Malaria-Free Maldives

World Health Organization
Regional Office for South-East Asia

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WHO Library Cataloguing-in-Publication data

World Health Organization, Regional Office for South-East Asia.

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1. Malaria 2. Public health I. Maldives.

ISBN 978-92-9022-514-0 (NLM classification : WC 750)

Acknowledgements:

This document was developed with contributions from Khadeeja Samad Abdulla, Permanent Secretary, and Sheeza Ali, Director General Health Services, together with Razana Faiz, Fatimath Nazla Rafeeq and Mohammed Faisal of the Ministry of Health of the Republic of Maldives, based on published data, WHO reports and the publications of Ibrahim Shaheem and Abdul Sattar Yoosuf, with support from WHO. The document was drafted by Sohaila Abdulali, and designed by Rupinder Kaur.

Printed in India

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Foreword

Over one thousand islands. Zero malaria.

This is the true story of defeating malaria in Maldives. It is the story of visionary planning, of how dedicated women and men worked, and are still working, at global and local levels to overcome stunning odds. It is the story of how eliminating a disease contributed to a nation's progress, and created a replicable model that is very relevant in other public health battles worldwide.

Starting in the 1960s, the government of Maldives, collaborating with WHO and harnessing the enthusiasm and hard work of talented local health workers and the community, waged a multi-pronged campaign to eliminate malaria. They went from house to house. They sprayed insecticide. They educated the public. They deployed larvivorous fish. They tested anyone coming in from infected countries. They sailed from island to island. They carefully collected data and analysed it, using the findings to defeat malaria and develop the tools to keep it at bay.

Today, despite being a country of islands with heavy rainfall that should be ideal for malaria epidemics, Maldives remains free from malaria. Seven hundred years after the explorer Ibn Battuta called it “Maldivian fever,” the name no longer makes sense.

This is an epic tale. The accomplishment was tremendous, and the results are far-reaching. It is no coincidence that Maldives went from being a low-income nation to a middle-income one. Jeffrey Sachs, the development economist, has pointed out the correlation between malaria elimination and economic prosperity.

Over one thousand islands. Zero malaria. And a first for the WHO South-East Asia Region.

A tale to be told indeed.

Dr Poonam Khetrapal Singh
Regional Director

‘…the malaria seizes the inhabitants in the depopulated streets, and nails them in front of the doors of their houses whose plaster is all falling with the sun, and there they tremble with fever under their brown cloaks, with all the bed-blankets over their shoulders.’

Giovanni Verga, “Malaria”, 1883[1]

[1] Giovanni Verga, celebrated Italian writer and author of a short story “Malaria” (1883), one of the earliest literary depictions of the disease.

Malaria-Free Maldives:

An Epic Tale

You might easily miss the *Anopheles* mosquito as it flits by you in the twilight. But this tiny speck, which breeds in water, carries the plasmodium malaria parasite – a threat to the health and lives of over half the people on earth. In 800 B.C., an ancient Indian Ayurvedic text describes mosquitoes as: “Their bite is as painful as that of the serpents, and causes diseases… [The wound] as if burnt with caustic or fire, is of red, yellow, white, and pink color, accompanied by fever, pain of limbs, hair standing on end, pains, vomiting, diarrhoea, thirst, heat, giddiness, yawning, shivering, hiccups, burning sensation, intense cold…”[2] In the 14th century, Ibn Battuta[3] travelled to Maldives and contracted malaria. It was so common here that it was called “Maldivian Fever.” In the 21st century, however, you couldn’t get it here if you tried.

The Republic of Maldives has been malaria-free since 1984. In a country of 1192 islands spread across 90 000 square kilometres, in water, on water, surrounded by water, lashed by tropical rain -- how did this happen?

Malaria is a terrible scourge, but this paper tells a story of a public health victory, of heroism and persistence, of how the people of Maldives, supported by the World Health Organization (WHO), defeated malaria – and how they plan to keep it that way.

> “In a resource-poor country of 1192 dispersed islands with high malaria burden....how did this happen?”

[2] Zimmer, M. (2015). *Illuminating Disease: An Introduction to Green Fluorescent Proteins.* Chapter 4. Malaria.

[3] The great Moroccan traveller and Muslim scholar (1304–1368)

nearly

1200

ISLANDS

364 000

PEOPLE
LIVE HERE

198

INHABITED

1965

INDEPENDENCE
FROM THE BRITISH

26

NATURAL ATOLLS
in the Indian Ocean

2015

MALDIVES DECLARED
MALARIA FREE
BY WHO

Map of Maldives

Introduction

On 18 December 1897, Ronald Ross, an English medical officer in India, wrote in the *British Medical Journal*: "The [putative malarial] cells appear to be very exceptional; they have as yet been found only in a single species of mosquito fed on malarial blood; they seem to grow between the fourth and fifth day; and they contain the characteristic pigment of the parasite of malaria." In 1911, Ross argued that "malaria can be completely extirpated in a locality by the complete adoption of any one of the three great preventive measures, namely personal protection, mosquito reduction, and treatment". To this day, his prescription holds the secret to its elimination.[4]

The nearly 1200 islands of Maldives, of which 198 are inhabited, form 26 natural atolls in the Indian Ocean. About 364 000 people live here, with their livelihoods primarily dependent on fishing and tourism. The country gained independence from the British in 1965, and became a full republic in 1968.

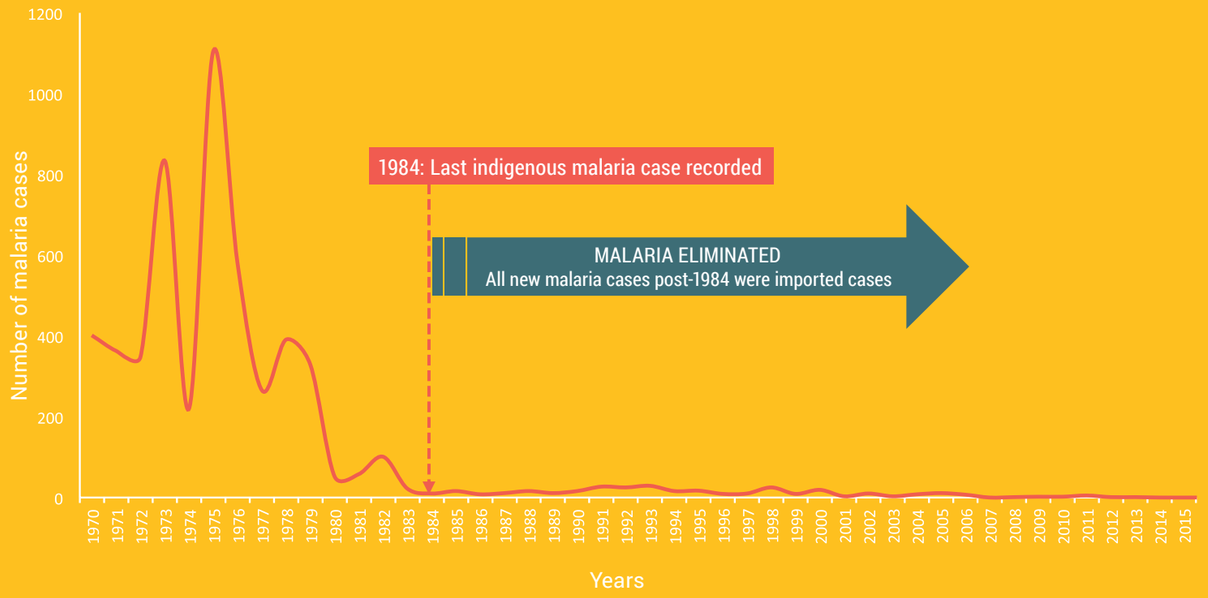
Although the Global Malaria Eradication Programme launched in 1955 was about to be withdrawn, Maldives, despite limited resources, ventured into malaria elimination. In 2015, WHO officially certified the country as malaria-free.

Maldives was the first country in the WHO South-East Asia (SEA) Region to achieve this success, and its achievement is particularly stunning for several reasons:

- From the time that regional malaria elimination campaigns were catalysed by the establishment of WHO in 1948, until the global eradication goal was abandoned in 1969, malaria was eliminated in many countries in Europe, North America, the Caribbean and parts of Asia and South-Central America. Sub-Saharan Africa and South Asia continued to suffer. Given this context, Maldives' achievement is noteworthy.
- As a newly independent country, its income status, health status, and human infrastructure were precarious. Only a strong political will and commitment made victory possible.
- Maldives was the first country in the WHO SEA Region to turn into a middle- and upper-income country. It went from being one of the poorest, to one of the most economically well-off in the region. Malaria elimination played a key role in this process.

[4] Ross R. On Some peculiar pigmented cell found in two mosquitoes fed on malarial blood. BMJ. 1897

Malaria Cases in Maldives



Defeating Malaria

Fighting malaria might be an unlikely topic for an epic tale, but the successful battle against malaria in Maldives has involved many heroes and heroines: visionaries at the global and local level, both men and women – some very young – who braved rough seas and long hours to stop local malaria transmission. And, like all good heroes and heroines, they prevailed. Before WHO came on the scene, efforts to control malaria in Maldives were sporadic at best. Those unfortunate enough to be infected were given quinine, a natural drug made from the bark of the Cinchona tree since ancient times. Later, chloroquine became the drug of choice. Despite this treatment, there was no systematic plan or effort to control the spread of the disease: no surveillance, no vector control, no environmental management, and not nearly enough resources. There were no seaworthy boats dedicated to health-related travel and certainly no facilities available for fingertip blood testing.

Stopping Malaria: WHO global efforts (1955 - 1969)

1955

malaria eradication

It all began in 1955, with the establishment of the WHO Global Malaria Eradication Programme. The Eighth World Health Assembly, the apex Governing Body of WHO, adopted a policy of malaria eradication everywhere except for sub-Saharan Africa and Madagascar.

By 1969, the programme had rapidly achieved results in North America, Europe, Australia and Central Asia. Until the 1970s, some Asian countries, particularly Singapore, Malaysia and Philippines, were singled out as targets for elimination. Development of drug and insecticide resistance led to slow progress in many countries.

1969

malaria control

At the Twenty-second World Health Assembly in 1969, WHO revised its malaria strategy and abandoned the global eradication goal in favour of malaria control.

What makes Maldives unique, and what lessons can we learn from this island country's experience?

In 1967, WHO recommended the policy of training very young people in Maldives to be health workers. WHO had been in Maldives since the early 1950s doing a filariasis survey that was expanded to malaria in the next decade. In May 1966, a year after the Republic of Maldives became a WHO Member State, WHO began formally collaborating with the government to control malaria. The programme can be divided into four phases, or rather, since this is an epic tale, into four acts.

Preparatory Phase

act one (1965–1966)

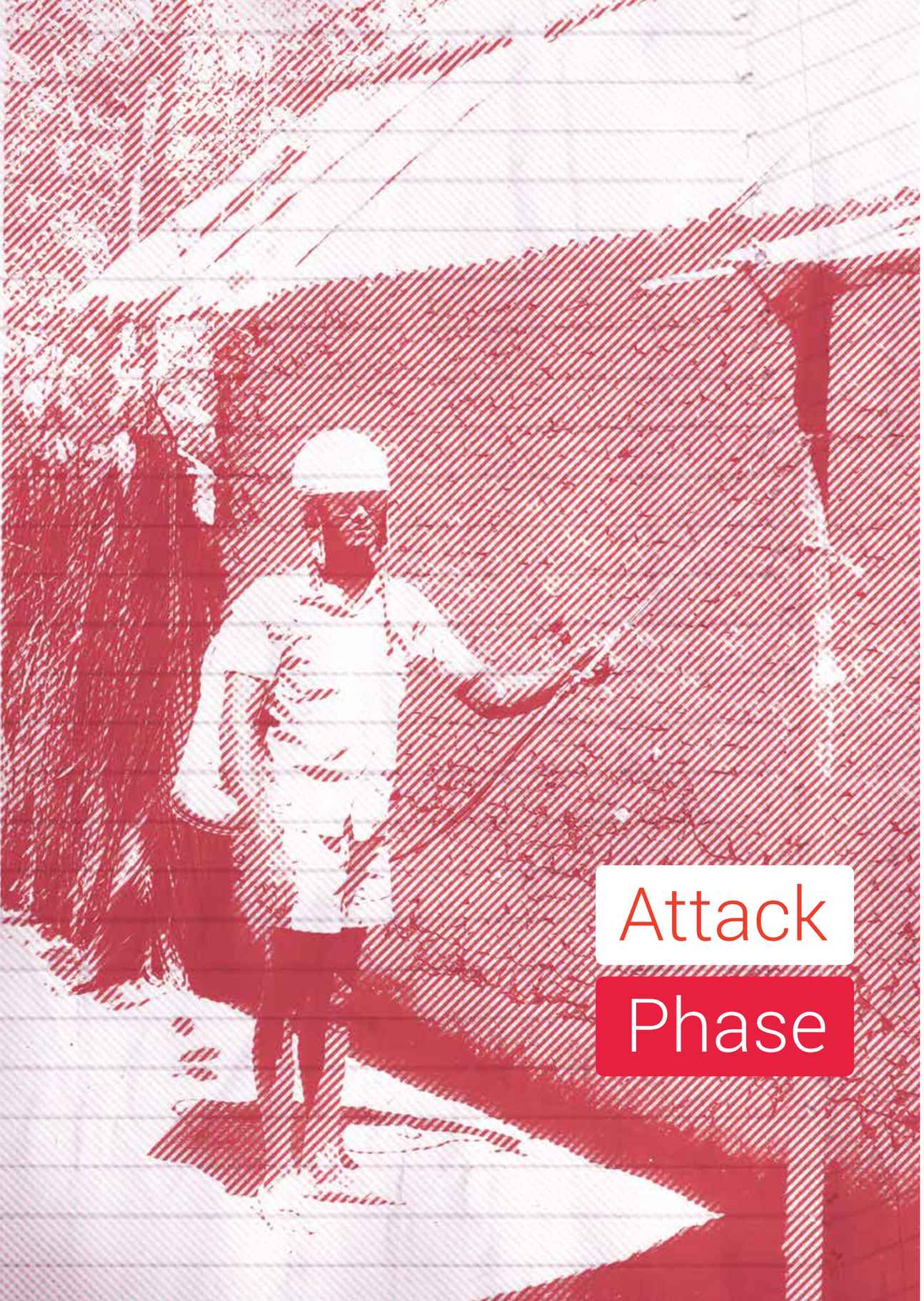
Maldivians were vulnerable to three species of malaria parasites: *Plasmodium falciparum, P. vivax* (which accounted for about half of all infections) and *P. malariae.* The primary malaria-carrying mosquitoes were *Anopheles tesselatus* and *Anopheles subpictus.*

Prevalence surveys in the early 1970s showed that spleen rates (the proportion of the population with palpably enlarged spleens due to infection) were between 10% and 15%. This meant that one person in every seven to 10 people was infected.

Dr Sathiyanathan, WHO's first medical officer in the Maldives, conducted malariological surveys in Malé and Malé Atoll in 1965. Pre-spraying surveys found parasite rates ranging from 0.22% to 52%. He found that the spleen rates for children aged 2–9 years in Malé were as high as 15%, and the parasite rate was 35%. On Hulhule Island (which was then inhabited, but is now the site of the airport), the spleen rates in the same age group were as high as 60%, and for children under two years, the prevalence rate was 50%. Clearly, these were alarming numbers.

The official malaria programme started on 23 May 1966. All health staff were comprehensively trained to be experts on malaria, malariology, and DDT spraying techniques. By July 1966, all necessary supplies and transport were available.

In the early 1960s, the British government presented the *Golden Ray,* a hospital boat, to the Maldives government. It was equipped to carry the whole malaria team and all its supplies as the operation moved from island to island. The work was tedious, but it had its moments of drama as the ship made a grand entrance in every community.



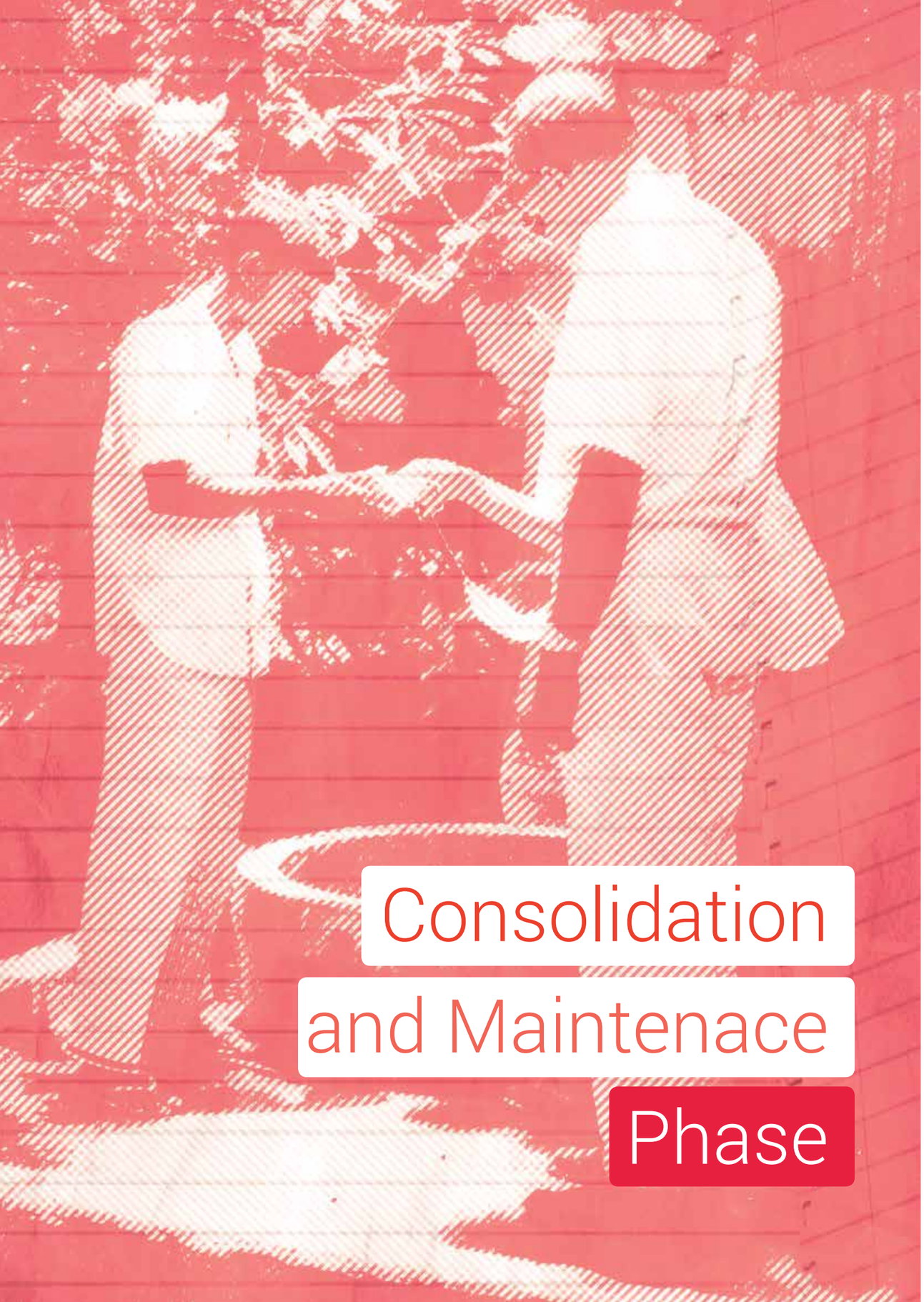
act two (1966–1968)

Act 2 opened in May 1966 with the launch of an intensive programme in the capital city of Malé and the islands of Malé Atoll. Insecticides such as DDT, drug supplies for mass treatment, and other necessary supplies and equipment had been received by mid-June 1966.

The programme included indoor residual spraying with DDT, blood examination and tedious, painstaking searches for malaria vectors (those tiny *Anopheles*) and their breeding sites in lakes, ponds, streams, barrels, tanks, coconut husks, basins, outdoor reservoirs, water jars, rooftop puddles, potholes, and yam pits. Completed by December 1966, this initial operation provided improved estimates of required supplies.

The programme was then expanded to cover every relevant island, well-armed with DDT, primaquine (to eliminate relapses) for mass radical treatment, and other necessary supplies and equipment, including the *Golden Ray.* Vector control activities and mosquito surveillance were both increased; this meant that DDT was deployed on every inhabited island, as well as on nearby uninhabited ones. Trained “spray men” went from house to house with canisters of DDT on their backs. Team members searched for larvae and adult *Anopheles* mosquitoes, as well as their habitats. Surveillance interventions among the population at household level were scaled up. Health-care workers conducted detection of malaria case activities, including malaria prevalence surveys. They also conducted mass drug administration of chloroquine and primaquine for five days to every inhabitant on every island of Maldives.

These specialized teams of workers were ably supported by the leaders of the community: the Island Chiefs. Since very few health facilities were available, the Chiefs were trained in detection, treatment and follow-up care. They shouldered this responsibility until family health workers took over, starting in 1979.



Consolidation and Maintenace Phase

act three (1969 –1984)

In the 1970s, the malaria control programme was overseen by the Communicable Diseases Division under the Ministry of Health. The malaria clinic, opened in April 1972, initially managed all malaria-related matters. By the end of 2000 the Vector-Borne Disease Control Unit was the coordinating agency.

Island residents received specific advice and instructions: If small containers contain larvae, empty them. If you're using a well or a tank, cover it and make it mosquito-proof. Until 1978, the team recommended the introduction of larvivorous fish. After 1970, people were advised to use temephos as a larvicide rather than kerosene and diesel. In 2000, *Bacillus thuringiensis Israelensis* larvicide was introduced.

A gradual decrease in malaria incidence was recorded until 1977 as the number of malaria cases and the annual parasite incidence decreased by about 50% each year. To sustain this status, a special intensified programme – including a permanent team to cover the four vulnerable atolls – was organized and planned during 1978. The team's main activities were ultra-low volume spraying and destroying larvae with the larvicide temephos. Preventive spraying was carried out in neighbouring islands. Intensified epidemiological and entomological surveys were conducted from 1980 to 1994.

These expanded interventions led to dramatic declines in malaria. In 1975, the last indigenous case of *P. falciparum* was reported in Haa-Alif Atoll. 1984 was a landmark year: the last indigenous case of *P. vivax* was reported in Baa Atoll. Incredibly, teams of determined people in boats and on foot, wading through ponds, walking down roads with spray tanks and notepads, going house by house, village by village, and island by island, all focused on interrupting local malaria transmission, had outsmarted the once-ubiquitous *Anopheles.*

Did it work? How could we be sure? Act 3 involved assessing the programme and measuring its impact. This meant revisiting all the islands and checking boats arriving to Malé from other islands for the presence of malaria mosquitoes, and parasites in infected humans. This and regular blood sampling of returning travellers were initiated through joint announcements by WHO and the national government.

Anopheles tesselatus and *Anopheles subpictus* were the principal and secondary malaria vectors. *A. subpictus* persisted on a few islands where transmission continued until 1984. In 1989–1990, *A. tessellatus*, which prefers brackish water, was reported at low densities on four islands of one atoll, but that has not happened since. In 1999–2001, entomological studies on the *Anopheles* species were conducted on 32 islands, including uninhabited ones, and nobody found a single malaria-transmitting mosquito.

Ongoing entomological surveillance to detect the presence of malaria vectors remains a key component in maintaining Maldives' malaria-free status.

Remaining

Malaria-Free

act four (1985 onward)

It is gone, and we don't want it back. Act 4 involves measures to prevent re-introduction and re-establishment. For 30 years, thanks to ongoing surveillance, Maldives has been successful in maintaining its malaria-free status and preventing the re-establishment of local transmission. While it has certainly benefited from being a group of atolls, Maldives has nonetheless faced the repeated importation of malaria from endemic neighbouring countries.

Indeed, since 1984, the only reported cases of malaria in Maldives have been imports – people bringing the disease from other countries. Since the last indigenous case, Maldives has recorded 216 imported cases of malaria between 1984 and 1997, mostly from India, Sri Lanka, and Bangladesh. Between 2001 and 2015 there were 102 cases of imported malaria.

It is no exaggeration to call this an "epic public health tale." Consider this statement by Jeffrey Sachs and Pia Malaney:
"Where malaria prospers most, human societies have prospered least. The global distribution of per-capita gross domestic product shows a striking correlation between malaria and poverty, and malaria-endemic countries also have lower rates of economic growth. There are multiple channels by which malaria impedes development, including effects on fertility, population growth, saving and investment, worker productivity, absenteeism, premature mortality and medical costs."[5]

Meanwhile, Maldives is one of the first two countries in the region to become an upper-middle-income nation. Banishing a disease can contribute to improving the economic profile of a country – epic, indeed.

In addition, the success of the multipronged public health campaign provided a useful launchpad for other public health initiatives, in particular those aimed at eliminating filariasis, another mosquito-borne disease. Thanks to integrated vector control and successful chemotherapy, Maldives became the first country in the region to eliminate filariasis as a public health problem.

The government's commitment and malaria programme expertise, supported by WHO, were responsible for making Maldives malaria-free, but it would have been impossible without the contributions of the local people, health workers, and communities who wholeheartedly threw themselves into the effort. They carried out surveys; implemented education programmes, spraying, larval surveys, and cultural events to spread the message; and complied willingly to make every effort to follow all the protocols to banish malaria from their country in 2016.

[5] Sachs J, Malaney P. The economic and social burden of malaria. Nature 2002;415:680–5. doi:10.1038/415680a

“Malaria control is a nation-building strategy – a powerful attack on the root causes of poverty; and a very smart and rewarding investment in sustainable development.”

Dr Margaret Chan
Director - General, World Health Organization

World Malaria Day, April 2016

Preventing re-establishment of malaria transmission

Today, Maldives is malaria-free. Nobody can afford to take that statement for granted for even a moment.

Maldives is a water-bound nation with high rainfall, and in this globalized world of constant and increasing movement – of humans as well as parasites – keeping it malaria-free is no easy task.

The threat of malaria reintroduction and re-establishment is ever-present. Maldives’ malaria-free status can only be maintained through adequate surveillance and proper case management. This must be sustained by ongoing public health and environmental management, general mosquito control and specific and targeted disease vector management. Early detection, access to treatment, and adequate screening protocols are key, as is a well-oiled system of preparedness and vector control.

WHO and the government remain deeply committed to working collaboratively to maintain Maldives’ malaria-free status. The Malé-based Health Protection Agency (HPA), the country’s central public health agency, is in charge of malaria-related activities. It monitors and coordinates all public health responses. Each atoll and island health facility has a public health unit that provides immunization, health awareness and advice, and reproductive health services. It also conducts surveillance and manages the control of communicable diseases, including malaria. In each atoll, the public health unit of the atoll hospital supervises the public health staff at each island health centre.

How does Maldives remain free of the scourge?

The successful formula consists of:

Epidemiological Surveillance

BY HEALTH CARE PROVIDERS:
Malaria is a notifiable infectious disease for rapid response for containment. This means that any cases, indigenous or imported, must be immediately reported to the HPA, and thoroughly investigated, classified, radically treated, and entered into a central database according to protocol.

BY THE COMMUNITY:
Since the fight against malaria began, health workers have done the majority of the hard work. Supervised by Island Chiefs, they were and continue to be responsible for monitoring, supervision and follow-up. In reality, this means diligent door-to-door work, talking, informing, educating, empowering, and mobilizing individual, families and communities. It means screening, testing, tracking, recording, and reporting. Today this is not needed for malaria, but such surveillance provides a basis for containing other mosquito-borne diseases.

Prevention through Port Health and International Travel Health

As international travel continues to increase and connect all parts of the globe, malaria importation remains a significant threat. Importation has clinical, epidemiological and economic implications, which could undo all the hard-won progress. Therefore, Malé International Airport, Malé Seaport, ports in Lhaviyani, Gaafu Alifu, Seenu and Haa Dhaalu, and most other ports of entry are constantly monitored. All vehicles and passengers arriving by air from countries with endemic malaria are screened and tested as per port health standards and in accordance with WHO's International Health Regulations (2005). Vigilance is maintained for imported vectors and any malaria cases are detected early and followed up and radically treated and cured.

Public health staff continue to be rigorously trained in malaria prevention, case detection, treatment, and elimination protocols. Ministry of Health keeps a central stock of antimalarial drugs and public health insecticides and larvicides for treatment and potential containment of any outbreaks and emergencies.

Gone are the days of waiting anxiously for a letter to come by ship. Today, with satellite communications, the Internet, and sophisticated tools for surveillance, disease detection and control, and modelling scenarios, the task of keeping malaria out of Maldives seems less daunting, despite the risks of increased travel back and forth. If we could do it in the 1960s and 1970s, we can certainly do it now.

Effective Health Care

The Ministry of Health provides comprehensive primary care, prevention and treatment. It subsidizes health care for everyone. In 2011, almost 90% of inpatients and 70% of outpatients were served through the public health-care system. Today, Universal Health Care has been rolled out nationwide, covering the entire population. The drug authority monitors the quality of health care and compliance with national health policy. Continued public health education and community engagement are also important.

Integrated Vector Surveillance and Control

Mosquito surveillance and mosquito and larva control through insecticides and larvicides are the pillars of an integrated vector control strategy for mosquito-borne diseases. People are educated to cover water cisterns and tanks, drain stagnant water sites, clean roof gutters and other areas that may collect water, regularly empty and clean overhead tanks, introduce larvivorous fish such as guppies, fill in disused wells, and use larvicidal agents when necessary. Vector control for other diseases plus selected entomological surveillance for malaria will keep the country resilient to fight any resurgence of malaria.

All epic tales end with the moral of the story, and this one has several.

Lessons Learned

The Maldives story shows how careful planning that includes taking into account the cultural and geographical context, an intelligent collaboration, and the commitment of both health staff and the public can lead to spectacular results.

The looming threat of dengue and zika all over the world and the increasing threat of global warming poses new challenges to Maldives. With the twin elimination of filariasis and malaria, the country is well-positioned to write the script for the next epic tale.

Today, you can sit on your veranda on the beach in Malé at twilight, and if a mosquito does bite you, you don't have to worry about contracting one of the most common and debilitating diseases known.

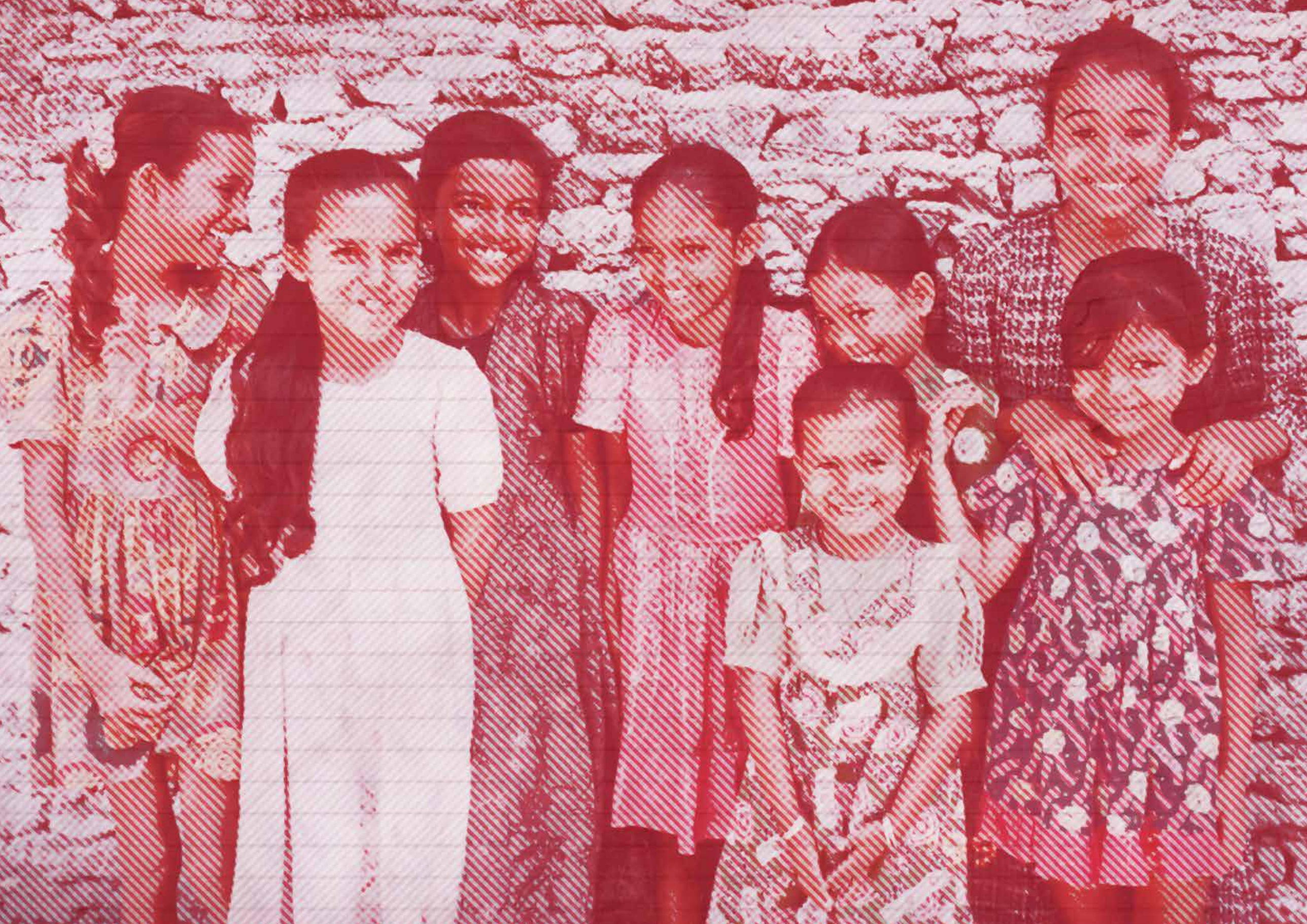
Mosquitoes might be tiny,
but this achievement is huge.

Rich or poor, countries can eliminate malaria.

Geographic conditions are no barrier.

Political determination always matters.

Community engagement is crucial.



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ISBN 978 92 9022 514 0