-measures in clear up the source of infection in order to effectively interrupt transmission in confirmed foci. The core intervention is 1-3-7 approach.

Achlevements: No indigenous cases reported since 2017, and malaria-free certified by the WHO in 2021.

6 Post-elimination phase (2021-)

Key documents: Management Measures for Preventing Reestablishment of Malaria Transmission, Technical Guideline for Preventing Reestablishment of Malaria Transmission.

Strategy & Key interventions: Prompt and precise identification of cases, and interrupt transmission in advance. Comprehensive interventions around intensified 1-3-7 appraoch used.

Achlevements: No indigenous cases reported to date.

Scientific and technological innovation

Malaria elimination and the prevention of its resurgence in China have received significant support from advancements in science and technology. Research conducted in both fundamental science and practical field applications has yielded substantial contributions to the country's malaria elimination endeavours. This research extends beyond control and elimination strategies, encompassing essential technologies spanning pathogen biology, vector biology, and interventions like diagnostics, antimalarial drugs, insecticide-treated mosquito nets, and radical vivax malaria treatment. The swift translation and application of these research findings have notably propelled the realm of science and technology for malaria control and elimination.

A pivotal grid-based strategy targeting high-risk populations, including MMP, along the China-Myanmar border region has played an indispensable role in bolstering and securing malaria elimination achievements. By tracking and promptly identifying potential cases of imported or re-established malaria among MMPs, this strategy has been instrumental in advancing and solidifying elimination efforts. The grid-based surveillance strategy stands as a foundational pillar in community malaria case management within the Yunnan border area. Its ability to reach high-risk populations accelerates malaria elimination initiatives and holds potential for expansion to similar regions in the Greater Mekong Subregion (GMS).[xxxv]

Sustaining Malaria Elimination: Guiding Principles

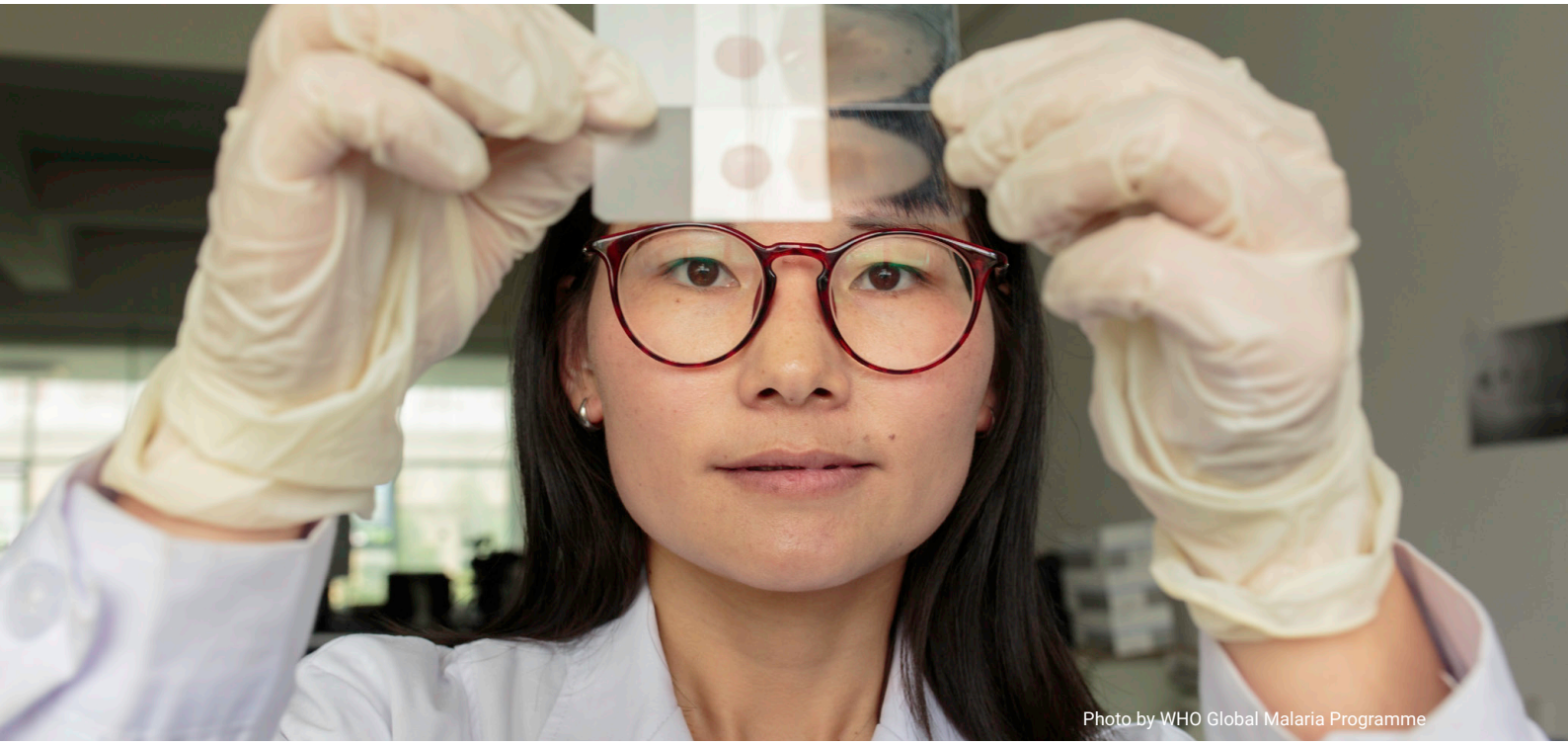
Photo by WHO Global Malaria Programme

Sustaining the status of malaria elimination is of paramount importance due to the substantial benefits to public health. Ending malaria translates to improved quality of life for individuals, families, and communities by freeing them from the physical, emotional, and financial burdens imposed by the disease. It fosters tourism, trade, and investment by creating a healthier and more attractive destination. In the context of global health security, continuing and maintaining malaria elimination prevents the risk of international transmission, reinforcing global efforts to control the disease and mitigating the potential for drug-resistant strains to emerge and spread. By upholding a malaria-free status, nations uphold their commitments to the Sustainable Development Goals, promoting equitable and sustainable development for all. The following are select key guiding principles learnt from the efforts of China and Sri Lanka.

LEADERSHIP AND INVESTMENT

Whole-of-government approach: Collaborative effort from all government sectors ensures a comprehensive approach to prevent re-establishment. Coordinated strategies and resource allocation across ministries strengthen surveillance, response and cross-sectoral engagement, minimizing the risk of resurgence.

Sustained political commitment: Unwavering commitment from political leaders fosters an environment where malaria remains a priority. This commitment sustains funding, resources and policy attention, reinforcing the vigilance needed to prevent re-establishment.

Sustained investment and funding: Continuous financial support guarantees the availability of resources for surveillance, vector control, and case management. Long-term funding commitments ensure the sustainability of effective prevention measures.

HEALTH SYSTEM STRENGTHENING

Strengthened health systems: A robust health system with skilled personnel, functional laboratories, and efficient supply chains strengthens diagnostic and treatment capacities. This infrastructure forms a resilient foundation against potential malaria resurgence.

Advocacy to sustain malaria-free status: Advocacy campaigns engage stakeholders, communities, and policymakers to emphasise the ongoing importance of malaria prevention of re-establishment. Advocacy efforts maintain public awareness, support, and resources required to sustain a malaria-free environment.

Community awareness and engagement: Involving communities empowers them to take ownership of prevention efforts. Education, awareness campaigns, and community participation enhance vigilance against malaria re-establishment.

Anti-malaria policies, guidelines, and strategies: Clear policies and guidelines provide a framework for consistent actions to ensure that prevention measures are well-defined, communicated, and adhered to across all levels of the health system. Implementing proven strategies such as vector control and entomological surveillance, early notification system and prophylactic treatments sustains the barrier against transmission, reducing the risk of re-establishment.

Vigilant parasitological surveillance: A vigilant surveillance system detects and responds to any malaria cases promptly, preventing unnoticed outbreaks and enabling swift intervention.

Case management: Proper diagnosis and effective treatment of malaria cases ensure quick recovery and prevent further transmission, which is essential for maintaining a malaria-free status.

Entomological surveillance and vector control: Regular monitoring of mosquito populations and effective vector control strategies prevent the resurgence of malaria by interrupting transmission cycles at the source.

Maintaining knowledge and skills of health staff: Continuous training of healthcare personnel ensures their proficiency in diagnosing, treating, and preventing malaria, contributing to a strong frontline defence.

Scientific research and technology: Collaborative research and technological advancements enhance surveillance accuracy, diagnostic capabilities, and vector control strategies. This scientific collaboration bolsters prevention effectiveness.

Border malaria management and travellers' education: Managing border regions and educating travellers about malaria risks helps prevent introduction of cases. Targeted interventions and informed travellers contribute to prevent potential re-establishment.

ROBUST PARTNERSHIPS

Multisectoral collaboration: Collaboration across sectors — including health, education, armed forces, border affairs and agriculture — harnesses resources, expertise, and knowledge. This integrated approach maximizes prevention effectiveness and minimizes gaps and vulnerabilities.

Global partnership: Collaborative global partnerships play a pivotal role in preventing the re-establishment of malaria. International organisations, governments, non-governmental organisations (NGOs), research institutions, and communities unite to share expertise, resources, and knowledge. These partnerships facilitate the exchange of best practices, funding, and technical support.

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