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Elimination of Infectious Diseases from the South-East Asia Region

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ISSN 2192-3698 ISSN 2192-3701 (electronic)
SpringerBriefs in Public Health
ISBN 978-981-16-5565-4 ISBN 978-981-16-5566-1 (eBook)
https://doi.org/10.1007/978-981-16-5566-1

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Foreword

It gives me immense pleasure to introduce this book that outlines the historical context, country experience and best practices, which led to the elimination of malaria, yaws, lymphatic filariases, trachoma and mother-to-child transmission of HIV and syphilis from one or more geographic regions or countries of the WHO South-East Asia (SEA) Region.

Countries of the SEA Region have been fighting these diseases for decades, and their efforts are showing satisfying and encouraging outcomes. However, the work remains unfinished and much must be done to eliminate them completely not only from South-East Asia but also from the entire world.

As the following pages highlight, the SEA Region has in recent decades made real progress against communicable diseases. The most celebrated is India's victory over polio, which led to the SEA Region having eliminated polio and being certified as polio free. The following chapters provide a compelling insight into the recent achievements of countries in the SEA Region, and how they have catalyzed a paradigm shift in how stakeholders think about communicable diseases. As the Sustainable Development Goals (SDG) highlight, for most diseases, elimination is now the goal.

The emergence and spread of COVID-19 across the SEA Region is providing challenges to achieving the SDG targets due to changing priorities and overstretched health systems. Today the challenge is to harness this crisis to invest in and build health systems that are stronger and more robust, populations that are better able to resist infections, and services that provide for communicable diseases at all levels.

It is my firm belief that as technical advances continue to become available, we will sooner or later be able to sustainably eliminate, and even eradicate some of these communicable diseases, and I am pleased that this book shows so clearly the efforts made in the SEA Region. It should now be used gainfully by researchers and other stakeholders in the Region, and across the globe.

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Preface

National, regional and global campaigns to eliminate or eradicate infectious diseases can galvanize health systems, donors and governments and achieve significant success in easing the disease burdens and reducing the health disparities. From the mid-twentieth century to the present, many countries of the WHO South-East Asia Region have eliminated one or more infectious diseases, from mother-to-child transmission of HIV, to malaria, lymphatic filariasis, yaws and trachoma.

This book examines the historical context, country experiences and best practices that led to disease elimination in select countries and for select diseases. This may prove valuable to other countries still working towards elimination targets. Whatever a country's status on disease-specific targets, the lessons contained herein may inform disease control and elimination efforts. By 2030, the UN Sustainable Development Goals (SDGs) aim to end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases, and to combat hepatitis, water-borne diseases and other communicable diseases.

The book has 12 chapters. The first chapter outlines disease elimination as a concept. The remaining chapters document country experiences in disease elimination, which holds important lessons. While campaigns to eliminate or eradicate infectious diseases can achieve great success, they must be technically feasible and must complement overall health systems strengthening and the drive towards universal health coverage—the Flagship Priority and SDG target that underpins all others. In service of that goal and a healthier, more sustainable Region and world, I am certain this book will contribute.

Dr Poonam Khetrapal Singh
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About the Editor

Dr. Poonam Khetrapal Singh was the first Indian elected Regional Director of WHO's South-East Asia Region. She was also the first woman in the region to assume the office of WHO Regional Director for South-East Asia in February 2014. In September 2018, she was unanimously elected for a second five-year term by the 71st Regional Committee and 144th Session of the WHO Executive Board. Prior to Dr Khetrapal Singh's service as Regional Director of the WHO South-East Asia Region, for over two decades she was a civil servant in India as a member of the Indian Administrative Services (IAS). In 1987 she moved to the Health, Population and Nutrition Department of the World Bank and in 1998 she joined WHO headquarters, Geneva as Executive Director, Sustainable Development and Healthy Environments Cluster, and became a member of the Director-General's Cabinet

Dr Khetrapal Singh has devoted more than three decades to strengthening public health as a leader and manager at national and international levels. Dr Khetrapal Singh has vast experience in developing evidence-based, scientifically sound policy in complex state, national and international health systems due to her work in low-resourced health systems, leading large multi-sectoral teams and collaborating with global partners and public health leaders. Dr Singh has a PhD in Public Health and is a Fellow of the Royal College of Physicians (FRCP), of the University of Edinburgh, UK.

Abbreviations and Acronyms

AFC	Anti-Filariasis Campaign
ANC	Antenatal care
ART	Antiretroviral therapy
ARV	Antiretroviral
ASHA	Accredited Social Health Activist
AZT	Zidovudine
BI	Bacteriological index
CDC	U.S. Centers for Disease Control and Prevention
COMBI	Communication for Behavioural Impact
DEC	Diethylcarbamazine
DOTS	Directly observed treatment, short-course
DWSS	Department of Water Supply and Sewerage
EMTCT	Elimination of mother-to-child transmission
ENL	Erythema nodosum leprosum
EQA	External quality assurance
FHB	Family Health Bureau
FPA	Filariasis Prevention Assistant
G2D	Grade 2 disabilities (in leprosy)
GET 2020	Global Elimination of Trachoma by the year 2020
GVAC	Global Validation Advisory Committee
HDI	Human Development Index
HPA	Health Protection Agency
ICT	Information, education and communication
IDSP	Integrated Disease Surveillance Programme
IEC	Information, education and communication
IOM	International Organization for Migration
IRS	Indoor residual spraying
ITI	International Trachoma Initiative
IU	Implementation unit
LTTE	Liberation Tigers of Tamil Eelam
MCH	Maternal and child health
MDA	Mass drug administration

MDGs	Millennium Development Goals
MDT	Multidrug therapy
Mf	Microfilaria
MMDP	Morbidity management and disability prevention
MMR	Maternal mortality ratio
MoH	Ministry of Health
MoHP	Ministry of Health and Population
MoPH	Ministry of Public Health
MTCT	Mother-to-child transmission
NGO	Non-governmental organization
NLEP	National Leprosy Elimination Programme
NNJS	Nepal Netra Jyoti Sangh
NSACP	National STD/AIDS Control Programme (Sri Lanka)
NTD	Neglected tropical disease
NTP	National Trachoma Programme
NVC	National Validation Committee
NVP	Nevirapine
NVT	National Validation Team
PAM	Penicillin G with 2% aluminum monostearate
PCR	Polymerase chain reaction
PEPFAR	US President's Emergency Plan on HIV/AIDS
PHIMS	Perinatal HIV Intervention Monitoring System
PLHIV	People living with HIV
PMTCT	Prevention of mother-to-child transmission
PNC	Postnatal care
RPR	Rapid plasma regain
RVS	Regional Validation Secretariat
RVT	Regional Validation Team
SAFE	Surgery for trichiasis, Antibiotics to clear infection, Facial cleanliness, and Environmental improvement to limit transmission
SDG	Sustainable Development Goal
SDGs	Sustainable Development Goals
SEA	South-East Asia
STD	Sexually transmitted disease
STH	Soil-transmitted helminthiasis
STI	Sexually transmitted infection
TB	Tuberculosis
THELEP	Scientific Working Group on Chemotherapy of Leprosy
TPHA	*Treponema pallidum* haemagglutination assay
TRS	Trachoma rapid survey
UHC	Universal health coverage
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
VCT	Voluntary counselling and testing

VRS	Vital Registration System
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
YEP	Yaws Elimination Programme

Chapter 1
A Historic Paradigm Shift in Communicable Diseases in South-East Asia: From Control to Elimination

Poonam Khetrapal Singh

Abstract Communicable diseases such as HIV, TB, malaria and NTDs are among the leading causes of illness, death and impoverishment in the WHO South-East Asia Region. The SDGs state that the goal of ending these diseases has the potential to have an unprecedented impact on human development. In moving towards UHC, the challenge now is to target several pressing communicable diseases while also building sustainable, people-centered health services for all. Despite the many challenges the Region faces, it has made important progress towards eliminating several communicable diseases. In 2014, the Region was certified polio free and in 2016 it was validated to have eliminated maternal and neonatal tetanus. Measles and rubella have been eliminated from several countries, and yaws has been eliminated from India. Thailand, the Maldives and Sri Lanka have eliminated maternal and child transmission of HIV and syphilis, and the Maldives, Sri Lanka and Thailand have eliminated lymphatic filariasis. The Maldives and Sri Lanka have eliminated malaria, and Nepal has eliminated trachoma. To advance progress towards the complementary goals of disease elimination and UHC, several areas should be of focus: linking disease elimination efforts with UHC; prioritizing multisectoral engagement; ensuring strong subnational action; ensuring the rapid transmission of information; prioritizing disease surveillance; involving communities and people; maximizing access to global public goods; and recognizing the rights of affected people and communities. The global community has committed to making communicable diseases a thing of the past. Disease elimination and eradication are powerful ideas that can galvanize health systems, donors and governments, while easing the disease burden of the poor and the disadvantaged and reducing health disparities.

1.1 Introduction

From 2000 to 2015, under the Millennium Development Goals (MDGs), the world made unprecedented progress in combating communicable diseases. A confluence

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_1

of factors made this possible, including better diagnostics, treatments and vaccines, improved health systems surveillance, increased investment in health programmes, and strong and sustained political leadership towards this end. The MDGs themselves both reflected and helped spur progress, with five of the eight MDGs specifically focused on health, including one devoted to communicable diseases. Under the MDGs, antiretroviral therapy averted more than 7.4 million deaths; the global malaria mortality rate declined by 58%; and enhanced TB prevention, diagnosis and treatment saved 37 million lives [1].

Progress against HIV was at the fore of what is often called the golden era of global health. Following the discovery of HIV in 1984, the virus spread rapidly to every corner of the globe, cutting life expectancy, threatening national and regional economies, decimating communities and placing extraordinary burdens on health systems. Many experts predicted that HIV would never be conquered—that it would instead become a fact of life in our increasingly globalized world. To avert this outcome, the global community mounted a concerted response, which also forged new norms, including the right of infected individuals to participate as full and equal partners in society. The 36% drop in new HIV infections worldwide from 2000 to 2017, combined with the earlier elimination of smallpox and the near-elimination of polio, helped to inspire an increasingly ambitious global health agenda [2].

The 2030 Agenda for Sustainable Development, which United Nations Member States adopted in 2015, embodies this paradigm shift [3]. The health goal, Sustainable Development Goal (SDG) 3, is to "ensure healthy lives and promote well-being for all at all ages". As part of achieving SDG 3, by 2030 the world must end the epidemics of AIDS, tuberculosis (TB) and malaria—diseases that the MDGs also targeted. In addition, SDG 3 calls for ending epidemics of neglected tropical diseases and for enhanced action to combat hepatitis, waterborne and other communicable diseases [4].

Whereas the MDGs focused on control or mitigation, the SDGs focus on elimination, which is defined separately for each disease and embedded in the relevant SDG indicators and strategic plans of the World Health Organization (WHO). Embracing the elimination targets reflects a broad recognition that these are technically possible, economically affordable and operationally feasible. But the SDGs mark another important shift. While the MDGs focused on specific diseases and the health needs of specific populations, the SDGs envisage a more integrated approach to health. A key aim of SDG 3 is to achieve universal health coverage (UHC) by 2030. SDG 3 recognizes that there is no either/or choice between broadly accessible health services and enhanced focus on communicable diseases.

Today, our challenge is to do both—to build robust, flexible health systems capable of providing holistic, tailored care to patients and to seize the historic opportunity we have to eliminate several communicable diseases. In examining the paradigm shift that created these imperatives, this book focuses specific attention on the World Health Organization Region of South-East Asia. The Region has made dramatic gains in human health and well-being in recent years, and is determined to continue its progress against communicable diseases as it responds to the coronavirus

disease 2019 (COVID-19) pandemic and works towards achieving its eight Flagship Priorities, WHO's "triple billion" targets [5] and the SDGs.

1.2 Disease Elimination as a Goal—The Early Years

While humans have struggled with disease-causing microbes for as long as humanity has existed, only in the past two centuries have humans waged an organized war against them. But it was never just about the science. Early efforts to control or eliminate communicable diseases underscored the global need for a multilateral organization capable of coordinating and strengthening surveillance and control efforts among countries and regions. Founded in 1948, WHO, under the aegis of the United Nations, capitalized and built on the early momentum. The World Health Assembly—WHO's supreme governing body—calling for the worldwide eradication of malaria in 1955 and smallpox in 1959. The burden of both diseases was unconscionable and unnecessary.

In the years following World War II, malaria persisted as a major public health problem. While the use of dichlorodiphenyltrichloroethane (DDT) for indoor residual spraying (IRS) succeeded in reducing the number of malaria cases, massive population displacement, importation of malaria from troops returning from endemic areas and destruction of key infrastructure contributed to a resurgence. It was against this backdrop that WHO launched the Global Malaria Eradication Programme (GMEP) in 1955, with a focus on IRS with DDT, combined with case detection and treatment [6].

The first-ever global campaign to eradicate a vector-borne disease yielded important but modest results—37 out of 143 countries became malaria free, including 27 countries in Europe and the Americas. But the campaign soon lost momentum owing to a lack of local participation and operational research. Resistance to antimalarial drugs emerged, and mosquitoes developed resistance to DDT and other insecticides. In 1969, WHO changed its approach from worldwide eradication to "malaria control with the ultimate aim of malaria eradication".

The creation in 2002 of the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) kick-started a renewed interest in malaria eradication and infused new funding into national malaria control efforts. The inclusion in the MDGs of the target of "reversing the global malaria epidemic" intensified monitoring and accountability for results in malaria control programmes. SDG 3 calls for the elimination of malaria in at least 35 countries by 2030, including at least 10 countries by 2020. Soon after the SDGs were adopted, Maldives became the first country in the world to be certified malaria-free, as it had not reported a single case of malaria since 1986. Sri Lanka was the second country to apply for certification, which it was awarded in 2016 [7].

The battle against smallpox was a more immediate success. In 1966, the World Health Assembly adopted a resolution to intensify smallpox eradication, leading to the launch of the Intensified Smallpox Eradication Programme in 1967 [8]. Whereas

the initial campaigns for yellow fever and malaria failed, the world succeeded in eradicating smallpox in a little over a decade. This was largely because of the broad uptake of an improved vaccine that made vaccination simpler and used a smaller quantity of vaccine. In addition to achieving 100% vaccination, the eradication strategy focused on disease surveillance. The programme benefited from strong political support at the highest levels, which helped secure adequate funding.

One of the most important lessons from the smallpox programme is that the planning of an eradication campaign should be based on clear objectives, and should have a clear strategy and management structure. Eradication programmes should likewise be guided by operational research and be sufficiently flexible to allow for course corrections. Strong political commitment at the national level is crucial, as is effective international coordination.

When WHO launched the smallpox elimination drive, wild poliovirus was endemic in 125 countries and caused paralysis in more than 1000 children every day. In 1988, there were more than 350 000 cases of polio worldwide. Emboldened by their success against smallpox, global partners launched the Global Polio Eradication Initiative (GPEI) [9].

Since its inception, the GPEI has focused on maintaining high vaccination coverage—at least three doses of live oral polio vaccine (OPV), providing supplemental rounds of vaccination, establishing mechanisms for surveillance of acute flaccid paralysis (AFP), and house-to-house "mop-up" campaigns. It has also emphasized the need for strong outbreak preparedness and laboratory networks. Mobilizing and engaging communities has likewise played a pivotal role in polio eradication strategies, particularly in countries and regions where there has been resistance to vaccine administration to children.

When the deadline for polio eradication ended in 2000, there were 2880 cases a year spread over 20 countries. In 2018, up to November, a total of 27 cases of wild poliovirus were reported from Afghanistan and Pakistan. Although the world has achieved a 99.99% drop in polio cases since the eradication drive began, the campaign has yet to attain its goal of zero cases. Significantly, while polio dropped by 99% from 1988 to 2000, the next 1% decline has taken nearly two decades and roughly US$ 1 billion in expenditure each year.

This highlights an important lesson, which the campaign against smallpox also underscored: the last mile towards eradication relies less on achieving 100% vaccination and more on strong, recalibrated surveillance and containment programmes that identify cases early and enable local vaccination to guard against further transmission. Both campaigns also highlight the critical importance of local planning and the need to make evidence-based adjustments where required.

Another disease targeted for eradication was Guinea worm disease. In 1981, to coincide with the International Water Supply and Sanitation Decade, the global community launched an eradication campaign for Dracunculiasis or Guinea worm disease—the first parasitic disease taken up for eradication. The campaign, which was hoped would promote the broader sanitation agenda, was based on the determination that dracunculiasis was eradicable because it was easy to diagnosis, control interventions were simple and cost-effective, the immediate host of the parasite was

not airborne, and the geographical distribution of the disease was limited. In 1986, an estimated 3.5 million new cases of dracunculiasis occurred, and 20 countries were endemic for the disease.

1.3 Disease Elimination and the Push for Universal Health Coverage

Even as the success of the smallpox eradication campaign inspired similar approaches to other vaccine-preventable diseases, the disease-specific approach to elimination attracted its share of criticism. In many respects, this criticism mirrors more recent debates regarding the rapid growth in funding for programmes to fight AIDS, TB and malaria. Critics have asserted that the smallpox programme obtained disproportionate funding and diverted resources from other priority health issues. It was also argued that if health workers could reach children in villages with the smallpox vaccine, they could also immunize children against other diseases.

The thinking behind these critiques led to the Expanded Programme on Immunization (EPI), which the World Health Assembly recommended for implementation in May 1977 [10]. By leveraging health workers mobilized and trained under the smallpox programme for broader immunization, the EPI aimed to reduce morbidity, disability and mortality from diphtheria, pertussis, tetanus, TB, poliomyelitis and measles, in addition to other diseases for which potent, safe and cost-effective vaccines became available. Though countries were keen to launch immunization campaigns, they often lacked sustainable funding, heat-stable vaccines and frameworks, protocols and mechanisms that guaranteed vaccine quality [11]. The United Nations Children's Fund (UNICEF) partnered with WHO to implement the EPI in its initial phase and was subsequently joined by other funding partners.

The EPI has been a great success. In 1974, global vaccination coverage was about 5% and it increased to 30% by 1980 for the first dose of diphtheria–tetanus–pertussis vaccine (DTP3). This further increased and by 1990, the global coverage for these vaccinations had reached 88%, and by 2012, it had reached 91%. In 2012, 59 countries, including several low- and middle-income countries, had achieved the target of reaching at least 90% of the population nationally, and at least 80% in every district. Though the EPI is a vertical programme within health systems, it helped to build the necessary capacity in many countries.

The relationship between vertical, disease-specific programmes and national health systems has always been contentious. From the beginning, the malaria eradication programme evolved on its own, distinct from broader national health systems. Malaria activities were carried out by a cadre of specially trained personnel who were deployed to reach the remotest parts of the country to map and spray all houses and structures, perform census counts, conduct mass blood surveys, distribute chloroquine and conduct general surveillance activities. Some have argued that the eradication programme led to the halting of studies that were more closely aligned with

the model of health service development compatible with primary health care [12]. The successful use of trained malaria workers for broader health service delivery—as occurred in India—constitutes a good public health practice that nevertheless occurred mostly as an afterthought rather than as an integral component of malaria control efforts.

The initial failure of WHO's global malaria campaign was a setback for the concept of eradication and led to new thinking that positioned primary health care as the cornerstone for health improvement globally. In 1978, a year after WHO launched the EPI, the Primary Health Care Conference in Alma-Ata recommended the integration of vertical programmes into horizontal, community-based health systems, thereby signaling an end (albeit temporary) to vertical disease control programmes. Although the shift to a primary care approach was appealing to many low- and middle-income countries, the real-world effects of this paradigm shift were limited. Ethiopia's experience illustrates the challenges of transitioning from vertical to more horizontal approaches. The only country in Africa to take up malaria eradication in the 1960s, Ethiopia attempted, following the failure of malaria eradication, to unify the Malaria Eradication Service and basic health service delivery. This approach ultimately failed, as the two organizations had separate budgets, staff and administration [13].

Under the MDGs, global attention was focused on a limited spectrum of communicable diseases and populations. This revived interest in vertical health programmes, as reflected in the creation of the Global Fund and the launch of the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), the largest bilateral health programme ever assembled to address a single disease. The move back towards vertical programmes stemmed from several factors, including the failure of health systems to control malaria in the years following Alma-Ata and the emergence of HIV in the 1980s as a new, globalized health challenge that demanded an emergency response [14].

In the wake of the tremendous progress made by vertical programmes in the MDG era, global health is once again focused on a more integrated approach centred on primary care. The entire 2030 Agenda for Sustainable Development, including health and non-health goals and targets, is animated by the vision of more integrated systems and responses. The policy goal underpinning SDG 3 is UHC, which will build the foundation for flexible, people-centred systems that are capable of addressing infectious diseases, non-communicable diseases and other health conditions.

In the midst of the increased emphasis on integrated health systems and multipurpose health service delivery, the world has an unprecedented opportunity to banish several communicable diseases as a public health threat. In moving towards UHC, the challenge now is to target several pressing communicable diseases while also building sustainable, people-centred health services for all.

1.4 Elimination in the South-East Asia Region

Global campaigns against specific diseases cannot, by definition, succeed without achieving their aims in the South-East Asia Region, which is home to more than a quarter of the world population and bears a disproportionate share of the global disease burden. Despite the many challenges the Region faces, it has made important progress towards eliminating several communicable diseases, and has formally endorsed all major global elimination programmes. Recent progress has been strong.

In 2014, the Region was certified polio free. The Region's last wild polio case was reported in India in January 2011.

In 2016, the Region was validated to have eliminated maternal and neonatal tetanus (MNTE) as a public health problem, with all districts in all 11 countries having reduced cases to less than one per 1000 live births [15]. The Region is the second after Europe to achieve MNTE.

Since 2014, eliminating measles and controlling rubella and congenital rubella syndrome has been a Flagship Priority. In 2017, Bhutan and Maldives became the first two countries in the Region to eliminate measles. They were followed in 2018 by DPR Korea and Timor-Leste and in 2019 by Sri Lanka. Six countries—Bangladesh, Bhutan, Maldives, Nepal, Sri Lanka and Timor-Leste—have been certified for controlling rubella and congenital rubella syndrome. The Region is now focuses on eliminating both measles and rubella through wider immunization programmes with support from partners such as UNICEF and GAVI [16].

Yaws

This book focuses on diseases like malaria, lymphatic filariasis, yaws, trachoma and mother-to-child transmission of HIV/AIDs and syphilis. Chapters highlight the historical context, country experience and the best practices which led to the elimination of these infectious disease by the SEAR Member States.

In May 2016, WHO certified India as yaws free after a team of experts verified interruption of disease transmission [17]. India became the first country under the 2012 WHO neglected tropical diseases (NTD) roadmap to eliminate yaws. Indonesia and Timor-Leste are now the only remaining countries in the Region with yaws transmission, which they are working to halt [18].

Mother-to-child transmission of HIV and syphilis

In 2016, Thailand became the first country in Asia to eliminate mother-to-child transmission of HIV and syphilis [19]. In 2019, Maldives and Sri Lanka followed, with all countries working towards the target [20].

Lymphatic filariasis

Three countries in the Region—Maldives, Sri Lanka and Thailand—have eliminated lymphatic filariasis (LF) as a public health problem [21, 22]. Six LF-endemic countries in the Region are working towards elimination—Bangladesh, India, Indonesia, Myanmar, Nepal and Timor-Leste.

Malaria

Two countries in the Region—Sri Lanka and Maldives—have been certified malaria free [23]. In just two years, India has reduced malaria incidence by half.

Trachoma

In 2018, Nepal became the first country in WHO South-East Asia Region to eliminate trachoma, a neglected tropical disease that leads to blindness, as a public health problem.

Leprosy

Leprosy, which was eliminated as a public health problem globally in 2000 and by 2010 in all countries in the SEA Region, still continues to occur and cause disabilities in large number of people at subnational levels in some countries of this Region. Leprosy elimination offers learning on how to sustain disease elimination.

1.5 The Way Forward

Disease elimination and eradication have returned to the global agenda, along with the need to strengthen primary health care and achieve UHC. Diseases targeted for elimination are typically those that disproportionately affect the poor and disadvantaged and include, but are not limited to, yaws, malaria and polio. Elimination campaigns are often attractive to decision-makers because they can attract substantial external and domestic funding, as in the case of AIDS, TB and malaria currently, and smallpox and polio in the past. Elimination campaigns are often accompanied by a sense of urgency that is seldom attached to health service delivery more generally. Disease elimination typically requires granular planning at the district level.

To drive progress towards the complementary goals of disease elimination and UHC, several areas should be of focus.

Link Disease Elimination Efforts with UHC

Disease elimination programmes have long been seen as distinct from broader health systems architecture. In practice, this distinction is not apparent, nor should it be. Elimination campaigns can, with thoughtful planning, promote service integration and strengthen basic services. This was seen in the smallpox campaign, which was leveraged to promote broader immunization strategies in India. The same can be said of malaria control and HIV programmes. Patient- and community-centric

disease elimination efforts can—and should—strengthen health service delivery more generally.

To achieve global elimination targets, the world will need investment in UHC and people-centred primary care systems as well as in focused elimination programmes. While disease control elements are often clear and simple, determinants of health coverage are complex and require multifaceted action along with an extended time-frame. In view of the goals and targets identified in the SDG framework, the global community must remain committed to UHC, with a linked outreach component of disease prevention. Such a linkage is necessary to ensure primary and secondary prevention against disease transmission and early detection, as well as treatment at the community level.

Prioritize Multisectoral Engagement for Disease Elimination

High-level political commitment and the involvement of non-health ministries are critical for most disease elimination efforts. Elimination drives should ideally be led by the office of the head of State or planning through a structure similar to the one used for the AIDS response, which has included national AIDS councils or coordinating bodies. While such platforms have, on occasion, marginalized health system-led responses, some variants of national AIDS councils have empowered health systems rather than weakening them. Such platforms have not yet been developed for the diseases set for elimination under the SDG framework. Doing so could potentially aid efforts to go the last mile, and also protect against disease resurgence and even accommodate campaigns for certain non-communicable diseases, such as the phasing out of trans-fats.

Ensure Strong Subnational Action

Key to the elimination agenda is developing subnational frameworks of validation. Although not all disease elimination efforts have done this (opting instead for a national-level approach), subnational frameworks have demonstrated their utility many times over. In the case of malaria elimination efforts, subnational frameworks have allowed for micro-level planning, local administrative ownership (including through monitoring and validation), and locally led efforts to sustain elimination. Subnational frameworks also facilitate the estimation of local resource needs, in addition to local output and outcome measurements. All countries should develop and implement subnational frameworks to sustain and accelerate progress towards the elimination targets.

Ensure Rapid Transmission of Information

Disease elimination efforts have often been guided and informed by arbitrary national benchmarks. In the case of leprosy, for example, reliance on national benchmarks has allowed all countries in Asia to have technically eliminated leprosy, even as substantial pockets of leprosy persist. The achievement of elimination based on national targets has too often limited the long-term political commitment required to address persistent, localized pockets of disease burden.

Every disease elimination campaign must have the capacity to make course corrections, at both the pre-elimination stage, as well as during the last mile. Real-time reporting can inform strategic decision-making for mid-course corrections, for example, by addressing resource gaps and supply failures. But real-time monitoring has yet to become a reality in all programmes, even with a widespread availability of digital communications networks. This must change.

Prioritize Disease Surveillance

Although elimination efforts underscore the need for robust communicable disease surveillance, this function is typically either absent or too weak. Since surveillance is one of the most essential elements for elimination, health systems must initiate and/or strengthen surveillance.

Involve Communities and People

The involvement of local communities can have a significant impact on the success or otherwise of disease elimination efforts. Community engagement can occur in a number of ways. Traditionally, programmes such as insecticide spraying, and the delivery of condoms or medicines to sex workers, were shaped and administered by actors outside the community. They were often met with resistance. Another approach is to involve the community at different stages of planning, design and evaluation of the programme. For example, opening clinics in times and locations acceptable to drug users or LGBT people are good examples of community-centred and informed interventions that local communities have helped shape. These approaches tend to be more successful, although they may be unsustainable once funding has been exhausted.

Increasingly, and especially in the case of HIV, there is growing emphasis on the need for services that are delivered by members of affected communities. Growing evidence indicates that these community-delivered approaches are sustainable, cost-effective and highly successful in achieving the health goals. All efforts should be made to apply similar programmes where appropriate.

Maximize Access to Global Public Goods

To hasten disease elimination, the global community must link technologies and technical approaches developed in the Global North with technical expertise and local know-how in the Global South. The potential impact of combining the strengths of the Global North and South are evident in successful campaigns against smallpox, polio and Guinea worm disease, and should be applied in the present moment as much as possible.

Recognize the Rights of People Affected by Communicable Diseases

Too often, disease control efforts have been motivated more by a desire to protect the "general" population than a recognition of the rights of every person, including those who are marginalized, to the highest attainable standard of health. The interests of local populations were often regarded as secondary. This approach is both heartless

and short-sighted. If the SDGs are to be realized, the world must promote and protect the rights, health and well-being of all communities, rich and poor.

Keep the Promise

The global community has committed to making communicable diseases a thing of the past. Taking account of the extraordinary toll these diseases have taken and the threat they continue to pose to future health and well-being, the world must follow through on its pledge, throughout the response to the COVID-19 pandemic and beyond. Disease elimination and eradication are powerful ideas that can galvanized health systems, donors and governments, while easing the disease burden of the poor and the disadvantaged and reducing health disparities. It is an idea that must complement health systems strengthening and the drive towards UHC so that the Region—and the world—can achieve SDG 3 and build a healthier and more sustainable future for all.

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Chapter 2
Thailand: Elimination of Mother-to-Child Transmission of HIV and Syphilis

Rangsima Lolekha, Usa Thisyakorn, and Mukta Sharma

Abstract On 7 June 2016, the World Health Organization (WHO) certified that Thailand had eliminated mother-to-child transmission (EMTCT) of HIV and syphilis, becoming the second non-member country (after Cuba) of the Organization for Economic Co-operation and Development to achieve these goals. The HIV epidemic in pregnant women in Thailand started in the 1990s and the national HIV prevalence among pregnant women attending antenatal care (ANC) clinics peaked at 2.3% in 1995. The Thai government launched a nationwide programme to incorporate the provision of AZT as a routine component of ANC care in 2000 which played a key role in EMTCT of HIV and syphilis. Scale-up of the programme was facilitated by a tripling of the national budget for prevention of mother-to-child transmission (PMTCT) and by local generic manufacture of less costly versions of the drug. Thailand has an excellent public health system and most citizens are covered by one of the health insurance schemes—Universal Health Insurance scheme, Social Security scheme, Civil Servant Medical Benefit Scheme and Private Health Insurance. These were some other factors that supported Thailand in EMTCT, along with the integration of PMTCT into MCH services in 2000. Thailand's EMTCT exemplifies key attributes that define a results-driven response to HIV, including strong sustained political commitment, using scientific data to guide responses, adapting systems and policies to drive progress and investing in strategic information systems.

CDC disclaimer: The findings and conclusions in this report are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_2

2.1 Background

On 7 June 2016, the World Health Organization (WHO) certified that Thailand had eliminated mother-to-child transmission (EMTCT) of HIV and syphilis, becoming the second non-member country (after Cuba) of the Organization for Economic Co-operation and Development to achieve these goals [1]. Thailand's EMTCT of HIV offers both inspiration for the ambitious HIV agenda outlined in the Sustainable Development Goals and practical lessons that other countries can take on board. Thailand, an upper-middle-income country, has demonstrated that the vision of an AIDS-free generation is feasible not only for high-income countries but also for other countries [1]. This was an inspiration for many other countries in the South-East Asia (SEA) Region to take action and attempt similar elimination efforts.

2.2 The Process

The HIV epidemic in pregnant women in Thailand started in the 1990s [2] and the national HIV prevalence among pregnant women attending antenatal care (ANC) clinics peaked at 2.3% in 1995 [3]. In 2016, Thailand's certification by WHO followed many years of strong and sustained political support for HIV prevention.

2.2.1 The Initial years

In 1988, the first known case of an HIV-positive pregnant woman was reported [2]. Then, the Ministry of Public Health (MoPH) started a programme to provide infant formula for infants born to HIV-positive mothers to lower the risk of MTCT of HIV. In 1993, Thailand began implementing HIV voluntary counselling and testing (VCT) for pregnant women at ANC setting in some provinces. According to the findings of the paediatric clinical trial ACTG 076 on the effectiveness of zidovudine (AZT) for the prevention of mother-to-child transmission (PMTCT) in 1994, AZT became the standard of care for PMTCT in Western countries. However, the use of AZT in resource-limited settings was limited due to high drug costs. Although study results reported in 1994 indicated that the use of AZT could substantially reduce the risk of MTCT of HIV [4], the cost of the regimen was beyond the means of the national programme [1].

2.2.2 Reducing Costs

The Thai government in 1995 collaborated with the U.S. Centers for Disease Control and Prevention (CDC) in Thailand and other partners to undertake short-course AZT studies. They found that an affordable, short course of oral AZT reduced the risks of MTCT by half [5]. These results showed a 50% reduction in transmission, which prompted the government to launch a nationwide programme to incorporate the provision of AZT as a routine component of ANC care in 2000 [1]. Scale-up of the programme was facilitated by a tripling of the national budget for PMTCT and by local generic manufacture of less costly versions of the drug [1].

Between 1997 and 1999, the MoPH conducted pilot projects for PMTCT of HIV in the north and north-eastern regions of Thailand [6, 7]. The Thai Red Cross Society also provided public donations of standard PMTCT services under the patronage of Her Royal Highness Princess Soamsawali, an example that non-governmental organizations (NGOs) can also lead policy development [8, 9]. From 1996 to 1999, there were almost 3000 HIV-infected pregnant women and their infants from 81 hospitals in 40 provinces receiving AZT through this programme [10]. In 2000, the MoPH launched a national PMTCT policy in all public hospitals to integrate PMTCT of HIV into routine maternal and child health (MCH) services, including HIV VCT, syphilis and hepatitis B infection screening among pregnant women, provision of antiretroviral (ARV) prophylaxis for HIV-positive pregnant women, and provision of infant formula and ARV prophylaxis for infants born to HIV-positive mothers. From 2000 to 2014, drug regimens were changed according to updated Thai and international guidelines [2, 11]. Finally, lifelong antiretroviral therapy (ART) option B+ was adopted in 2014. The milestones of the PMTCT programme are depicted in Fig. 2.1.

At a time when global coverage for ARV prophylaxis in ANC settings was minimal, Thailand was, by 2001, providing two out of three pregnant women with services to prevent MTCT of HIV [6]. Beginning in 2001, the Thai government committed to ensure universal access to PMTCT and incorporated these services into the country's universal health coverage (UHC) scheme [1]. Coverage of services for PMTCT rapidly rose, with 94% of pregnant women receiving HIV testing and counselling in 2009 and 94% receiving ARV prophylaxis. In recent years, the coverage of HIV-positive pregnant women receiving ARVs for PMTCT has exceeded 95% [2]. In 2015, more than 99% of infants born to HIV-positive mothers in Thailand received ARV prophylaxis to prevent MTCT of HIV [2].

2.2.3 Moving Towards Elimination

Thailand actively embraced the global goal of EMTCT, as set forth in the Global Plan towards the Elimination of New HIV Infections among Children and Keeping their Mothers Alive [12]. To guide countries in their efforts to eliminate MTCT of

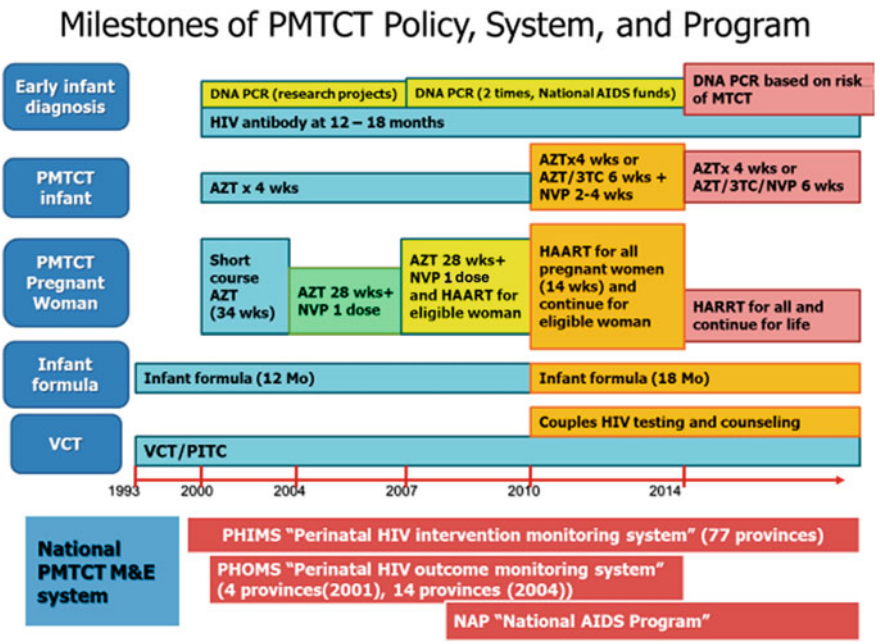

Fig. 2.1 The PMTCT policy, system and programme: 1993–2014 [2]. 3TC: lamivudine; AZT: zidovudine; HAART: highly active antiretroviral therapy; M&E: monitoring and evaluation; NVP: nevirapine; PCR: polymerase chain reaction; PITC: Provider-initiated testing and counselling; PMTCT: prevention of mother-to-child transmission; VCT: voluntary counselling and testing

HIV, WHO outlined criteria for validation of EMTCT of both HIV and syphilis [13]. To qualify for validation, countries must achieve 50 or fewer new paediatric HIV infections per 100,000 live births and an MTCT rate of less than 2% among non-breastfeeding populations (less than 5% in breastfeeding populations) for at least 1 year [13]. The validation also requires at least 95% ANC coverage (at least one visit), at least 95% HIV and syphilis testing coverage among pregnant women, and at least 95% ART and syphilis treatment coverage among HIV-positive pregnant women [13] (Table 2.1). The impact and process indicators for validation of EMTCT in Thailand are shown in Table 2.1. The timeline of the Thailand EMTCT process is summarized in Table 2.2.

2.2.3.1 Reaping the Benefits of Elimination

As WHO certified in 2016, Thailand's commitment to EMTCT has achieved striking results and met WHO's EMTCT validation criteria. The MTCT rate in the 1990s exceeded 20%; it fell to just 4.6% in 2008 due to overall success in controlling the HIV epidemic and fell further to less than 2% with focused PMTCT interventions in 2015 (Fig. 2.2) [2].

Table 2.1 Impact and process indicators for validation and re-validation of EMTCT of HIV and syphilis in Thailand [2, 14]

Impact indicators	EMTCT targets [13]	Validation		Re-validation	
		2014	2015	2016	2017
1.1 MTCT rate of HIV by birth cohort	Non-breastfeeding <2% Breastfeeding <5%	2.0%	1.91%	1.79%	1.68%
1.2 Annual rate of new pediatric HIV infections per 100,000 live births	≤50	12.2	11.5	10.7	9.7
1.3 Annual rate of congenital syphilis per 100,000 live births	≤50	11.0	10.9	15.1	14.7
Process indicators					
1.4 Population-level antenatal care coverage (at least one visit)	≥95%	98.1%	98.3%	98.5%	98.5%
1.5 HIV testing coverage of pregnant women	≥95%	99.8%	99.6%	99.7%	99.8%
1.6 Syphilis testing coverage of pregnant women	≥95%	99.3%	99.1%	99.2%	99.1%
1.7 ART coverage of HIV-positive pregnant women	≥95%	95.3%	95.6%	96.5%	96.5%
1.8 Treatment coverage of syphilis-positive pregnant women	≥95%	96.5%	95.9%	97.8%	97.5%

While an estimated 3000 children were acquiring HIV each year in Thailand in the late 1990s, fewer than 100 have become infected annually since 2013 [15]. While 85 children became infected with HIV in 2015, it is estimated that 1,076 would have acquired the virus if the country had not invested in services to prevent MTCT [2]. The country's efforts to prevent MTCT are estimated to have saved 17,000 infants from becoming infected with HIV [2].

Table 2.2 Timeline Thailand EMTCT of HIV and Syphilis Validation Process [2]

Dates	Key timeline
November 2014	Invited by UN to be a candidate country for EMTCT validation
December 2015	Submitted an official request to WHO SEARO from Thailand MOPH for validation of HIV and Syphilis
April 2016	Submitted the final Thailand validation of EMTCT of HIV and syphilis report to WHO SEARO
17–22 April 2016	Pre-validation visit to Thailand by the WHO regional validation team
7 June 2016	WHO announced Thailand first country in Asia to eliminate MTCT of HIV and syphilis

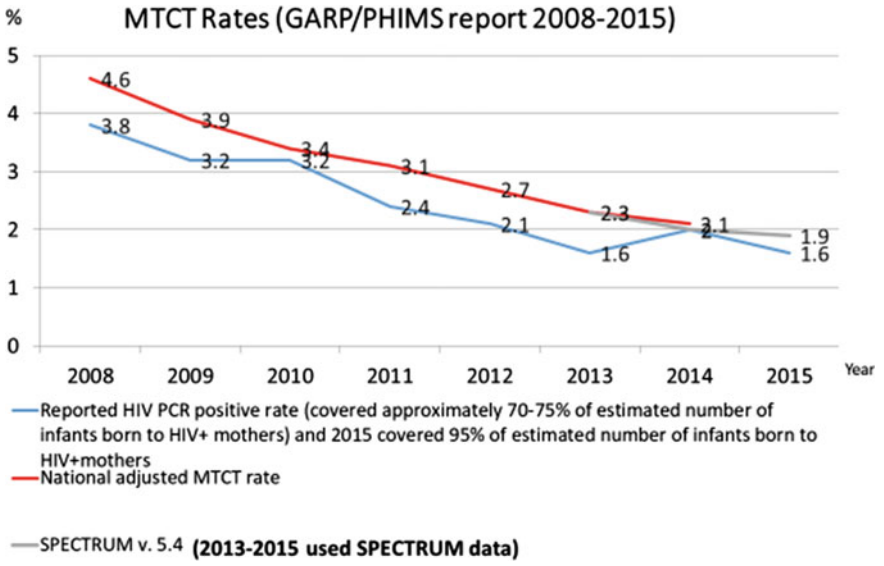

Fig. 2.2 Rate of MTCT of HIV in Thailand: 2008–2015 [2]. *Note* HIV DNA PCR data (2008–2014) were from National AIDS Program Database and 2015 data were from 14 national and regional Department of Medical Science laboratories, Department of Medical Technology Chiang Mai University laboratory and Ramathibodi Hospital laboratory. GARP: Global AIDS Response Progress Report; MTCT: mother-to-child transmission; PCR: polymerase chain reaction; PHIMS: Perinatal HIV Intervention Monitoring System

As the scientific evidence on optimal ways to prevent MTCT evolved, Thailand's approach evolved as well. For example, evidence of the benefit of lifelong ART for pregnant women prompted Thailand to implement this approach in 2014 [2].

Thailand's success in eliminating MTCT builds on its investments in health. Thailand ensures UHC, including documented and undocumented migrant populations. In 2015, more than 98% of pregnant women in Thailand accessed ANC [2, 7].

2.3 Other Factors for Success

Thailand has an excellent public health system and most citizens are covered by one of the health insurance schemes—Universal Health Insurance scheme, Social Security scheme, Civil Servant Medical Benefit Scheme and Private Health Insurance [2].

The MoPH ensures that the health services are efficient, equitable and standardized. The MoPH seeks participation from key stakeholders of society including government partners, Universities, private sectors and civil society organizations in national health development. Civil society engagement for HIV services is also strong.

The integration of PMTCT into MCH services in 2000 and expansion of the national HIV treatment programme in 2001 [7, 16, 17] with combination prevention efforts in Thailand led to a sharp decrease in the number of estimated new infections from 28,241 [16] in 2000 to 7816 in 2014 [16, 17] (Fig. 2.3). In 2014, Thailand had an estimated 445,504 PLHIV and 7,816 new infections at the time WHO invited Thailand to participate in the validation of EMTCT of HIV [17]. Thailand has also implemented the new guideline of providing antiretroviral treatment to all HIV-positive people regardless of CD4 cell count (Test and Treat) nationwide since October 2014 [18].

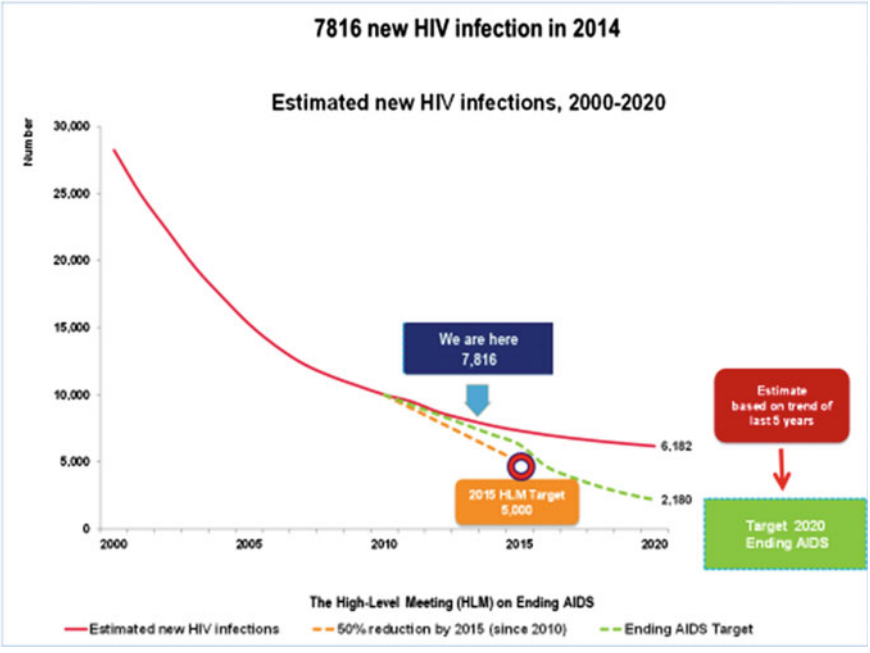

Fig. 2.3 Declining trends in new HIV infections 2000–2020 [17]

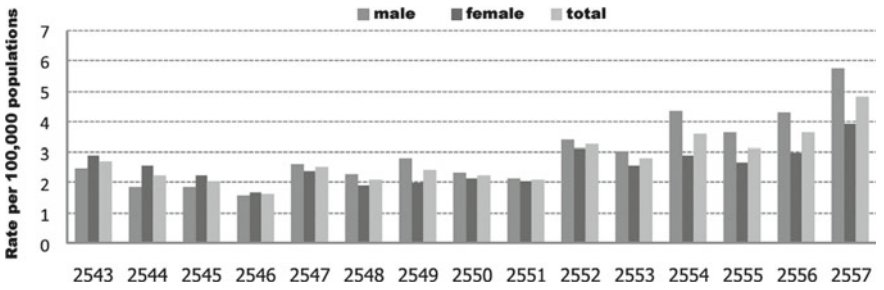

Fig. 2.4 Rate of syphilis per 100,000 population in Thailand, 2000–2014 [19]. *Source* National guidelines on elimination of congenital syphilis in Thailand 2015. Bangkok: Department of Disease Control, Thailand Ministry of Public Health; 2015
Note Years specified in x-axis are Thai years

The prevalence of syphilis has also declined over the years from 2000 to 2003 but some rising trends were seen from 2009 onwards (Fig. 2.4).

Thailand's longstanding investment in responding to HIV also enabled the country's elimination of MTCT. Thailand's pioneering national HIV prevention efforts in the 1990s sharply lowered HIV incidence, which at the time was rapidly rising [20]. Thailand's sustained commitment to HIV prevention has enabled new HIV infections to continue to decline in subsequent years. Since 2000, the number of new infections in Thailand has fallen by 80%—from 28,241 in 2000 [16] to 6400 in 2016 [17]. Significantly, Thailand has remained vigilant even in the midst of success; when evidence emerged of reductions in condom use and a possible spike in new HIV infections, Thailand made major new investments in condom and other HIV prevention programming [15]. By reducing the overall risks of acquiring HIV in the population, Thailand's prevention efforts ensured that fewer women would become infected, thereby strengthening the country's efforts to prevent new infections among children.

The country's EMTCT of HIV also underscores the importance of strategic data (Fig. 2.5). To inform and guide its efforts in preventing new infections among children, in 2000, the MoPH launched the Perinatal HIV Intervention Monitoring System with technical support from the U.S. CDC in Thailand [6]. Thailand has collected and analysed monthly data from hospitals, enabling public health officials at each level (province, regional, national) to respond in real time to emerging trends [2, 7]. Thailand also put in place a monitoring system specifically designed to track health outcomes of children born to HIV-positive mothers [21].

2.4 Maintenance of Validation

As per validation guidelines, countries that have been validated have to apply for maintenance of validation every two years. Accordingly, Thailand's progress from

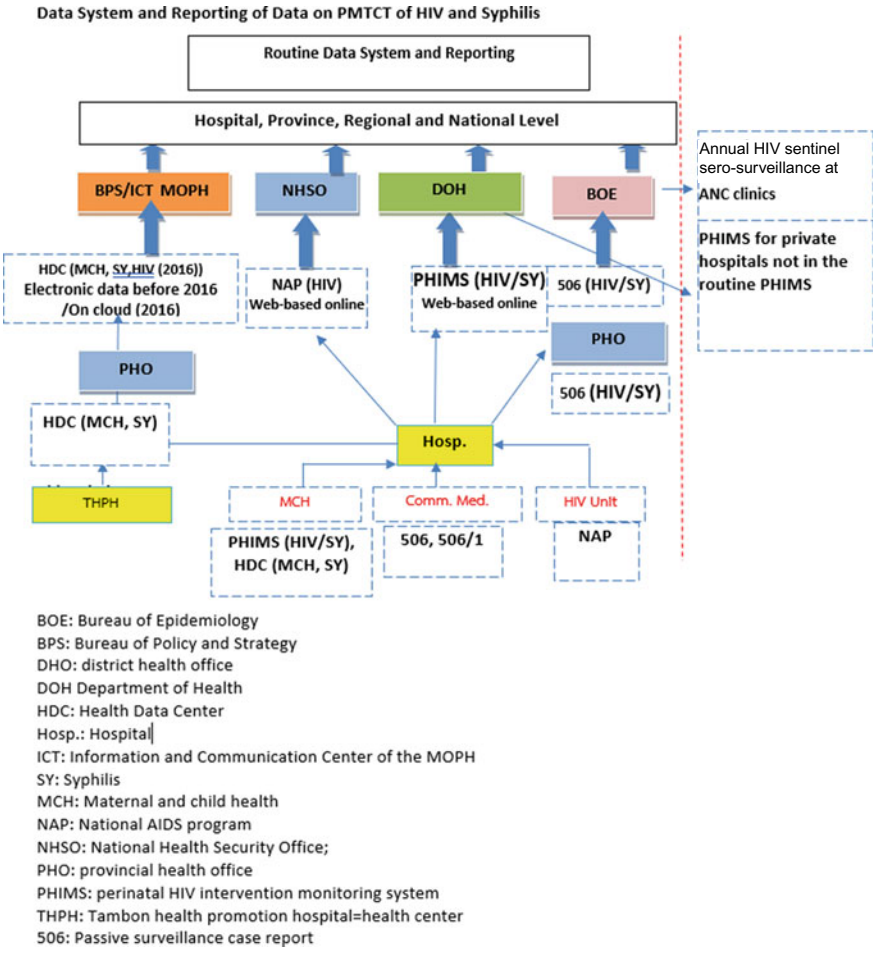

Fig. 2.5 Data system and reporting of data on PMTCT of HIV and syphilis [2]

2016 to 2018 was reviewed during the meeting of the Global Validation Advisory Committee (GVAC) in June 2019 [14]. The GVAC noted that Thailand met all the HIV and syphilis process and impact indicator targets for 2016 and 2017 (Table 2.1). In addition, the Thai MoPH has set more challenging goals for the EMTCT of HIV and syphilis [2, 7]:

- MTCT of HIV to <1% by 2020.
- No new perinatal HIV infections by 2030.
- Congenital syphilis case rate 0.05 per 1000 live births by 2030.

The GVAC unanimously approved Thailand for the maintenance of validation of EMTCT of HIV and syphilis in 2019. Subsequently, the country has been again validated in 2020 for having maintained the EMTCT of HIV and syphilis.

Thailand's EMTCT exemplifies key attributes that define a results-driven response to HIV, including strong sustained political commitment, using scientific data to guide responses, adapting systems and policies to drive progress and investing in strategic information systems. These are some of the building blocks that all countries in South-East Asia will require as they work to end the epidemics of HIV and STIs as public health threats.

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Chapter 3
Yaws: Freeing Young Children in India from an Old Scourge

Sujeet Singh, S. K. Jain, and Mohamed A. Jamsheed

Abstract In 2016, India became the first endemic country in the world to have been verified by the World Health Organization (WHO) as having eliminated yaws. Yaws was first reported in India in 1887, more than 125 years ago, from tea gardens in the state of Assam. It spread in central and central-eastern parts of India. However, by the late 1960s it declined dramatically worldwide including in India, where it was confined to 51 districts across 11 states of the country. The establishment of the anti-yaws campaign in 1952 and the launch of a restructured yaws elimination strategy in 1996 were game-changing moments in India's successful effort to eliminate yaws. The Government of India's enduring commitment to eliminate yaws had a determinative impact. Even after the disappointing re-emergence of yaws in the 1970s, a national commitment was sustained. Yaws elimination in India was built on a technically sound approach and on robust surveillance that enabled the programme to target high-priority settings and communities and verify the lack of transmission. Locally tailored strategies were undertaken to raise awareness of yaws in marginalized communities. Extensive training enabled medical officers, health workers and community functionaries from diverse departments to promote yaws identification, treatment and health education. Mobilization of financial resources also played a pivotal role in yaws elimination. India's successful decades-long push to become yaws-free offers important lessons for other endemic countries in the WHO South-East Asia Region, including Indonesia and Timor-Leste. Simpler treatment regimens should encourage other endemic countries that elimination of yaws is feasible.

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_3

3.1 Background

Yaws is a disfiguring and debilitating disease that affects the poorest and most marginalized. It primarily affects young children. In the absence of treatment, yaws leads to disability, stigmatization and often to the discontinuation of schooling. Its overall impact could be lifelong diminution of economic, educational and social opportunities.

Yaws is easily treated with a single oral dose of azithromycin, offering the potential for the elimination of the disease through well-designed treatment programmes. In 2016, India became the first endemic country in the world to have been verified by the World Health Organization (WHO) as having eliminated yaws [1]. India's successful decades-long push to become yaws-free offers important lessons for other endemic countries in the WHO South-East Asia Region, including Indonesia and Timor-Leste.

3.2 Disease of the Young

Yaws is part of a group of chronic bacterial infections known as endemic treponematoses. It is caused by a spiral bacterium that is related to the causative agent for syphilis [2]. As humans are the only known host for the infectious agent that causes yaws, effective treatment of yaws cases can interrupt the chain of transmission [2].

Yaws primarily affects people who live at the "end of the road", as it typically affects geographically remote areas with limited or non-existent access to health services [1]. The spread of yaws is closely linked with poverty, low socioeconomic conditions and suboptimal personal hygiene [2]. Yaws tends to affect poor communities living in warm, humid areas [2].

Most (75–80%) people who develop yaws are under the age of 15 years, with a peak incidence occurring between 6 and 10 years of age [2]. Males and females are equally vulnerable to yaws-related infection and disease [2]. The average incubation period of the disease is 21 days but can range up to 90 days [2].

Yaws affects the skin, bones and cartilage, first manifesting through lesions that typically occur on the limbs [2]. In the absence of treatment, the papilloma that typically serves as the first clinical sign of yaws will ulcerate [2]. Papillomata and ulcers associated with yaws are highly infectious [2]. Within weeks or months of primary infection, secondary yaws occurs in the form of multiple raised yellow lesions or pain and swelling of the long bones and fingers [2]. The infection often becomes latent, with relapse possible for 5–10 years [3]. Globally, it is estimated that latent cases of yaws outnumber clinically apparent cases sixfold [4].

Symptoms of primary and secondary infection offer opportunities for clinical diagnosis of the disease, and WHO has developed training materials to aid health and community workers in recognizing the disease [2]. However, once the papilloma ulcerates, diagnosis becomes more difficult and requires serological confirmation [2].

Latent infection can be diagnosed only with serological tests. Traditional laboratory-based tests to identify the causative agent of yaws cannot distinguish yaws from syphilis, often making interpretation of results in adults difficult [2]. Point-of-care rapid tests are available for the detection of both past and current infection [2]. Definitive confirmation of yaws requires polymerase chain reaction (PCR) technologies, which also have the capacity to detect resistance to azithromycin [2].

Two antibiotics—azithromycin and benzathine penicillin—can effectively treat yaws [2]. In 2012, a controlled clinical trial in Papua New Guinea found that a single oral dose of azithromycin for the treatment of yaws was non-inferior to a single intramuscular dose of benzathine penicillin [5]. Due to ease of administration and logistics, single-dose azithromycin is the preferred treatment for yaws [6].

The epidemiology of yaws is imperfectly understood, as yaws is not a notifiable disease in many countries [3]. Of the 13 countries that are known to be endemic for yaws, only eight regularly report data to WHO [2]. Among the eight endemic countries that report to WHO, more than 46 000 yaws cases were reported in 2015 [2]. It is estimated that 89 million people worldwide live in areas where yaws is endemic [3]. In South-East Asia, it is estimated that 34.6 million people in Indonesia are living in yaws-endemic districts in 2012, and 1.2 million in Timor-Leste (Fig. 3.1) [3].

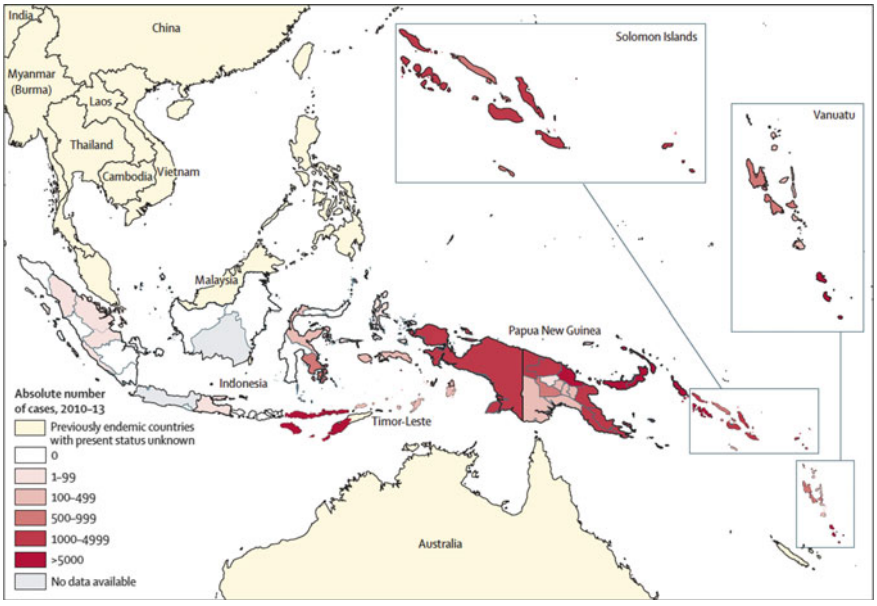

Fig. 3.1 Cumulative number of yaws cases in the WHO South-East Asia and Western Pacific regions. *Source* Global epidemiology of yaws: a systematic review. Lancet Glob Health. 2015;3(6):e324–e331

WHO, in collaboration with the United Nations Children's Fund (UNICEF), targeted yaws for elimination in the years following its founding in 1948 [2]. The validation of a simple, single-pill, oral regimen for the treatment of yaws prompted WHO in 2012 to adopt a new global strategy for the elimination of yaws [6]. Known as the Morges strategy, the global elimination strategy focuses on interventions wherever the disease occurs. The strategy includes two approaches—total community treatment (or treatment of an entire endemic community) or targeted individual treatment, which focuses treatment efforts on confirmed cases and their contacts [6]. In addition to the 13 endemic countries, 73 previously endemic countries are advised to take steps to confirm whether they remain yaws free [2].

To qualify for WHO verification as being yaws free, countries must demonstrate (i) the absence of a new indigenous case for three consecutive years; (ii) lack of evidence from sero-surveys of yaws transmission for three consecutive years; and (iii) negative PCR results in suspected lesions [2].

3.3 India's Approach to Yaws Elimination

The first cases of yaws in India were noticed in 1887 among tea plantation workers in Assam. The disease probably came from Sri Lanka where it was known as "parangi" or foreigner's disease, possibly because it was introduced there by Europeans during the colonial period. From Assam, yaws later spread to other states—Orissa and Madhya Pradesh. In the tribal region of Bastar, historical records suggest that a mass campaign employing arsenicals was implemented between 1935 and 1946 to tackle yaws. In the 1940s, yaws was prevalent in a geographically contiguous area covering districts in Madhya Pradesh, Uttar Pradesh and Bihar. Around the same time, the disease had ceased to exist in Sri Lanka, mainly due to efforts such as the use of parenteral arsenicals and general improvement in health care in rural areas.

A yaws control programme was initiated in India in 1952, with support from WHO and UNICEF. The objective of the programme was threefold: (i) making available modern methods of yaws control in the affected regions; (ii) building up coordinated action against the disease to ensure that there was no possibility of reintroduction; and (iii) integrating mass treatment into existing health services. Active case search and treatment programmes were launched in Orissa, Madhya Pradesh, Maharashtra and Andhra Pradesh. Villagers were surveyed to identify cases and their contacts and treat them with long-acting penicillin. These initial treatment surveys were then followed by resurveys at varying intervals. The programme included selective mass treatment of all cases, their households and other contacts with a single injection of PAM (penicillin G in oil with 2% aluminum monostearate). Between 1952 and 1964, this effort resulted in the medical examination of approximately 6 million people, and identification and treatment of 200 000 cases as well as their contacts [1]. The strategy yielded dramatic results in the five targeted states—the prevalence of yaws fell to about 1% [1].

Following the decline in disease transmission, management of yaws was transferred to the general health services in states. Surveillance and treatment of residual cases were to be handled by the general health services and most states abandoned active anti-yaws activities. After 1964, specific activities, including mass treatment in endemic areas, continued through a network of primary health centres and subcentres. The emphasis was on infectious foci rather than on resurveys of burnt-out foci. The result of this approach was re-emergence of the disease. In 1977, 21 cases were reported in Madhya Pradesh, mostly in children.

Resurgence of yaws in the 1970s and 1980s persuaded the national government to undertake a comprehensive investigation of yaws, and collect information from all states and union territories in India. In 1986, the National Institute for Communicable Diseases (now the National Centre for Disease Control) restructured the country's yaws eradication strategy to prioritize active search and treatment with benzathine penicillin, health education and social mobilization.

In 1997, the country launched its Yaws Eradication Programme (YEP) as a national health scheme, beginning with pilot projects in Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra and Orissa. In 1999, the Programme was scaled up to 51 districts in 10 states that had previously reported yaws cases [1]. The Programme strategy included development of human resources, detection of cases through active search, simultaneous treatment of cases and contacts, and awareness activities. Cases were detected during house-to-house visits by multipurpose workers and community functionaries. This activity was undertaken twice a year—April to May and October to November. To facilitate the identification of cases, paramedical workers were provided with coloured disease recognition cards and health education materials. Yaws teams were deployed in few endemic areas with poor health delivery systems [7]. The cases thus detected were treated along with close contacts simultaneously and immediately after detection. For every case detected, about 10 contacts were treated. Typically, contacts would include family members, playmates, school friends, depending on the age and mobility of the patient. Injection of long-acting benzathine penicillin G given in a single dose was the drug of choice.

There were several important aspects of the programme, including political commitment and monitoring at the highest level and close inter-sectoral coordination and collaboration with other departments.

The National Health Policy 2002 included yaws elimination in its policy statement, indicating national commitment to get rid of this scourge. A task force, led by the Director General of Health Services of the federal Ministry of Health, was formed for timely monitoring of the programme and providing technical guidance. An important aspect of the Programme was close intersectoral coordination and collaboration with other departments and schemes—tribal development, Integrated Child Development Scheme, Panchayati Raj (local bodies), forest and education. Representatives of all these departments participated in programme reviews at all levels. Community-level functionaries of other departments also helped in the identification of cases. Schoolteachers and community-level functionaries of other departments were trained in case detection using yaws recognition cards and were encouraged to report to the nearest health institutions.

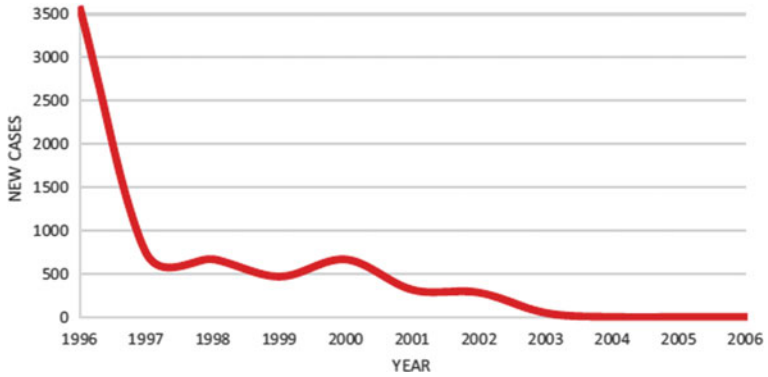

Fig. 3.2 Yaws cases in India since 1996. *Source* World Health Organization. Regional Office for South-East Asia. (2017). From neglecting to defeating NTDs. https://apps.who.int/iris/handle/10665/258727

The Programme was backed by a robust health infrastructure on the ground in all the 51 districts. In all, 570 community health centres, 2150 primary health centres, 13 500 subcentres covering about 35 000 villages were involved in the task. In terms of the human resources deployed, 4300 medical officers, 6950 male multipurpose health workers and 15 600 female multipurpose health workers participated in the yaws initiative. In addition, about 92 000 Anganwadi workers and 84 890 village-level health workers called Accredited Social Health Activists (ASHAs) also worked in tandem with the health departments. In this way, even remote and inaccessible villages were reached for detection, treatment and follow-up surveys.

The YEP achieved striking results (Fig. 3.2). Reported yaws cases in the country declined from 3571 cases in 1996 to 664 cases in 2000 [1]. In 2002, the Government of India announced in the national health policy its aim to end yaws transmission by 2005. In 2003, the last reported cases of yaws in India were diagnosed and treated [1].

The structural frameworks constituted for oversight of YEP helped provide technical guidance as well as the necessary political and administrative commitment. For the implementation of the eradication strategy, the district was taken as a unit. All the districts from where yaws cases were ever reported in the past were treated as endemic under the Programme. All villages of endemic districts were divided and categorized as yaws and non-yaws villages on the basis of information about the presence of yaws cases. Sero-surveys were conducted in villages to ascertain if transmission had been interrupted.

After reporting zero yaws cases for three years from 2004 to 2006, the country in 2006 launched an innovative, multi-component effort to confirm that yaws had, in fact, been eliminated. Incentives were introduced for confirmed cases of yaws and mechanisms were established for reporting and investigating rumours. A unique reporting system was devised to check reports of suspected cases even if they were unverified or were rumours. Anybody, including a suspected case, could report a

rumour of yaws to any functionary of the health system—health worker, medical officer or district health officer. A system was established for verification of rumours. Rumour registers were maintained at the district level. Preliminary verification was done by the medical officer of the primary health centre concerned. The rumour was then cross-checked by a multidisciplinary team at the district level consisting of a clinician (dermatologist), epidemiologist, microbiologist and district health officer. Finally, a multidisciplinary team from the Central Government investigated the case.

A cash incentive was given for voluntary reporting of yaws cases and the first informer of a confirmed case. In 2007, the Central Government introduced an incentive of INR 500 for an informer and INR 5000 for every confirmed case to encourage voluntary case reporting.

Another innovation to assess cessation of community transmission was serological surveys among children 1–5 years. Since clear guidelines from international bodies were not available for undertaking sero-survey among children in this age group, the yaws elimination nodal office developed a plausible, statistically valid methodology. It was based on a sampling design for sero-surveillance; type of serological test and logistic requirements; guidelines for collection and transport of blood samples; training of personnel; quality control of diagnostic kits; and identification of regional referral laboratories. These surveys, undertaken both in formerly yaws-endemic villages and in non-endemic villages, detected zero seropositivity annually for three consecutive years. Special care was taken to keep an eye on the migration of yaws in contiguous border areas of districts covered under the eradication programme. This was in addition to an active case search by Integrated Disease Surveillance Programme (IDSP) operational throughout the country.

In 2015, the national yaws programme submitted a dossier to WHO, documenting yaws elimination, which was confirmed by an international team of experts who visited the country to verify the interruption of transmission [1].

3.4 Challenges Faced by India in Its Efforts to Eliminate Yaws

One of the most substantial challenges that India faced in combating yaws was the concentration of the disease in geographically remote areas [1]. This created challenges with respect to identifying and treating cases. In the latter stages of India's elimination effort, the country confronted challenges in undertaking careful surveillance in geographically remote areas to identify any remaining cases and to verify the absence of transmission.

As in other countries, yaws in India predominantly affected poor, remote communities with limited access to health services. Although health coverage in India has markedly increased in recent years, rural Indians often remain the least likely to have meaningful access to health services [8], a pattern that a major new initiative by the national government to further expand health coverage aims to rectify.

As the most striking gains against yaws in India occurred prior to the 2012 study validating the single-pill oral regimen for treatment of yaws, India's successful elimination campaign focused on the delivery of benzathine penicillin, which requires an intramuscular injection. The fact that India succeeded in eliminating yaws with a treatment intervention that is more complicated to deliver than the preferred oral regimen attests to India's extraordinary commitment to yaws elimination.

Early success in the country's yaws elimination efforts prompted the country in the mid-1960s to adopt a diminished disease-specific focus, leaving it to the general health services to address new yaws cases. As a result of the loss of focus, yaws re-emerged in the 1970s. The return of yaws as a public health concern led to renewed commitment and focus, with a concentration on active search and treatment of new cases, health education and social mobilization.

3.5 Yaws Elimination in India: Key Elements of Success

Establishment of the anti-yaws campaign in 1952 and the launch of a restructured yaws elimination strategy in 1996 were key "game-changing" moments in India's successful effort to eliminate yaws. The Government of India's enduring commitment to eliminate yaws had a determinative impact. Even after the disappointing re-emergence of yaws in the 1970s, a national commitment was sustained. The National Centre for Disease Control trained and sensitized states regarding yaws, and district-level advocacy meetings were organized to extend further awareness of the disease. National commitment to eliminate yaws extended well beyond the last confirmed new case, as the government undertook concerted efforts to maintain vigilance and to confirm the actual elimination of the disease.

Yaws elimination in India was built on a technically sound approach and on robust surveillance that enabled the programme to target high-priority settings and communities and verify the lack of transmission. Locally tailored strategies were undertaken to raise awareness of yaws in marginalized communities where vulnerability to the disease was highest. Extensive training enabled medical officers, health workers and community functionaries from diverse departments to promote yaws identification, treatment and health education. Trained paramedics and community workers carried out house-to-house visits, covering at least 90% of the population in endemic areas to identify cases and provide needed treatment. Protocols were implemented to deal with adverse events, and biosafety measures were put in place. For purposes of quality assurance, independent experts were retained to monitor the YEP.

Surveillance played a central role in the elimination of yaws in India. These efforts were especially challenging, as they were conducted in remote areas where health services were limited or non-existent. Innovative methods, such as incentives and rumour reporting, complemented the findings from serological surveys. Serological surveys, using the rapid plasma reagin (RPR) test with *Treponema pallidum* haemagglutination assay (TPHA) for confirmation, were carried out during 2009–2011. The surveys, which covered over 18 000 children in erstwhile yaws villages, found no

serological evidence of yaws infection. For comparison purposes, over 39 000 children in non-yaws villages were also tested and none was found positive [9]. These surveys clearly indicated the cessation of yaws transmission in the community and the country.

Yet another key factor for India's success in eliminating yaws was the active involvement and leadership of communities. With the support of the national government, community-level health volunteers raised yaws awareness, identified cases and followed up on treatment. Active search campaigns were undertaken in yaws-endemic areas, and various means, including posters and billboards, messages during weekly markets in tribal areas, active messaging by community leaders, and folk songs and other traditional methods were employed to educate and engage affected communities.

Mobilization of financial resources played a pivotal role in yaws elimination. Since 1952, the Government of India provided all the financial support for training, awareness-raising and costs of implementing the yaws programme. The government also underwrote all costs associated with the provision of incentives for reporting confirmed cases after 2006 and the serological surveys that confirmed the interruption of transmission.

3.6 The Road Ahead: Lessons Learned

The eradication of yaws from India provides important lessons for countries currently reporting cases– including in Indonesia and Timor-Leste. Political commitment and availability of financial resources ensured prioritization of programme implementation by state health departments. Early case finding, contact tracing and treatment guided by disease surveillance and programme monitoring led to the cessation of transmission. Intersectoral coordination and innovative approaches to reach hard to reach population ensured community participation. Leveraging strengths of the health system for a focused programme, with strong oversight, is important. In addition, involvement of other ministries and departments such as tribal development, drinking water and sanitation is also critical in the eradication of a disease that mostly affects marginalized people living in remote areas.

Factors such as the absence of any animal reservoir, localized foci of infection in endemic countries and minimum training required for the diagnosis make yaws amenable to eradication. But efforts need to continue till the last case is diagnosed, treated and cured, as demonstrated by India [9]. The elimination of yaws in India could offer inspiration as well as important lessons for other countries where the elimination process is in progress. India's experience highlights the importance of sustained political and financial commitment, the need for proactive approaches to find cases and deliver essential treatment, the importance of surveillance in guiding elimination efforts, and the value of local innovation and community engagement.

The strengths of the existing health system were leveraged for the elimination programme, which shows the effectiveness of strategic deployment of available

resources with necessary inputs such as training of healthcare workers. The success was also due to close cooperation and coordination between the central health agencies and state health departments, as well as the involvement of other ministries and departments in charge of tribal development, drinking water, sanitation and forests. Such a collaborative effort ensured optimum use of resources available in remote areas where interventions had to be carried out. The collaborative spirit also helped in monitoring, feedback and surveillance, in addition to the implementation of the elimination strategy. Independent experts visited remote areas at regular intervals to verify that community transmission of yaws had been interrupted.

The fact that India achieved yaws elimination prior to the validation of the currently preferred, simpler treatment regimen should encourage other endemic countries that elimination of yaws is feasible. Now, single-dose oral treatment with azithromycin given in one or two rounds of large-scale administration may be sufficient to interrupt transmission, depending on the initial coverage [10]. There are several reasons why yaws is unlikely to re-emerge post-elimination, including its geographical concentration and the fact that humans are the only known reservoir of infection. Still, the Government of India is maintaining vigilance following WHO verification of yaws elimination, as yaws training has been integrated into the general health services.

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Chapter 4
The Maldives: A Long Battle to Banish Malaria

Mohamed Hameed, Hussain Habeeb, Zakiyya Hassan, Maimoona Aboobakuru, and Arvind Mathur

Abstract After having remained malaria-free for more than three decades, Maldives was the first country in the WHO South-East Asia Region to eliminate malaria. Maldives has maintained its malaria-free status over more than three decades, successfully averting the resurgence of malaria that has occurred in many countries of the world. Maldives was formally certified as malaria-free by the World Health Organization in 2015. Malaria had long been a health scourge in pre-Independence Maldives, and this was the status at the time of Independence. The earliest malaria surveys in Malé and Malé Atoll, undertaken with WHO support, found parasite rates ranging from 0.22 to 52%, with as many as 50–60% of children in some parts of the country exhibiting signs of infection. In the late 1960s, the Global Malaria Eradication Programme which was launched in 1955, was about to be withdrawn and the Maldives, despite limited resources, ventured into malaria elimination. The successful formula which led to elimination of malaria from Maldives consisted of strong epidemiological surveillance, ensuring prevention through port health and international travel, effective health care, and integrated vector surveillance and control. 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.

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_4

4.1 Background

The Maldives became the first country in the WHO South-East Asia Region to eliminate malaria, after having remained malaria-free for more than three decades. The last indigenous case of malaria in the country was recorded in 1984. It is significant that the Maldives has maintained its malaria-free status over more than three decades, successfully averting the resurgence of malaria that has occurred over recent decades in many countries across the world. WHO formally certified the Maldives as malaria free in 2015 [1]. The country became malaria free against considerable odds and could have achieved and sustained this status only through strong political commitment, innovation, mobilization of communities and evidence-guided action.

When the Republic of The Maldives became independent in 1965, it was one of the poorest countries in the Region, with limited and fragile human infrastructure. Formally educated doctors and nurses were rare to find in the early 1960s. Today, The Maldives is an upper-middle-income country, and malaria elimination has played an important role in the country's rapid economic development, which is closely linked to tourism [2].

Malaria had long been a health scourge in the pre-Independence Maldives, and this was the status at the time of Independence. The earliest malaria surveys in Malé and Malé Atoll, undertaken with WHO support, found parasite rates ranging from 0.22 to 52%, with as many as 50–60% of children in some parts of the country exhibiting signs of infection [3].

Maldivians were vulnerable to three species of malaria parasites: *Plasmodium falciparum*, *P. vivax* and *P. malariae*. Although *P. falciparum* occurred predominately among malaria cases globally and across most of South-East Asia, *P. vivax* accounted for roughly half of all infections in the Maldives [2]. Malaria posed a significant health challenge in the Maldives as it was highly endemic in all the inhabited islands spread across the natural atolls in the Indian Ocean that make up the Maldives. For any elimination strategy to yield the desired results, it had to be equally effective in all the islands where people lived and malaria-carrying mosquitoes thrived. The disease was so common for such a long time in the country that some of the earliest records of foreign travellers refer to it as the "Maldives fever". The famous fourteenth-century traveller, Ibn Battuta, is said to have contracted the Maldives fever during his visit to the islands [4].

All the conditions necessary for a vector-borne disease like malaria to flourish are present in The Maldives—temperature and relative humidity levels that favour the development and longevity of vectors, rainfall patterns that help mosquitoes to breed, parasite determinants and the problem of resistance [5]. Mounting a nationwide programme to eliminate malaria against all these odds was an uphill task.

4.2 Challenges Faced in Eliminating Malaria

When The Maldives launched the malaria control programme in 1966, a year after it attained Independence, it had extremely limited health infrastructure and human resources for health [6]. As a low-income country at the time of Independence, The Maldives had only limited financing resources to build its health system and undertake malaria control activities. Till then, efforts to control malaria were sporadic and were limited to the administration of quinine and then chloroquine when it became available as the drug of choice. There was no systematic plan in place to control the spread of the disease by way of surveillance, vector control or environmental management.

Interestingly, when the Maldives launched its malaria programme, the Global Malaria Eradication Programme, launched by WHO in 1955, was in the process of being withdrawn [2]. The global malaria eradication goal was abandoned in 1969 after malaria had been eliminated in many countries in Europe, North America and the Caribbean, but it continued to be a public health problem in South Asia and Africa [7]. The Maldives was not deterred by the change in global focus—from eradication back to control—and decided to push its anti-malaria campaign vigorously.

The Maldives confronted considerable challenges as it worked to combat malaria. The biggest challenge it faced was from the peculiar geography of the country [8]. The Maldives is made up of nearly 1200 islands that form 26 natural atolls in the ocean. Of these islands, 198 are inhabited. This kind of scattered geography and sparse populations inhabiting remote islands posed a formidable task for the malaria programme. This presented inherent problems in monitoring malaria and in linking at-risk individuals, households and communities to needed prevention and treatment interventions [2].

The main reason was the lack of mechanized transport between the islands, forcing malaria workers to use hand-operated small boats. These boats were slow and time consuming, putting an extra burden on health workers. Dedicated mechanized, seaworthy boats became available much later for the malaria programme and other health services.

The second challenge was that of the weather—many islands become inaccessible for months due to incessant rainfall and cyclonic weather and many of them did not have any harbour. In the initial phase, the programme also lacked the necessary human resources and skills required for carrying out a large elimination programme. These capacities and skills were developed as the programme went along. Another challenge was to ensure the uninterrupted availability of drugs and other supplies necessary for the malaria programme, given the fact that almost 100% of supplies had to be imported.

4.3 The Maldives' Approach to Malaria Elimination: Long Road

The first set of malaria control measures were introduced in Malé and Malé Atoll. These measures focused on indoor residual spraying, blood examination, entomological surveillance and mass drug administration of chloroquine and primaquine [5]. Malaria vectors and their breeding grounds were tracked for spraying in lakes, ponds, streams, barrels, tanks, coconut husks, basins, outdoor reservoirs, water jars, rooftop puddles, potholes and yam pits.

When the programme was launched, the malaria problem in the Maldives was significant. The spleen rates (the proportion of the population with palpably enlarged spleens due to infection) among children aged 2–9 years in Malé were as high as 15%, while the parasite rate was 35%. In Hulhule Island (which was then inhabited), the spleen rates in the same age group were as high as 60%, and for children under 2 years, the prevalence rate was 50%. In the early 1970s, prevalence surveys had shown that spleen rates were between 10 and 15%. This meant that one person in every 7–10 people was infected.

The initial malaria control operations undertaken in Malé helped health personnel to estimate the kind of resources and supplies needed for conducting operations in the rest of the inhabited islands. From 1967 to 1969, the programme was expanded countrywide. All health staff received training in malaria control, including spraying DDT. Given the scarcity of health facilities, the programme trained island chiefs also in tasks, including case detection, treatment, vector control and follow-up care [5]. Armed with DDT and primaquine (to eliminate relapses) for mass treatment, and other supplies and equipment, health workers went from island to island. A hospital boat, *Golden Ray*, donated by the British government, came in handy for these operations. Both vector control and mosquito surveillance were intensified, with DDT sprayed not just in every inhabited island but in nearby uninhabited ones also. Trained "spray men" were deployed to move from house to house with spray tanks of DDT on their backs, to search for larvae and adult *Anopheles* mosquitoes, along with their breeding sites. In addition, other vector control measures were carried out, such as the introduction of larvivorous fish and the administration of larvicides. Surveillance interventions at the household level were scaled up. Health workers conducted malaria prevalence surveys and mass drug administration of chloroquine and primaquine for five days to every inhabitant on all the inhabited islands of The Maldives.

All the malaria-related operations in the country were supervised by a malaria clinic opened in Malé in 1972. Subsequently, the malaria elimination programme was brought under the supervision of the Communicable Diseases Division in the Ministry of Health. Public awareness efforts were ramped up to educate people on how to prevent mosquitoes from breeding. In 1979, family health workers were inducted to assume responsibility for malaria control activities that were previously handled by island chiefs [5].

A combined result of all the control efforts was a remarkable drop in annual parasite incidence by about 50% each year during the 1970s [5]. As a result, malaria cases also plummeted, with the last case of *P. falciparum* reported in 1975, though *vivax* malaria continued to occur [2]. In 1975, the last indigenous case of *P. falciparum* was reported in Haa-Alif Atoll.

In order to sustain these results, a special intensified programme was organized and planned in 1978. As a part of this, a permanent team was posted to cover four vulnerable atolls. Its job was to undertake ultra-low-volume spraying and destroy larvae with the larvicide temephos. Preventive spraying was carried out in the neighbouring islands. Intensified epidemiological and entomological surveys were conducted from 1980 onward. The year 1984 proved to be a landmark year in the journey that began in 1966—the last indigenous case of *P. vivax* malaria was reported in Baa Atoll. The transmission of malaria, which appeared an uphill task in the 1960s, had finally been halted.

In the Maldives, the principal and secondary malaria vectors were *Anopheles tesselatus* and *Anopheles subpictus,* respectively. *A. subpictus* persisted on a few islands where transmission continued until 1984. In 1989–1990, *A. tessellatus*, which thrives in brackish water, was reported at low densities on four islands of one atoll. That was the last time it was reported. Entomological studies carried out during 1999–2001 for *Anopheles* in 32 islands, including uninhabited ones, did not find even a single mosquito carrying malaria parasites (Fig. 4.1).

Beginning in 1980, the government intensified surveillance and case management. Since the last case of malaria was reported in 1984, the government has continued to invest in malaria control activities, including surveillance, integrated vector control and larval control. Early detection, access to treatment, and adequate screening protocols are critical part of the post-elimination phase [2]. Malaria was included in the diseases made notifiable by the Health Protection Agency (HPA) of the Ministry of

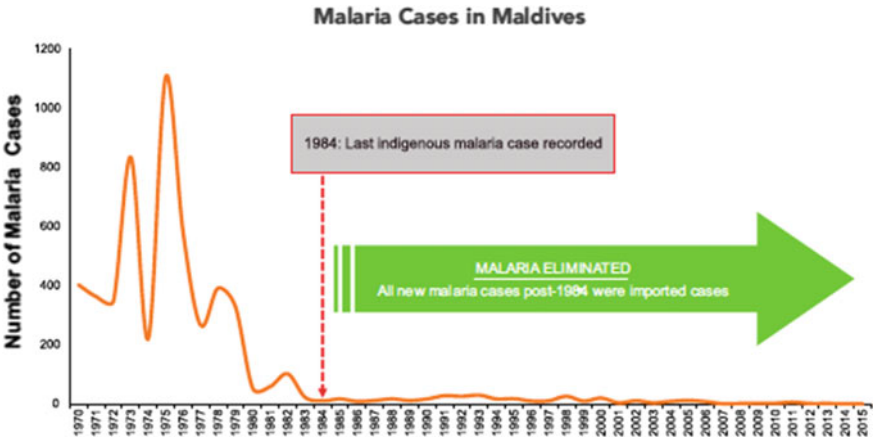

Fig. 4.1 History of malaria elimination in the Maldives. *Source* 0. Malaria-free Maldives. New Delhi: World Health Organization Regional Office for South-East Asia; 2016

Health [9]. This means that every case—indigenous or imported—must be immediately reported to the HPA, and thoroughly investigated, classified, radically treated and entered into a central database according to the protocol. Migrant workers from endemic countries are screened and treated as necessary, and vector control activities are undertaken for all inbound flights and ships. This is important because there is substantial population movement and in-migration of people from malaria-endemic countries, posing a challenge to post-elimination surveillance and vector control. Such high vigilance has proved to be extremely useful. Between 1984 when the last indigenous case was reported and 1997, The Maldives recorded 216 imported cases of malaria. They came mostly from India, Sri Lanka and Bangladesh. Between 2001 and 2015, 102 cases of imported malaria were detected. This underlines the need for a constant vigil to sustain a malaria-free status in the Maldives, which is an international tourist destination.

Besides the movement of people from malaria-endemic regions, the threat of reintroduction and re-establishment of malaria is always high, as the Maldives is water-bound and a high-rainfall country. The Maldives can remain malaria-free only through adequate surveillance and proper case management. Other components of the strategy, such as public health and environmental management, general mosquito control and specific and targeted disease vector management also need to be sustained. The system should also be in a state of preparedness and vector control.

The country's central HPA is tasked with monitoring and coordinating all public health responses. Besides carrying out surveillance for malaria and other communicable diseases, each atoll and island health facility were handling immunization and health awareness campaigns. It also supervised the public health staff at each island health centre. Strong training programmes exist for Public health staff in malaria prevention, case detection, treatment and elimination protocols. The Ministry of Health keeps stock of antimalarial drugs and as well as insecticides and larvicides for treatment and potential containment of any outbreaks and emergencies.

4.4 Key Elements of Success

From national Independence to date, the fight against malaria in the Maldives has benefited from strong, sustained political support. Political support for malaria elimination is reflected in the government's decision to press on with malaria control efforts even following the abandonment of the global eradication goal. The Maldives illustrates the importance of political support in the post-elimination phase in order to sustain progress and prevent the re-emergence of the disease. Along with the support of WHO and international partners, the Government of Maldives has ensured that the malaria control efforts are adequately financed. Presidents who directly monitored progress ensured that implementation of the programme remained on track to achieve the goal of elimination.

The Maldives' successful drive to eliminate malaria also relied heavily on technically sound strategies and programmes. Integrated vector control and investments in public education aided the decline of parasite incidence and helped the Maldives to achieve a malaria-free status. Drawing on the contributions of both health workers and communities, the country used surveillance to guide and strengthen malaria prevention, detection and treatment efforts. Through extensive training, The Maldives ensured that all healthcare workers developed the necessary capacity for state-of-the-art malaria control activities.

Innovation, especially with respect to human resources, has been a hallmark of The Maldives' successful push to eliminate malaria. In the absence of robust health infrastructure and ready health workforce, The Maldives looked to island chiefs to aid in basic malaria control functions. This role was ultimately supplanted by trained family health workers and mobile teams who conducted case identification, treatment and post-treatment follow-up. Innovative vector control activities were used, such as the introduction of larva-eating fish.

Communities have been central partners in the country's successful elimination of malaria. Given the dispersed geography of the Maldives and its limited resources at the time of Independence, early progress in combating malaria necessarily depended on the active involvement and leadership of local communities. The involvement of people contributed to the success in vector control. The key elements of integrated vector control strategy for mosquito-borne diseases are mosquito surveillance, and mosquito and larva control through insecticides and larvicides.

When the malaria control programme started in 1966, the general health services in the country were not fully developed and equipped. As the programme evolved, health services too were strengthened with the development of capacity for tackling vector-borne diseases. Health workers were trained specifically for the malaria programme as well. Over time, health care has become universally available in the Maldives, with nearly 90% of inpatients and 70% of outpatients in 2011 served through the public healthcare system. A strong health system such as this was pivotal for the Maldives to become malaria free and remain so for over three decades.

4.5 Moving Forward: Lessons Learnt

The Maldives, with the support of WHO, is committed to remaining malaria free. Maintenance of the country's malaria-free status builds on four pillars: (i) epidemiological surveillance, including making malaria a notifiable condition since the 1980s to ensure rapid response and containment of any new case that might emerge; (ii) prevention of importation of the vector or disease through monitoring at ports of entry; (iii) universal availability of health care; and (iv) integrated vector surveillance and control [5].

Malaria vectors—carriers of plasmodium parasites—are the most important determinants of malaria [10]. The distribution of vectors and their biological adaptation—as well as resistance—in a given environmental setting is a key determinant of the

endemicity of malaria. In the Maldives, therefore, vector control was the most important element of malaria elimination, to the extent that it is widely believed that the *Anopheles* vector has been eliminated in the country. The systematic and methodical manner in which vector control was achieved in the Maldives can serve as a strategic template for other countries in the Region. Involving the community in vector control activities through education, awareness and empowerment is critical not only for elimination but also for sustaining a malaria-free status. Giving the responsibilities to island chiefs to monitor, supervise and follow-up implementation of the programme underlines the significant role local bodies and community organizations can play in supplementing the efforts of health agencies.

The Maldives' elimination of malaria shows how careful planning, international collaboration, innovation and measures to optimize the use of evidence-based interventions can achieve extraordinary results. The combination of political commitment, community engagement and education, and well-trained and committed healthcare staff has enabled the Maldives to achieve the milestone of malaria elimination. With most of its gains achieved before it began its rapid economic climb, the Maldives demonstrates that malaria elimination is feasible in both rich and poor settings and in the face of substantial geographical challenges. The experience of the Maldives illustrates the importance of tailoring malaria elimination efforts to match the cultural and geographical context.

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Chapter 5
Unburdening the Poor: Elimination of Lymphatic Filariasis in the Maldives

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Abstract The Maldives is one of three countries in the WHO South-East Asia Region to have eliminated lymphatic filariasis as a public health problem. Efforts to address the problem in the Maldives go back to much before the country became free in 1965. WHO-supported surveys were undertaken in 1951 in 34 habitable islands. It was found that 37% of inhabitants in these islands were either infected with W. bancrofti or exhibited clinical signs of lymphatic filariasis. Since 1968, when the National Filaria Control Programme was established, the unswerving political commitment and allocation of dedicated financial resources for case detection and treatment served as cornerstones of the Maldives' successful effort to eliminate lymphatic filariasis. The unique geography and scattered population in the country poses logistical challenges in rolling out health initiatives. However, highly trained health workers, linked to the WHO-supported global surveillance system for lymphatic filariasis, helped catalyse case-finding and treatment services in the Maldives. Another significant move was to make lymphatic filariasis a notifiable disease under the Public Health Protection Act, which came into force in 2012. The law provides for mandatory reporting of communicable diseases. The elimination of lymphatic filariasis from the Maldives has also demonstrated how technical capabilities, backed by strong political will and financial backing, help countries to tackle the scourge of NTDs. The resolve of the Maldives to achieve the elimination target ahead of the global deadline of 2020 set for elimination of lymphatic filariasis could serve as a template worth emulating by health systems in the Region and other countries facing the challenge of NTDs.

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_5

5.1 Background

The Maldives is one of three countries in the WHO South-East Asia Region to have eliminated lymphatic filariasis as a public health problem. It is a painful and disfiguring disease that affects this Region more than any other in the world. WHO officially validated the Maldives for having eliminated lymphatic filariasis as a public health problem in 2016. The country's success in eliminating the disease is a story of political commitment, focused action and rigorous public health surveillance spanning decades.

Popularly known as elephantiasis, lymphatic filariasis affects people of all age groups. Although children can acquire the disease, it may visibly manifest much later in adulthood [1]. The disease is caused by three species of thread-like worms known as filariae—*Wuchereria bancrofti*, *Brugia malayi* and *Brugia timori.* An estimated 90% of infections with lymphatic filariasis are caused by *Wuchereria bancrofti*, of which humans are the only host [2]. Mosquitoes are the primary vector of *W. bancrofti*. Globally, Brugian parasites are found only in South-East Asia, primarily Indonesia, Timor-Leste, Malaysia and Thailand [2]. Factors influencing the risk of transmission in a community include the number of infected persons, the density of microfilaria in infected persons' blood, density of vector mosquitoes and the frequency of human–vector contact [2].

Male and female worms join together in the human lymphatic system, which is a key component of the body's immune mechanism that maintains the fluid balance between the blood and body tissues [1]. The majority of infected people are asymptomatic, although virtually all infected individuals experience lymphatic damage and up to 40% have associated kidney damage. The clinical manifestations of lymphatic filariasis vary, such as swelling of the limbs and various genital disorders (including swelling of the scrotum and penis). The disease can recur through painful attacks that may be accompanied by fever [1].

5.2 Blueprint for Elimination

The disease is now in global focus, as the Sustainable Development Goals (SDGs) seek to eliminate neglected tropical diseases (NTDs), including lymphatic filariasis, by 2030. WHO too has a global strategy for the elimination of lymphatic filariasis, with two main pillars. The first aims to end transmission through preventive chemotherapy in the form of mass administration of the drug diethylcarbamazine citrate (DEC) in all endemic districts. WHO recommends annual mass drug administration (MDA) for at least 5 years in all endemic areas, with coverage reaching at least 65% of the at-risk population [3]. The use of common table or cooking salt fortified with DEC has also been recommended [3]. The second pillar of the global elimination strategy is the alleviation of suffering of infected individuals through the administration of a minimum recommended package of care. In endemic settings,

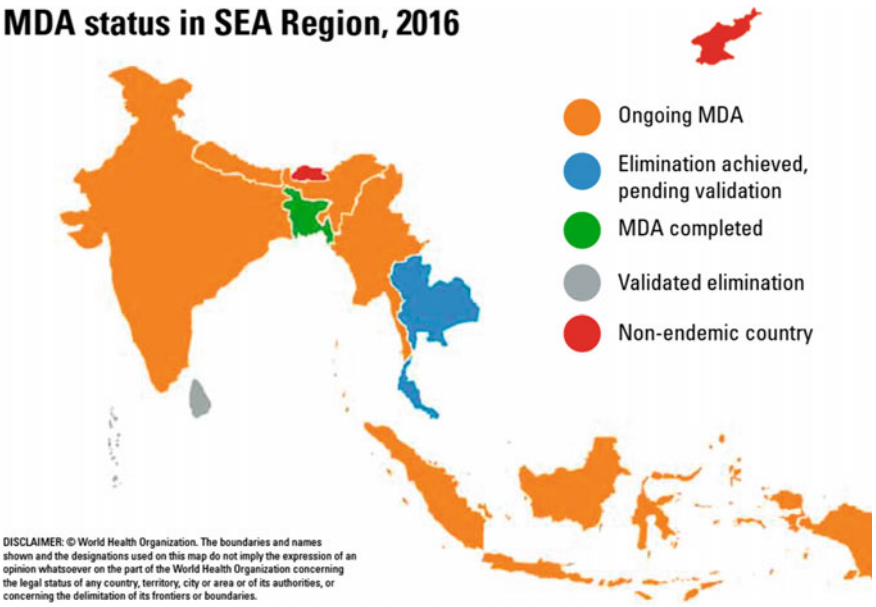

Fig. 5.1 Status of mass drug administration in the South-East Asia Region. *Source* WHO-generated map based on the endemicity of lymphatic filariasis in the Region and progress made by countries

all primary health systems should be prepared to administer this package to patients with lymphatic filariasis [3].

South-East Asia accounts for 57% of the 1.1 billion people worldwide who are at risk of lymphatic filariasis [2]. Nine countries in the South-East Asia Region of WHO are endemic for lymphatic filariasis (Fig. 5.1). Three countries in South-East Asia have been validated as having eliminated the disease as a public health problem—the Maldives, Sri Lanka and Thailand—and Bangladesh is in the surveillance phase following MDA in all endemic areas [4]. In 2000–2014, India accounted for 70.3% of all people in the South-East Asia Region needing preventive chemotherapy, and for 62.3% of all people who received these treatments [4].

To facilitate the roll-out of MDA, all endemic countries in South-East Asia have mapped the geographical distribution of the disease. In 2016, over 449 million people in South-East Asia were targeted for receiving preventive chemotherapy, and 272.9 million (60.7%) received treatment [5]. Regionally, 88.9% of endemic districts achieved effective coverage with preventive chemotherapy [5], with India, Nepal and Timor-Leste having achieved 100% coverage [4]. The number of total treatments provided, as well as the number of people targeted for chemoprophylaxis, have declined in recent years, as countries are able to scale down interventions following implementation of MDA and confirmation of the successful interruption of transmission through transmission assessment surveys [4]. However, hotspots of high prevalence and substantial ongoing transmission persist in some countries in South-East Asia despite several rounds of MDA [4]. Particular challenges have

been experienced in the roll-out of MDA in urban districts, as many urban dwellers perceive lymphatic filariasis as a problem of rural people [4].

The Maldives now serves as a success story in the effort to end lymphatic filariasis, having reached the milestone after decades of sustained effort and considerable energy. Efforts to address the problem in the Maldives go back to much before the country became free in 1965. WHO-supported surveys were undertaken in 1951 in 34 of the habitable islands. It was found that 37% of inhabitants in these islands were either infected with W. bancrofti or exhibited clinical signs of lymphatic filariasis [6].

5.3 Overcoming Challenges to Eliminating Lymphatic Filariasis

At the time of Independence, the Maldives was among the poorest countries in the South-East Asia Region. The burden of communicable diseases and NTDs was high, while the health infrastructure was in a poor stage. The lack of health facilities and an acute shortage of health workers impeded progress with regard to various disease control programmes initiated after 1965 [6]. In the case of lymphatic filariasis, efforts to deliver preventive chemotherapy and manage the care of people with the symptomatic disease were hindered in the early stages of the response by inadequate mapping of endemic areas [6].

Inadequate sanitation and various local practices often enabled the breeding of mosquitoes. The country's geographical spread—being a conglomeration of hundreds of islands spread across different natural atolls—posed a formidable challenge for any vector control activities. The hot, humid climate, coupled with heavy rainfall days, are ideal conditions for vectors to breed and thrive, making it tougher for control activities to be implemented. Yet another challenge was the fact that most countries in the South-East Asia Region from where the Maldives gets a substantial number of the migrant workforce, are endemic for lymphatic filariasis. This meant that even if vector control measures were successful, the risk of the disease being imported via migration continued [6].

5.4 Long Campaign to Eliminate Lymphatic Filariasis

Historical records show that filariasis has existed in the islands of the Maldives for a long time, with several misconceptions around it. In the early days, people believed that filariasis was transmitted through direct contact with someone who had developed clinical signs such as elephantiasis of the leg or an enlarged scrotum. This belief resulted in a system of segregation and isolation of people with filariasis. They were shifted to uninhabited islands and kept in isolation there with support from the

State. The practice of segregating symptomatic cases of filariasis was in place in the Maldives till as late as 1959. It was discontinued only after WHO recommended doing so following the shocking results of the filariasis survey it conducted in 1951. The survey, covering 34 islands in three atolls, included mass night blood testing to detect microfilaria (Mf) carriers, recording clinical cases and sampling to identify mosquito breeding sites. It revealed that all the 34 islands were endemic, while disease prevalence was 19.5% in females and 28.0% in males. *Cx. quinquefasciatus* emerged as the principal vector while *An. tessellatus* was the secondary vector. Step wells were reported to be a major breeding source of *C. fatigans* [7].

In the years following Independence, a programme for control of filariasis was launched in collaboration with WHO. The initiative, launched in 1968, focused on passive case detection and treatment, larvicide-based vector control with Abate 500C, and 12-week treatment of all positive cases with a weekly regimen of DEC [6]. A clinic to address lymphatic filariasis was established in Malé on the lines of those for tuberculosis and leprosy. In rural islands that lacked medical facilities, the island chiefs were given the responsibility of treating the Mf-positive cases and conducting follow-up blood film testing after treatment as per instructions given by visiting filaria teams. All these efforts showed early results—the Mf rate in Malé fell from 5.5% in 1969 to 1.3% in 1973 [6]. Nevertheless, lymphatic filariasis persisted in many parts of the country, with Mf prevalence ranging between 1 and 21% on 34 islands in 1974 [6]. A change in programme management was effected in 1984 when the malaria control programme reached its maintenance phase. Till then, the malaria and filaria control programmes were being run as separate vertical programmes. Filaria control activities, such as case detection and treatment as well as vector control, were intensified and expanded to cover the entire country in 1984, and the services for filariasis were integrated with malaria control activities to extend their reach and public health impact. In 1985, a mobile filariasis survey team was introduced. Its job was to provide a full package of primary health care, including activities of all national disease control programmes. Besides supervision and follow-up of filaria control activities, team members also trained other health professionals. Such a decentralized model helped in improving the quality of filariasis case detection and treatment. These efforts, in conjunction with the work of atoll health facilities and the malaria control programme, led to a sharp decline in Mf-positive cases.

In the 1990s, nearly all hospitals, health centres and health posts were equipped with diagnostic facilities for screening for Mf. In addition, all regional and atoll hospitals as well as health centres were staffed with doctors, nurses, community health workers and laboratory technicians. All these helped to further strengthen filaria control activities throughout the country. They also helped to decentralize vector control as well as case-finding and treatment activities under the supervision and support of the filaria control programme. From 1978 to 1998, the national programme analysed 560000 blood samples—equivalent to 1.6 times the population of the Maldives [6].

In 2000, WHO formally joined together with the Ministry of Health to establish the Vector-Borne Disease Control Unit [6]. The National Task Force on Filariasis Elimination was constituted in 2003. It was headed by the Medical Director, Ministry

of Health and had members representing the Ministry of Health, Ministry of Atolls Administration, Ministry of Education, Department of Public Health, and Vector-Borne Disease Control Unit. The responsibility of this Task Force was to oversee and coordinate the implementation of the National Plan for Elimination of Lymphatic Filariasis. The Task Force subsequently ceased to exist, following the dissolution of the Atolls Administration.

During 2002–2007, a five-year focused effort was undertaken to eliminate lymphatic filariasis. The first round of MDA was carried out in 2004. Simultaneously, training of family health officers was undertaken and they were deployed to work on 34 islands in 10 atolls [6]. The training also included methods of morbidity management and disability prevention (MMDP) due to lymphatic filariasis. The teams travelled to 10 endemic islands and carried out vector surveys and also trained people with chronic filariasis in MMDP methods. For MDA, local teams were formed for each round and team members were trained prior to drug administration. By 2003–2004, only one island (L. Fonadhoo) remained endemic, prompting the country to launch five annual MDA rounds on the island. Drug consumption surveys were also conducted in 2007 and 2008 to assess the level of non-compliance and reasons for the same (Fig. 5.2).

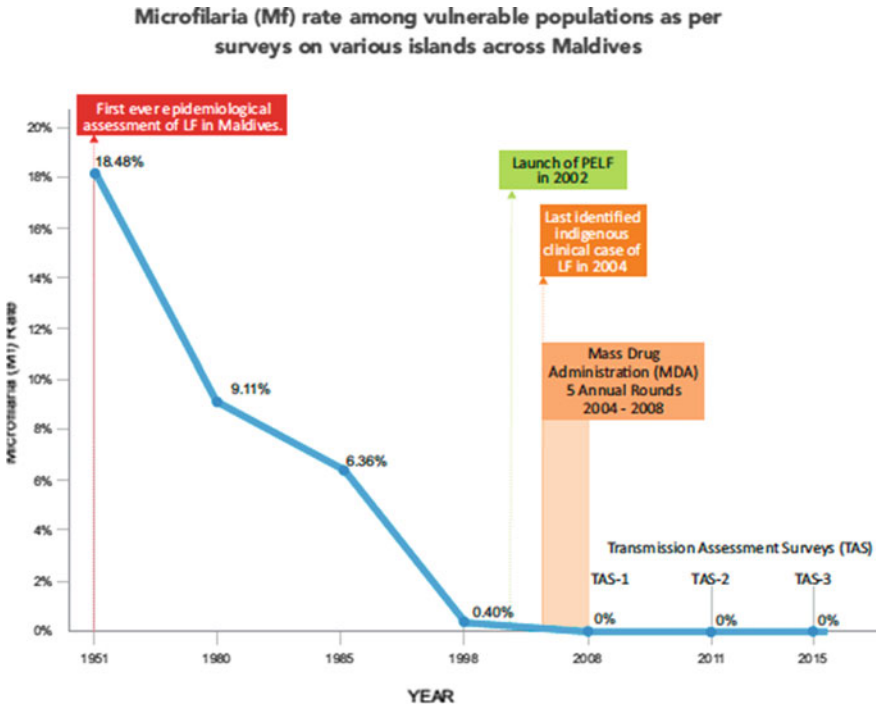

Fig. 5.2 Microfilaria (Mf) rate among vulnerable populations as per surveys on various islands across the Maldives. *Source* Graph generated by WHO based on data provided in the country dossier for validation of elimination of LF as a public health problem

In addition to MDA, the elimination strategy placed equal emphasis on vector control activities, particularly following the tsunami in December 2004, which affected a number of previously filariasis-endemic islands [8]. Since no indigenous malaria case had been reported since 1984, malaria-specific vector control activities were not in place but dengue was still endemic and a community-based source reduction system was in place. The practice was to conduct thermal fogging with synthetic pyrethroids during epidemics. On the ground, there is no formal vector control programme and all vector control as well as vector surveillance activities have been integrated with the primary healthcare system. In most of the islands, underground drainage has been provided, practically eliminating vector breeding sources like open drains, cess pits and septic tanks. Yet the threat exists of importation from endemic countries. The Maldives, being a global tourist destination, attracts a huge inflow of people from all over the world. About 18000 aircraft land in the Maldives every year. Those from malaria- and yellow fever-endemic zones are disinfected regularly. In 2013, as many as 5340 aircraft were disinfected. Passenger surveillance and ship inspections at international seaports are also key elements of the surveillance strategy.

By 2008, transmission assessment surveys found zero Mf prevalence and no immunochromatographic test (ICT)-positive persons, and no indigenous case of lymphatic filariasis countrywide since 2004 (although a few imported cases were reported among foreign migrants) (Fig. 5.2) [6]. Subsequent surveys, using updated guidelines, confirmed the absence of transmission in Fonadhoo Island and Laamu Atoll. WHO in 2016 formally validated the Maldives to have eliminated lymphatic filariasis as a public health problem.

5.5 Key Elements of Success

Since 1968, when the National Filaria Control Programme was established, the unswerving political commitment and allocation of dedicated financial resources for case detection and treatment served as cornerstones of the Maldives' successful effort to eliminate lymphatic filariasis [6].

The unique geography and scattered population in the country poses logistical challenges in rolling out health initiatives. In the case of control and elimination initiatives for lymphatic filariasis, the challenge was greater because internal migration was very high in the 1980s and 1990s, taking people from endemic areas to non-endemic ones and vice versa. The intense effort brought down the endemicity to smaller pockets. In the final phase, the target population was more or less confined to one island and could be reached with the delivery of interventions such as MDA. Tasks such as conducting impact assessment surveys could also be implemented as this population moved out of the island. Another key decision was to integrate surveillance with the primary health care system.

The programme was fully financed with domestic resources, which was especially challenging in the years immediately following Independence, given the country's

precarious economic situation in that era. Support from WHO as well as dedicated work by numerous health facilities and health workers helped the Government of Maldives in its elimination efforts. The government ensured access to MMDP in all parts of the country and, in 2012, made lymphatic filariasis a reportable condition to support post-elimination surveillance and vigilance [6].

Highly trained health workers, linked to the WHO-supported global surveillance system for lymphatic filariasis, helped catalyse case-finding and treatment services in the Maldives. A national regulation enacted in 1996 required all recruits to national security services and sailors, as well as students seeking education abroad, to undergo Mf blood screening as part of the health check-up. Strong surveillance efforts ensured the mapping of endemic areas to guide the implementation of the five annual rounds of MDA in 2004–2008. Since 2011, post-surveillance activities, including ongoing vector control to eliminate breeding grounds for mosquitoes, have worked to maintain the elimination of lymphatic filariasis in the Maldives.

A significant move was to make lymphatic filariasis a notifiable disease under the Public Health Protection Act, which came into force in 2012 [8]. The law provides for mandatory reporting of communicable diseases. Care providers are required to report communicable diseases so as to help in identifying outbreaks and epidemics at an early stage. Yet another measure was to enforce strict controls to prevent importation, as migrants from neighbouring endemic countries is a major concern. Therefore, impact assessment through Mf and antigenaemia surveys also covered migrant populations.

The social aspects of the response to lymphatic filariasis had an important effect on the country's successful response. Whereas it was common practice prior to 1951 to segregate and isolate people living with lymphatic filariasis in camps on uninhabited islands, this approach was abandoned following the results of early prevalence and transmission studies. Instead, the country focused on reducing stigma and mobilizing communities to aid in the fight against the disease, through island chiefs, frontline health workers and door-to-door awareness campaigns.

5.6 Moving Forward: Lessons Learnt

The Maldives has committed to continuing post-elimination surveillance, including regular entomological monitoring, and screening of migrants for lymphatic filariasis. Efforts continue to reduce mosquito-breeding sites. All of the country's 124 health centres and 23 hospitals are equipped to manage morbidity, and an action plan has been prepared to assess the quality of medical services for people affected by the disease.

With the country's efforts aligned so closely to the strategies recommended under the Global Programme to Eliminate Lymphatic Filariasis, the Maldives' success is a powerful demonstration of the effectiveness of these recommended approaches. The elimination of lymphatic filariasis from the Maldives has also demonstrated how technical capabilities, backed by strong political will and financial backing, help

countries to tackle the scourge of NTDs. The resolve of the Maldives to achieve the elimination target ahead of the global deadline of 2020 set for elimination of lymphatic filariasis could serve as a template worth emulating by health systems in the Region and other countries facing the challenge of NTDs. It is also an important step towards fulfilling the global commitment to address NTDs under the Sustainable Development Goals (SDGs) framework. The presence of a strong health system, based on the principles of universal health care, can help countries achieve the goal, as ably shown by the Maldives. However, vigilance needs to be maintained to sustain the elimination status, in light of the challenge posed by climate change [9].

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Chapter 6
Sri Lanka: Long Battle to Eliminate Malaria

Kamini Mendis and Risintha Premaratne

Abstract Sri Lanka was certified by WHO for having eliminated malaria on 5 September 2016. The elimination of malaria brings to an end one of Sri Lanka's most devastating health burdens. Malaria epidemics and endemic transmission in Sri Lanka had intensified in the nineteenth and twentieth centuries as plantation, irrigation and agricultural projects—undertaken by the British colonial administration and then by the independent government—opened up forested areas. Major epidemics occurred every few years. The 1934–35 epidemic killed over 1·5% of the population. Sri Lanka's malaria elimination efforts had several key elements, including strengthened surveillance, active case investigation, comprehensive case management and health education. The introduction of long-lasting insecticide nets and the technical strategy of replacing single vector-control methods in the 1980s proved to be a critical turning point. Perhaps the most remarkable aspect of Sri Lanka's elimination of malaria is that the foundation for this achievement was laid during a protracted armed conflict between the government and the Liberation Tigers of Tamil Eelam (LTTE). Above all, these efforts were made possible and could be sustained as a result of strong and enduring political commitment, which ensured robust funding for malaria control even when resources were scarce. The story of malaria elimination in Sri Lanka has the potential to not only inspire other countries of the Region but to serve as a guide for them on optimal strategic and operational pathways they can adopt to banish malaria.

6.1 Background

Malaria is an ancient disease in the SEA Region, which is home to 2.2 billion people. With the economic growth that countries in the Region have achieved in the past few decades, disease patterns have changed considerably but communicable diseases

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_6

such as malaria persist [1]. In the 1950s and 1960s, malaria was a major public health priority in countries of the Region. It made a comeback on the radars of policy-makers and health ministries with the targets set under the Millennium Development Goals (MDGs) framework. The renewed focus helped countries to make remarkable progress in mitigating the regional health burden associated with malaria. The Region has made substantial progress in reducing malaria, with a 76% and 93% reduction in reported confirmed malaria cases and deaths between 2010 and 2018, respectively.

Building on this progress, the Region is now working towards the elimination of malaria by 2030, as envisaged in the global and regional strategies related to malaria. Since 2015, two countries in the Region—Maldives and Sri Lanka—have been certified by WHO as having eliminated malaria [2]. This marks a paradigm shift from control to elimination. Other countries in the Region (Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Myanmar, Nepal, Thailand and Timor-Leste) are working on national programmes for the elimination of malaria [3]. Although none of these countries have achieved zero malaria cases for three consecutive years, several have reported striking progress towards elimination. Since 2017 July, Timor-Leste has maintained zero indigenous cases, while Bhutan had reported only six indigenous cases in 2018.

6.2 Malaria in Sri Lanka

Sri Lanka was certified by WHO for having eliminated malaria on 5 September 2016 [4]. The certification represented the end of a long, trying battle against the disease in the island nation. The story of malaria elimination in Sri Lanka has the potential to not only inspire other countries in the Region but to also serve as a guide for them on optimal strategic and operational pathways they can adopt to banish malaria.

Malaria has been a major health challenge for Sri Lanka for centuries. It finds mention in ancient texts as a "depopulating disease" reported after repeated foreign invasions that destroyed irrigation systems [5]. The decimation of populations due to this disease is recorded to have led to shifting of the capital from one city to another. Records of a malaria-like disease are found in later periods too. When the island nation was under Dutch occupation in the seventeenth century, communities in the southern part of the country were wiped out due to "fever pestilence". In records dating to the late nineteenth century, there is mention of *kelae una* or forest fever reported by the local people. More than three out of four districts in the country had moderate-to-high risk of malaria, and by the early 1900s, the disease was firmly established [6]. The opening up of previously forested areas to make way for various agricultural activities, both by the British colonial administration and the national government following Independence in 1948, contributed to the intensification of malaria, with epidemics occurring every few years [7].

6.3 A Century of Malaria Control

The history of malaria control in Sri Lanka as we know it now is more than a century old, dating back to 1911 when documented control efforts were initiated. The first health personnel for malaria, a malariologist, was appointed in 1921 during British rule. In 1934, a large-scale malaria epidemic broke out, affecting 1.5 million people—which was almost one-fourth of the total population. The epidemic resulted in the death of over 80,000 people in a span of just seven months during 1934–1935. The preferred line of treatment was administration of quinine. Some preventive measures were also followed—filling up of ground depressions to prevent collection of water, application of oil in selected stretches of rivers as a larvicidal measure, etc. Quinine was also given as prophylaxis during the epidemic. The medicine was in short supply and had to be imported to meet the large demand.

A combined result of all the control measures, including the introduction of DDT, was a significant drop in cases of malaria infection. In 1958, the country shifted its focus from control to eradication under the Global Malaria Eradication Programme launched by the WHO in 1955. Malaria was made a notifiable disease in 1961, as the number of infections started dropping rapidly. Health services too improved in rural areas with expansion of the road network and other forms of connectivity. The number of infections dropped from 91,990 in 1953 to just 17 in 1963. Such dramatic progress within a decade made programme managers think that the disease was close to elimination. This led to complacency and control measures were relaxed. The number of infections started to climb once again, causing a full-fledged nationwide resurgence of malaria during 1967–1968. In 1969, there were half a million cases spread across the country. There were several epidemics in the years that followed [8].

6.4 Challenges to Malaria Control

The challenge to malaria control in Sri Lanka was compounded by the fact that infections were caused by several species of malarial parasites. While most infections occurred due to *Plasmodium vivax* and *Plasmodium falciparum*, rarely, malaria cases were also due to *Plasmodium malariae* and *Plasmodium ovale*. The principal vector for these infections was *Anopheles culicifacies* species E. There are 23 known species of anophelines in Sri Lanka. This species of mosquito has a wide range of habitats such as shallow water pools in rivers, shallow wells, swamps, rainwater depressions and so on. Some of the rivers and the vast number of small irrigation systems may become dry during the dry season, giving rise to the formation of pools—ideal breeding sites for mosquitoes [9]. Rainfall is favourable for malaria transmission, as the vector breeds extensively in stagnant pools of clear, sunlit water. In addition, this mosquito species bites in both indoor and outdoor locations but prefers the dusk hours for biting.

In the 1970s, both new challenges and control tools emerged as Sri Lanka once again focused on malaria control. The main challenge was the appearance of new breeding grounds for mosquitoes. As the country made progress in the agriculture sector with the expansion of irrigation canals, the process inadvertently created more artificial mosquito breeding sites. Another offshoot of the development process was migration of people in search of better livelihoods, including from non-endemic to endemic, newly irrigated areas. As these individuals were not immune, they developed more severe forms of clinical malaria. Once again, epidemics were reported from all over the island. Yet another challenge was mosquitoes developing resistance to DDT, forcing the authorities to introduce malathion in 1975. Subsequently, resistance to chloroquine—the first-line medicine used at that time—was also reported in 1984.

In 1977, the "Intensified Malaria Control Programme" was launched. The strategy was multipronged: using indoor residual spraying (IRS) with malathion as well as other vector control methods such as larviciding, active case detection and treatment, expansion of laboratory services, entomological surveys and health education and awareness campaigns for the general public. These are highly effective measures. Implementation of the programme was modified in 1989, with greater decentralization. Mobile clinics were pressed into services for diagnosis and treatment in the hinterland. The surveillance mechanism was made more rigorous. Yet, malaria resurged in the 1990s, with over 400,000 cases reported in 1991 [10].

With the support of the WHO Roll Back Malaria Initiative, the Sri Lankan government began turning the malaria challenge around in 1999–2000 [10, 11]. Control measures were further intensified. Health-care workers were retrained and surveillance was scaled up. Treatment modalities were made more efficacious. Soon, a steady decline was observed in 2000, with both *Plasmodium vivax* and *Plasmodium falciparum* infections deceasing significantly. In 2000–2001 alone, the malaria incidence in Sri Lanka declined by 68% [10, 11]. With the aid of grants from the Global Fund to Fight AIDS, Tuberculosis and Malaria, Sri Lanka achieved a 99% reduction in indigenous and imported cases between 1999 and 2007 [10, 11]. In 2008, for the first time, the country had no deaths due to indigenous malaria. This coincided with the introduction of artemisinin-based combination therapy. A year later, following the end of the three-decade-long separatist war, the malaria elimination drive was launched, which aimed for elimination by 2014. In 2011, only 124 indigenous cases were reported, which was a decline of 99.9% from the 1999 level [10].

6.5 Elements of Success

Sri Lanka's malaria elimination effort drew on several key elements. Surveillance and response to cases were strengthened, including through screening of individuals attending health-care settings; village-level screening in endemic areas; screening of high-risk groups (active case detection), including by mobile malaria clinics; active case investigation to inform malaria control efforts; and surveillance of the mosquito

vector to understand the distribution of species and susceptibility to insecticides [6, 11]. Comprehensive case management was undertaken for all malaria cases, quality assurance measures enhanced treatment effectiveness and health education raised public awareness of malaria, including among young people who had not experienced earlier malaria epidemics [6]. Introduction of long-lasting insecticide nets, made possible through assistance from the Global Fund, had a clear impact in endemic areas [6]. Additional vector control measures, including IRS, introduction of larvivorous fish, filling abandoned gem pits and intermittent flushing of canals and waterways also lowered the risk of malaria transmission [6].

In fact, the technical strategy of replacing single vector-control methods (IRS with integrated vector management) in the 1980s proved to be a critical turning point in the Anti-Malaria Campaign (AMC)'s war against malaria. Among the carefully selected interventions comprising the integrated approach were vector control measures for major irrigation and agriculture sites, strong entomological surveillance, targeted spraying, use of new classes of IRS insecticides, insecticide-treated nets and larval control. The approach yielded the desired results in the long term as it was combined with strengthened parasitological surveillance, active case detection and rapid response on detection.

The intensified control measures on the ground were backed by certain important policy interventions. It was made mandatory for doctors in the private sector to notify the AMC of any case of malaria. Antimalarial medicines were available only through the AMC, and private doctors had to approach it for the same. With falling numbers in the 2000s, malaria was fast disappearing from the radars of the medical profession, which meant there could be a delay in diagnosing cases by doctors [12]. To meet this challenge, clinicians were given regular updates on malaria with specific instructions to obtain a detailed travel history of patients. Another policy decision was to strengthen the already decentralized malaria control work by Regional Malaria Officers in all endemic districts. It helped in making the programme more responsive and efficient, as field-level staff could take the necessary decisions and respond rapidly to local epidemics on their own, based on the knowledge gained during capacity-building training programmes [11]. Above all, these efforts were made possible and could be sustained as a result of strong and enduring political commitment, which ensured robust funding for malaria control even when resources were scarce [6].

Perhaps the most remarkable aspect of Sri Lanka's elimination of malaria is that the foundation for this achievement was laid during a protracted armed conflict between the government and the Liberation Tigers of Tamil Eelam (LTTE). The 1980s began with an uprising of youth in the south and an armed conflict in the north and east. Both the rebels and armed forces were equally affected by malaria and, in keeping with the tradition of the strong public health focus in the country, there was cooperation between the rebel fighters and health authorities to ensure vector control and surveillance in conflict areas. By 2000, the districts with the largest number of malaria cases were all affected by the conflict, which began in the early 1980s [10, 11]. Working often in partnership with NGOs and the military and with the expressed support of the LTTE, the country's malaria control programme managed to scale up integrated vector control and treatment interventions in conflict-affected districts

[12, 13]. The effort managed to double the coverage of IRS in conflict-affected areas, achieving a higher coverage in these districts (52.2% in 2000) compared to in other parts of Sri Lanka [13]. Through the combined efforts of the national malaria control programme, a Sri Lankan NGO and United Nations (UN) agencies, long-lasting insecticidal nets were distributed in 2005 to the populations at risk living in conflict-affected areas. With the support of the Sri Lanka Red Cross, International Committee of the Red Cross and Médecins Sans Frontières, access to diagnostic and treatment services was expanded in conflict-affected areas. From 2008 onwards, the majority of indigenous cases were among military personnel, and interventions in the military camps were augmented through a strong collaboration between the AMC and the armed forces [7, 11]. In 2012, a little more than three years after the end of the country's armed conflict, Sri Lanka recorded its last case of indigenous malaria.

6.6 Lessons Learnt

The elimination of malaria in Sri Lanka is important for two main reasons, among others. Its geographical location and climate are conducive to the occurrence of vector-borne diseases such as malaria. The tropical climate, which shows little seasonal variation, makes it ideal ground for breeding of mosquitoes. Nearly a third of the country's territory falls in the so-called dry zone where vectors can breed and thrive. That is why 20 out of 25 districts in Sri Lanka were formerly endemic for malaria. Apart from being receptive to malaria due to ecological factors, the geographical location of Sri Lanka makes it highly vulnerable. The possibility of malaria importation from neighbouring countries is high. There is a constant flow of people, migration of the labour force and trade and tourism from malaria-endemic countries. These challenges make elimination of malaria from Sri Lanka—a tropical country with fairly large population—a unique case.

Sri Lanka's experience highlights important lessons learnt that can inform malaria control efforts across South-East Asia. These include the critical importance of political and technical leadership and commitment; the need to bring proven diagnostic, prevention and treatment strategies to scale; the importance of a dedicated and competent workforce at the periphery; and the vital role of a state-of-the-art surveillance programme for both cases and vectors in guiding and accelerating elimination efforts. The protocols developed in Sri Lanka for malaria elimination, though specific to its climate, geography and economic status, could serve as model templates for other countries in the Region. Today, Sri Lanka is working to prevent a re-establishment of malaria and to address other vector-borne infections [7].

6.7 Challenges Ahead

Maintaining zero-transmission status for malaria in Sri Lanka is a continuous and challenging task, given its high receptivity and vulnerability to malaria. A series of rigorous systems and methodologies have been put in place to prevent the re-establishment of malaria transmission. Although there is no local transmission of the parasite, the vector mosquitoes remain prevalent. Thus, persons coming into Sri Lanka infected with the parasite can potentially reintroduce malaria [14]. In surveys conducted a few months after Sri Lanka was certified malaria-free, the presence of *An. stephensi*, a vector of urban malaria in India, was reported for the first time in the country, from the island of Mannar in the Northern Province [15]. Such occurrences could pose a serious challenge to preventing re-establishment of malaria transmission in the country, in view of the role of *An. stephensi* in spreading urban malaria.

The national strategy to maintain the malaria-free status is multipronged. It focuses on strong disease surveillance, vector surveillance and integrated vector management based on surveillance data, early reporting with improved reporting mechanisms and case investigation and management with intense and radical therapy. In addition, awareness and education initiatives target at-risk population groups. There is improved communication regarding screening at ports of entry, case information and response.

In view of the likelihood of malaria making a comeback through migrants and visitors from countries where it is still prevalent, the surveillance guard cannot be lowered [14]. Health authorities pay attention to those entering the country with fever, particularly traders and business people, returning military personnel, pilgrims, refugees, migrants and fisherfolk from foreign shores [14]. A positive case immediately triggers a detailed and rapid response. Any relaxation in these protocols could prove to be costly.

The threat of reintroduction through migrants is much higher when they come through irregular channels [16, 17]. Health authorities are fully cognizant of such threats, having suffered the resurgence of malaria once before in the 1960s. A strong operational research base in malaria supports the efforts of the AMC in preventing the re-establishment of malaria [14, 18]. The AMC is engaged in a rigorous programme and works with a wide range of partners such as the medical profession to ensure early diagnosis of imported malaria, and others—from religious leaders to the military, and UN organizations—to ensure that it covers all possible avenues through which the parasite can come back into the country. The vigil against malaria should be continued because the cost of malaria resurgence could be very high and much higher than the cost of preventing its re-establishment [19, 20].

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Chapter 7
Lymphatic Filariasis Elimination in Sri Lanka: Overcoming the Odds

Sandhya Dilhani Samarasekera and Razia Pendse

Abstract In 2016, WHO formally validated the elimination of lymphatic filariasis as a public health problem in Sri Lanka. This brought the country closer to the end of a decades-long effort to reduce the burden of this painful, debilitating and stigmatizing condition. The disease is traceable in Sri Lanka as far back as the third century BC. In 1937–1939, the first countrywide survey found that Mf rates ranged from 20 to 24% across the island. The first organized response to lymphatic filariasis came in 1947 in the form of the Anti-Filariasis Campaign (AFC). Several features of Sri Lanka's approach to lymphatic filariasis are especially noteworthy. The technical soundness of the country's lymphatic filariasis programme was promoted by a collaboration of partners. Systematic surveys and surveillance were undertaken, including active searches, routine surveillance and sentinel surveillance. Mapping of endemic areas aided in targeting disease control efforts. Differential strategies were pursued for urban and rural settings; biomedical and public health approaches were complemented by robust social and communications sciences; and rigorous studies confirmed the elimination of the disease. A strong public health system proved to be vital for the success of the drive to eliminate lymphatic filariasis. The dedication of the health staff of the AFC and regional anti-filariasis units was noteworthy. Political support for the national effort to eliminate lymphatic filariasis was unwavering and sustained over time. Domestic resources largely financed the many activities associated with the national programme.

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SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_7

7.1 Background

In 2016, WHO formally validated the elimination of lymphatic filariasis as a public health problem in Sri Lanka. This brought the country closer to the end of a decades-long effort to reduce the burden of this painful, debilitating and stigmatizing condition. Sri Lanka's successful fight to eliminate lymphatic filariasis overcame considerable obstacles. It underscores the importance of strong national leadership, effectiveness of recommended strategies for elimination of lymphatic filariasis, value of decentralized services and engagement of affected communities.

Sri Lanka, a tropical island, has a widely varying topography and climate. Large swathes of the country experience heavy rainfall and humid conditions. These are the very conditions that facilitate the breeding of mosquitoes that serve as vectors for lymphatic filariasis. More than half (53%) of the country's over 20 million people live in three provinces where lymphatic filariasis was endemic [1]. These endemic provinces extended in a crescent along the western and southern shores of the country [1].

Lymphatic filariasis is one of four leading vector-borne diseases in Sri Lanka, along with dengue, malaria and Japanese encephalitis, and has long been a cause of disability in the country [1]. The disease is traceable in Sri Lanka as far back as the third century BC [1]. References to "elephantiasis" have been found in some early Buddhist texts and medical chronicles penned by the physician king Buddhadasa in the fourth century AD. More recent historical references to the disease as a serious problem date to the colonial period when the country was under British administration and known as Ceylon [1]. The disease finds mention in the 1821 book by John Davy as well as in official British records such as the reports of the Principal Civil Medical Officer and the Inspector General of Prisons in 1879. The earliest microfilaria case (*Filaria sanguinis hominis*) was detected in 1892 from Matara Hospital.

Some information about the extent of the problem appeared with small surveys done at the beginning of the twentieth century. In 1914, an early epidemiological study reported hotspots of infection in the southern, north-western, western and eastern parts of the country, with the highest microfilaria (Mf) rate (26.6%) recorded from Toppur in Trincomalee district [1]. Raised Mf rates (ranging from 8.8% to 14.2%) were also found in the southern part of the country [1]. The long-term effects of filariasis in the form of elephantiasis, hydrocele and chyluria were also reported in this survey, besides the presence of Mf. Another survey was conducted in 1925 in the southern province during which night blood films were taken. The Mf rate in this survey was found to be 4.8% and the type of filariasis present was presumed to be due to *Wuchereria bancrofti*. By the 1930s, the problem appears to have worsened. In 1937–1939, the first countrywide survey found that Mf rates ranged from 20 to 24% across the island [1].

The earliest epidemiological surveys found a nationwide prevalence of *W. bancrofti*, one of three species of thread-like worms that cause lymphatic filariasis, which is carried by mosquitoes. However, subsequent surveys found localized hotspots of *Brugia malayi*, primarily due to favourable local breeding conditions

for the *Mansonia* species of mosquito that carries the *Brugia malayi* strain [1]. *W. bancrofti* predominated in urban areas, while *B. malayi* cases were largely confined to rural areas [1]. There was geographical variation in terms of both the Mf rate and type of vectors involved, indicating that filariasis in Sri Lanka was highly localized and was restricted to areas environmentally conducive to the breeding of specific mosquito vectors. Subsequent studies showed that bancroftian filariasis emerged as a problem after the Second World War, mainly in the south-western coastal belt. The problem was traced to the proliferation of mosquitoes in bucket latrines in which wastewater used to stagnate, providing ideal grounds for vector breeding [1].

The health system responded to the problem early on, keeping in view the results of the various surveys. As early as 1926, steps were taken to strengthen the country's primary health care system and improve sanitation efforts [2]. The first organized response to lymphatic filariasis came in 1947 in the form of the Anti-Filariasis Campaign (AFC) established by the Department of Health under the administrative control of the Deputy Director of Public Health Services. Under this initiative, a central laboratory, a supply store, a workshop, and 17 peripheral investigation units with entomological assistants were established [1]. Subsequently, more health personnel were allocated for the AFC [1].

The Campaign mainly focused on night blood surveys, detection of clinical cases, health education for the general public, localization of infective foci and identification of insect vectors and their breeding sites. Initially, AFC activities were limited to parasitological investigation and control, vector control and limited health education campaigns in a few affected urban council towns. It was found that *W. bancrofti* was responsible for transmission of the disease in urban areas while *Brugia malayi* was the cause in rural areas.

7.2 Road to Elimination of Lymphatic Filariasis

A year after the AFC was launched, the first filariasis clinic was established at Dehiwala to enable patients with filariasis to obtain health services. Originally held once a week, the clinic soon expanded to three times a week, with specific, separate dedicated opening hours for men and for women [1]. The clinic helped to detect a large number of clinical cases of filariasis among family members and neighbours of patients who visited the clinic. The treatment consisted mainly of lithium antimony thiomalate, stibamine glucoside and the newly introduced diethylcarbamazine citrate or DEC. The new drug was administered orally in specified doses three times a day for seven days to a limited number of patients to see the impact on Mf count. A second clinic was established in August the same year. Along with treatment, mosquito control measures—DDT spraying in houses and water pools around them—were also launched in the areas that came under the two clinics. A WHO expert, who reviewed the situation in Sri Lanka, made a series of recommendations on various components of AFC implementation. One of the policy recommendations was to provide an efficient sewerage system in urban areas and give priority to targeting

infection with *W. bancrofti*. All municipalities had to undertake mosquito control measures as a part of general public health activity. Intensive training of entomological staff was recommended for filariasis control. Several of these recommendations were made part of operational procedures and additional clinics were established to address the disease.

Initially, the key campaign activities included night blood surveys, detection of clinical cases, public education, and mapping of vectors and their breeding spots [1].

It quickly became clear that the ambitious national campaign was understaffed, leading to an increase in staff numbers that more than doubled the per capita distribution of parasitological staff. Antilarval measures were expanded, a special health education unit attached to the campaign was established, and entomological work was reorganized and strengthened [1].

In the 1960s, Mf-positive persons were provided with three weeks of DEC treatment, and the contacts of Mf-positive individuals were given a week-long course of DEC. Blood films of all Mf cases and contacts were done within six weeks of treatment completion and at six-month intervals, with treatment repeated where necessary [1].

Efforts to manage and mitigate the symptoms of lymphatic filariasis were launched. All of the typical symptoms of lymphatic filariasis were found in the country. Genital symptoms were most frequently associated with bancroftian filariasis, while *B. malayi* cases manifested most often with affection of the limbs and glands [1]. Across the country, swelling of the legs was by far the most common clinical condition associated with lymphatic filariasis [1].

The first mass administration of DEC was implemented in 1969 in Walgama, a semi-urban area in Matara district with a population of over 10 000 people. At that time, about 230 people in this place were under treatment for filariasis. Mosquito breeding was very high in coconut husk soakage pits and quarry pits. The water supply came mainly from open wells, and also supplied sanitation pit latrines that were in use. Health personnel visited every registered household to give the required doses of DEC every day for five days. All the people were followed up and complaints of adverse reactions, fever, etc. were attended to. A night blood examination survey conducted from October 1970 to September 1971 showed that the Mf rate in Walgama had fallen to 1.52% from 3.9% in 1969.

By the early 1980s, the average Mf rate in endemic districts had been reduced to below 1% (Fig. 7.1) [2]. Further progress was made in reducing the Mf rate and, in 2002, Sri Lanka embarked on a targeted five-year campaign of mass drug administration (MDA) that was rolled out in all endemic districts. It was a carefully planned operation, based on analysis of data pertaining to Mf prevalence, clinical and transmission data in endemic districts as well as data from non-endemic areas. Each of the eight endemic districts was designated as one implementation unit (IU). Nine districts fell in the category of non-endemic and eight others were called “uncertain areas”. The strategy was to administer one dose of DEC for the clearance of microfilaraemia and sustain it for one year; and albendazole to enhance the effect of Mf clearance.

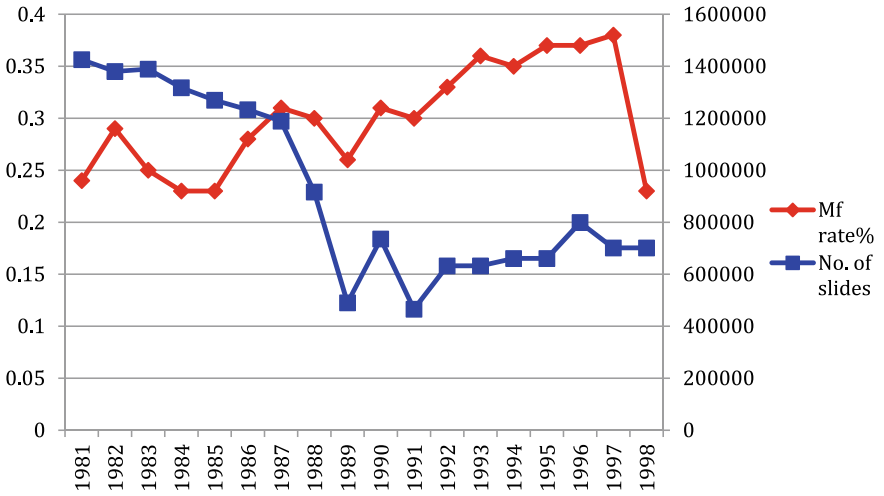

Fig. 7.1 Microfilaria rates and number of slides collected from endemic districts during 1981–1998. *Source* Graph generated by WHO based on data provided in the country dossier for validation

The AFC, along with the Medical Supplies Division of the Ministry of Health, worked hard to ensure drug supply in all the IUs to make the MDA campaign successful. On the ground, public health midwives and volunteers—called filariasis prevention assistants (FPAs)—played a key role. They ensured that every identified individual got the designated dose of the two-drug regimen. Each FPA was assigned 50 households to visit twice before MDA was rolled out—to enrol members for MDA and convince them by answering all their queries. In all, 50 000 of these foot soldiers toiled to make the programme a success. The day selected for administration of MDA was designated as National Filariasis Day, which was usually a Sunday. The AFC and the Ministry of Health also recognized the need for an effective, high-impact social mobilization campaign and communication–education support for the MDA programme. It was critical to achieve the goal of making 80% of all eligible household members consume tablets to prevent lymphatic filariasis. A social mobilization project—Communication for Behavioural Impact (COMBI)—was launched with the help of WHO. It included print, radio and television programming on different aspects of the disease, its transmission cycle, treatment with DEC and albendazole as well as morbidity management and control.

Community acceptance of the therapy, as a result of advocacy and persuasive communication, was critical for the success of MDA. When MDA with only DEC was administered for the first time in the entire endemic belt in 1999, the drug could be delivered to only 62.7% of the target population. In 2000, two rounds of MDA reported coverage of 68.2% and 70.5%, respectively. Subsequently, albendazole was added to MDA and was tried in only one district—Colombo—in May 2001. It achieved a coverage of 76.7%. The first national MDA with both the drugs was rolled out in July 2002 and covered 80% of the target population [1]. This could be

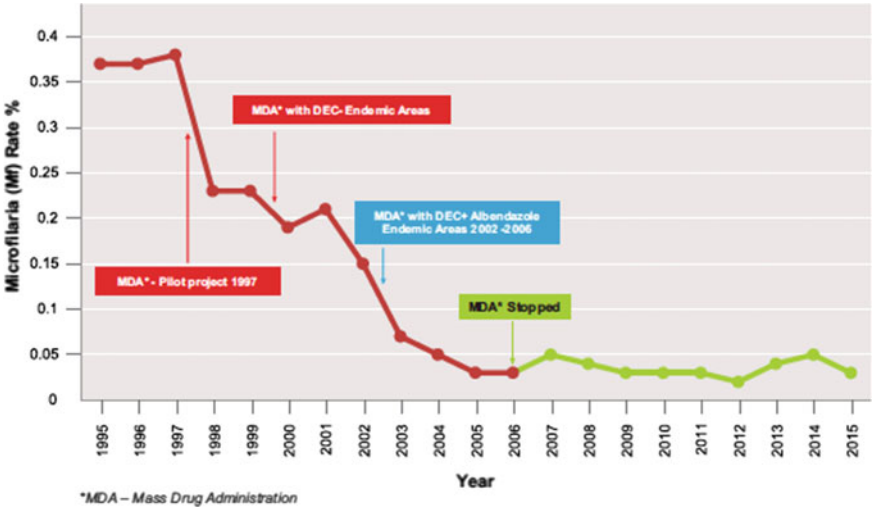

Fig. 7.2 Microfilaria rate in endemic districts of Sri Lanka (1995–2015). *Source* Graph generated by WHO based on data provided in the country dossier for validation

attributed to the success of COMBI, along with other factors, such as commitment of health workers, continuous supply of drugs and minimal side-effects of the two-drug regimen. Five consecutive rounds of MDA with DEC and albendazole were completed in 2006 and MDA was stopped in 2007. The average Mf rate at the end of the MDA rounds was reported to be 0.03%, much below the WHO elimination target of less than 1% (Fig. 7.2).

In 2008, post-MDA surveillance (using immunochromatographic test [ICT] kits among grade 1 schoolchildren in endemic areas) found no evidence of lymphatic filariasis transmission [2]. Subsequent transmission assessment surveys among schoolchildren and special night blood film surveys in highly endemic hotspots were undertaken to confirm the lack of transmission. Thereupon, Sri Lanka, under the guidance of WHO, compiled a dossier documenting the country's approach and achievements, leading to the 2016 validation that lymphatic filariasis as a public health problem had been eliminated in the country [2].

7.3 Overcoming the Challenges to Eliminating Lymphatic Filariasis

The long battle to eliminate lymphatic filariasis in Sri Lanka was marked by technical and political challenges. Even though national efforts had, by the 1980s, driven average Mf prevalence under 1% in all endemic districts, hotspots with rates above 1% (the agreed threshold for elimination) were found in Galle district [1]. This

necessitated intensified, locally focused efforts to lower Mf rates in this district below the elimination threshold.

The discovery of *Brugia malayi* also complicated national elimination efforts by requiring specific monitoring for the strain. In addition, massive periodic epidemics of dengue drew substantial national attention and resources, diverting human resources assigned for the elimination of lymphatic filariasis [2].

During the period of the elimination programme, the internal conflict in the northern and eastern parts of the country posed peculiar problems. Due to the separatist conflict in these areas, people were constantly on the move to find safer places. People from the civil war zones moved to different parts of the country, including Puttalam district, which was endemic for filariasis. Such internal migration put extra pressure on the elimination programme, necessitating surveys even in non-endemic districts. The armed conflict, which began in 1983 and ended in 2009, disrupted or fractured various disease control programmes [4]. The health staff worked against all such odds.

7.4 Key Elements of Success

Several features of Sri Lanka's approach to lymphatic filariasis are especially noteworthy. The technical soundness of the country's lymphatic filariasis programme was promoted by a collaboration of partners, including the national government, WHO, the Liverpool School of Tropical Medicine (UK), Washington University (USA) and others [2]. Systematic surveys and surveillance were undertaken, including active searches, routine surveillance and sentinel surveillance. Mapping of endemic areas aided in targeting disease control efforts [2]. Differential strategies were pursued for urban and rural settings; biomedical and public health approaches were complemented by robust social and communications sciences; and rigorous studies confirmed the elimination of the disease [2].

A strong public health system proved to be vital for the success of the drive to eliminate lymphatic filariasis. Since Independence, successive governments have prioritized the provision of free health care and education [1]. With broad oversight provided by the Ministry of Health, the health services, beginning in 1989, were decentralized, leading to the creation of provincial health ministries in each of the nine provinces [1].

The dedication of the health staff of the AFC and regional anti-filariasis units was noteworthy. In addition, the provincial and regional health authorities, staff of medical officers of health, including public health midwives and the many local volunteers (FPAs) they recruited played pivotal roles in the national push to eliminate lymphatic filariaris, serving as the interface between communities and drug distribution during MDA rounds [2]. House-to-house contact among roughly 50 000 frontline workers and volunteers, as well as an extensive WHO-supported community mobilization campaign, facilitated successful implementation of the MDA campaign [2]. Health workers trained patients in home-based care and provided adherence support [2].

Political support for the national effort to eliminate lymphatic filariasis was unwavering and sustained over time. Domestic resources largely financed the many activities associated with the national programme [2]. Political leadership ensured the domestic production and procurement of the drug DEC, as well as the importation of albendazole (with WHO support) for the MDA campaign [2].

7.5 Moving Forward

Sri Lanka has expressed strong commitment to maintaining the elimination of lymphatic filariasis, which will require continued vigilance for the remaining hotspots. In particular, Galle, in the southern part of Sri Lanka, remains an area of high endemicity. As needed, high-coverage treatment interventions, using methods such as directly observed therapy, will be conducted. Continued focus is needed on regular parasitological and entomological monitoring, elimination of mosquito breeding sites, and both special and routine surveillance [2]. Sri Lanka has to be on a constant vigil as the disease is still prevalent in neighbouring India from where there is a constant flow of people. From mid-2019, the Sri Lankan Government with the International Organization for Migration (IOM) initiated screening for four diseases, including filariasis, of travellers who request for a visa for more than 6 months.

The country's experience has also demonstrated the criticality of continuing robust surveillance even after MDA has ended. Such an exercise can help to identify the remaining hotspots of transmission. It may be difficult to obtain representative data in situations where lymphatic filariasis in one community may be below the threshold while the prevalence rate is high in a neighbouring village. Smaller units are more sensitive for detecting the persistence or resurgence of lymphatic filariasis [5]. It is also necessary to keep the health system geared for managing morbidity among chronic patients in previously endemic areas.

An impending threat is that of climate change, as far as vector-borne diseases such as lymphatic filariasis are concerned. By all available evidence, Sri Lanka is highly vulnerable to climate change. Extreme weather events such as high-intensity rainfall followed by flash floods and landslides are already being reported. The temperature pattern too is changing. The zone experiencing an annual average temperature of above 26 °C is increasing. It is feared that mosquito-borne disease transmission in coastal areas will be influenced by not just global climate change causing alterations in temperature, rainfall and humidity, but also due to rising sea levels [6].

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Chapter 8
Elimination of Lymphatic Filariasis in Thailand: A Model for Best Practices

Suwich Thammapalo and Daniel Kertesz

Abstract Work on lymphatic filariasis in Thailand started in 1949 with the first survey to identify lyphoedema cases. Thailand bore a high burden of LF and the disease was endemic in 11 provinces and the prevalence of microfilaraemia rate was as high as 41% in some areas. The National Programme for Elimination of lymphatic filariasis was launched in 2001, providing the final push against the disease. The success of the lymphatic filariasis elimination programme in Thailand is an excellent example of how strong political commitment combined with a robust health care system can achieve elimination goals. The political commitment was reflected in continued financial support to the programme, which was mostly funded through domestic resources. The country took care to ensure the technical soundness of its approach to lymphatic filariasis. Rigorous surveillance functioned as a cornerstone of the country's efforts. Periodic surveys identified endemic settings, guided MDA interventions and confirmed the success of these interventions. Trained volunteers provided house-to-house interventions, verifying that each household member took treatment. Communities have served as key partners of the national efforts to eliminate lymphatic filariasis. An information, education and communication campaign supported MDA implementation in all endemic sub-villages.

8.1 Background

In 2017, Thailand submitted its official dossier to WHO documenting its elimination of lymphatic filariasis as a public health problem [1]. Specifically designed to carry forward the actions recommended by the Global Programme to Eliminate Lymphatic Filariasis, Thailand's own national programme validates these global recommendations and demonstrates their effectiveness.

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_8

A hot, tropical country that experiences tropical monsoons throughout the year, Thailand is home to nearly 66 million people (2010 Census) [1]. Thailand has experienced rapid social and economic development, transitioning in a single generation from a low-income to an upper-middle-income country. The proportion of the population living in poverty fell from 67% in 1985 to 7.2% in 2015. The country provides free education till the age of 17 years [1]. While Bangkok is globally known as a commercial and cultural centre, the majority of Thailand's people (56%) live outside any municipality [1]. The country has six broadly diverse geographical regions, 76 provinces and two specially governed districts (Bangkok and Pattaya) [1].

Thailand has made substantial investments in health. The Ministry of Public Health is charged with formulating and implementing health-related policy, although its role has been complemented by various autonomous health agencies (focused on such areas as health research and health security). Provincial health offices coordinate health service delivery in each province, including oversight of regional and district hospitals [1]. Hospital-based nurses, primary health care workers and health volunteers provide such services as health education, nutritional support, maternal and child health, immunization, disease control and prevention, treatment of common diseases and conditions, and provision of essential drugs [1]. Thailand has a well-developed health workforce, with a density of doctors, nurses and midwives that is higher than the recommended global standard [1].

Since 2002, Thailand has provided universal health coverage, offering coverage to all Thai citizens who are not otherwise covered. Networks of providers deliver a comprehensive package of services free of charge. In addition to increasing health coverage, the country's universal coverage scheme has proven effective at protecting beneficiaries from the financial catastrophe associated with health expenses.

Lymphatic filariasis first emerged as a public health problem in Thailand in the 1950s, when several village leaders in peninsular Thailand reported the emergence of cases of elephantiasis. Epidemiological surveys in several of these provinces in 1953 found a microfilaria (Mf) prevalence rate of 21% and a prevalence of elephantiasis of 5.3% [1]. Further to the north near the country's western border, investigations in 10 villages along Kwai-Noi found an Mf prevalence of 13.7% and a disease prevalence of 8.7% [1].

Thailand has two strains of lymphatic filariasis—*B. malayi* (or brugian filariasis) and *W. bancrofti* (or bancroftian filariasis). Humans appear to be the only known reservoir of *W. bancrofti*, although epidemiological studies in Thailand detected the presence of *B. malayi* in cats [2]. Seven provinces in north and central Thailand (Chiang Mai, Lumphun, Tak, Mae Hong Son, Ratchaburi, Kanchanaburi and Ranong) are endemic for *W. bancrofti* (transmitted by *Aedes niveus* mosquitoes), and four southern provinces (Surat Thani, Nakhon Si Thammarat, Krabi and Naratiwat) are endemic for *B. malayi* (transmitted by *Mansonia* mosquitoes (Fig. 8.1) [1].

As early as the 1960s, Thailand had taken steps to combat lymphatic filariasis. In 1963, a pilot control project was launched in a village in Kanchanadit district in Surat Thani province. After an epidemiological assessment found a baseline Mf rate of 21.1% and an elephantiasis prevalence of 5.3%, DDT spraying of households (once or twice weekly) was undertaken and a six-week regimen of weekly

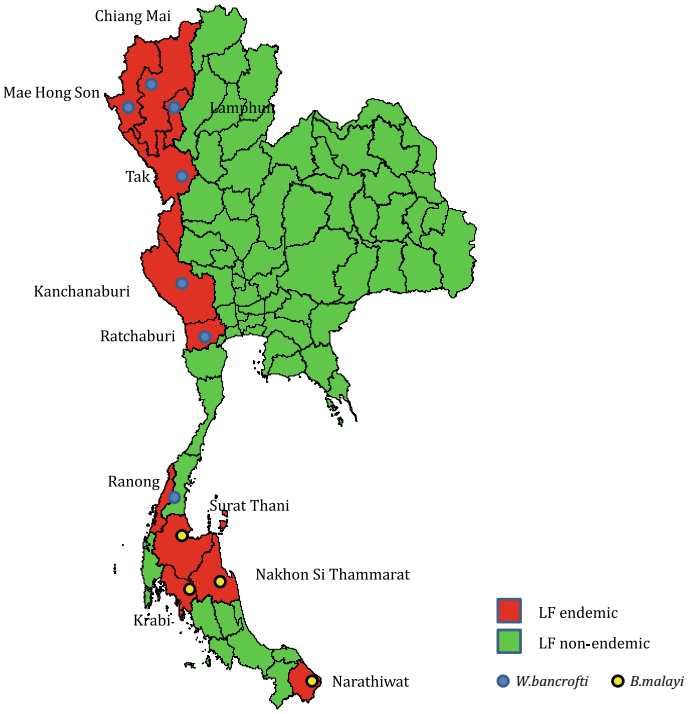

Fig. 8.1 Map of Thailand showing areas with lymphatic filariasis. *Source* Country dossier submitted by Thailand for validation of elimination of lymphatic filariasis

diethylcarbamazine (DEC) was provided to 87% of villagers. The Mf rate declined to 2.2% after one year, 0.4% after two years, and 0.5% after six years [1]. During 1965–1968, reports of occurrence of many cases of hydrocele were reported from Sangkhla Buri, Kanchanaburi province. Initial studies showed the prevalence of a subperiodic form of *W. bancrofti*. More comprehensive investigations revealed an Mf rate of 13.1% and disease rate of 8.7% in ten villages along Kwai-Noi, and 2.3% Mf rate and 1.9% hydrocele rate along the Maenam Mae Klong river. Periodicity studies showed that the parasite was a nocturnally subperiodic form. Mature filarial larvae of *W. bancrofti* were found in 6 of 2750 *Aedes niveus* group of dissected mosquitoes, indicating that *Ae. niveus* was the major vector of bancroftian filariasis in Thailand, with *Ae. annandalei*, *Ae. desmotea* and *Ae. imitator* acting as minor vectors in some endemic areas.

8.2 Thailand's Approach to Elimination of Lymphatic Filariasis

Though LF was endemic in only some parts of Thailand, the Ministry of Public Health (MoPH)decided to initiate serious efforts to identify endemic areas and take up control measures early on, keeping in view its public health importance and the hardships it caused to those affected. A Division of Filariasis was established under the Department of Health in 1961 to undertake administration of DEC in known endemic areas [3]. In order to further understand the problem and its extent, Mf surveys were conducted in 13 provinces in the 1970s. In 1994–1995, as many as 32 provinces were surveyed to understand the distribution of filariasis and confirm the endemicity in provinces with uncertain information on the prevalence of lymphatic filariasis. The surveys were so intensive that in some well-known endemic provinces, hundreds of villages were surveyed. In some of the highly endemic provinces such as Narathiwat, hundreds of villages were surveyed to evaluate the impact of DEC treatment.

In some provinces where prevalence was confined to a few villages, repeated treatment with DEC enabled elimination of lymphatic filariasis. Improvements in social and economic conditions also played an important role in reducing the overall prevalence of lymphatic filariasis.

The combined effect of sustained control measures and improvement in socioeconomic conditions was that the distribution of lymphatic filariasis becomes focal and restricted to some subvillages. The MoPH, therefore, decided in 2001 to launch a national programme for elimination of lymphatic filariasis. Within the Bureau of Vector-Borne Diseases, Department of Disease Control in the MoPH, the Cluster of Lymphatic Filariasis coordinates implementation of the national elimination effort. Provincial-level implementation is overseen by the provincial health office. The national elimination programme is responsible for data collection, transfer and management. To guide and support the national programme, a comprehensive mapping was undertaken. This enabled the programme to distinguish endemic areas from non-endemic areas and thereby focus mass drug administration (MDA) interventions appropriately. This mapping exercise built on the many surveys that had already been undertaken, including surveys in 32 provinces in 1994–1995 that assessed the distribution of lymphatic filariasis and the endemicity in different settings.

The national strategy had two key components: (i) interruption of transmission through MDA in all endemic areas; and (ii) management of morbidity and prevention of disability through the provision of appropriate health-care services to chronically ill patients [1].

Recognizing the highly focal nature of lymphatic diseases, especially following years of disease control measures, the national elimination programme undertook an extensive analysis of historical evidence and environmental conditions in different settings, with the aim of identifying all endemic subvillages. The first step was

to identify all endemic subvillages, with the evidence collected through extensive subvillage-level Mf surveys.

This effort led to the identification of 357 villages in 11 provinces—with a total population of 124,496—as eligible for MDA. Four provinces—Mae Hong Son, Tak, Kanchanaburi and Narathiwat—accounted for 336 of the 357 endemic subvillages.

In keeping with WHO recommendations at the time, Thailand used a combination of DEC and albendazole for its MDA programme in endemic districts. With provincial forecasting based on estimates provided by the health station in each subdistrict, the MoPH procured DEC from local pharmaceutical companies and albendazole through donations of the pharmaceutical company GlaxoSmithKline (GSK) (facilitated by the WHO Regional Office for South-East Asia). Medicines were procured in advance (at least 2–3 months) to avoid delays and stock-outs.

In 2002–2005, MDA rounds were undertaken every year in April in the 357 endemic villages. Yearly training was provided to health staff, who in turn served as trainers at the district level, who thereupon trained volunteer workers who administered the MDA. Health volunteers distributed the drugs (typically to 10–15 households per worker) and observed household members as they took the medicines. Treatments were typically distributed in the evening and taken post-dinner to minimize adverse events. In some settings, drugs were distributed at temples, mosques or community centres. All people in each subvillage were provided treatment, with the exception of children under the age of 2 years, pregnant women, chronically ill people and the very elderly. Mechanisms were put in place for reporting of severe adverse events. Impressive MDA coverage was achieved in the endemic subvillages, ranging from 68.04% in 2006 to 93.42% in 2012. Integrated vector management activities complemented MDA rounds in the endemic subvillages. To support control not only of lymphatic filariasis but also of dengue and malaria, Thailand undertook indoor residual spraying and promoted the availability of insecticide-treated nets. In Narathiwat province in southern Thailand, where surveys detected the presence of infection in cats, mass treatment of cats with ivermectin was undertaken in areas where the prevalence exceeded 1%. However, although lymphatic filariasis was eliminated all over the country, areas of unrest in Narathiwat still showed the presence of Mf. Control activities were interrupted. Social interventions such as mobilization were attempted. Influencers were identified in villages, motivated, honoured, encouraged, recognized and empowered to carry out activities such as blood surveys and MDA by themselves. Community participation was one of the key reasons for the success in eliminating lymphatic filariasis.

Rigorous surveillance served as a pivotal component of Thailand's successful efforts to eliminate lymphatic filariasis. In addition to baseline Mf surveys in 2001, Thailand supported interim and elimination surveys using night-time blood smear examination in 11 provinces from 2002 to 2013. These surveys aided in identifying persistent hotspots requiring more intensive interventions, in categorizing subvillages and in identifying situations where contact surveys and treatment were warranted. For example, while surveys documented the rapid decline of the disease in provinces with *W. bancrofti* following MDA interventions, the persistence of *B. malayi* in Narathiwat convinced health authorities to continue MDA beyond 2005 (for a total

of 11 rounds). Post-MDA elimination surveys found Mf prevalence in a single village with *W. bancrofti* infestation, and alerted the national elimination programme of the need to treat all detected Mf carriers in the village until interruption of transmission could be confirmed. Post-MDA surveys of children under 6 years in more than 260 endemic subvillages found no infection in villages with *W. bancrofti* and very low levels of infection in those with *B. malayi*—well below the elimination threshold. Two rounds of transmission assessment surveys were undertaken five years apart to confirm the elimination of lymphatic filariasis. Migrants from Myanmar continue to be monitored carefully to identify infection and deliver appropriate treatment.

Management of morbidity and prevention of disability occupied an important place in the national efforts to eliminate lymphatic filariasis. A 2001 survey of the chronic disease burden of lymphatic filariasis—at that point relatively low due to declines in the disease burden associated with disease control efforts—identified the number of people in endemic provinces with lymphoedema/elephantiasis. Nakhon Si Thammarat province accounted for the bulk of patients with chronic disease (64% in 2001 and 69% in 2016). For all patients identified with chronic lymphatic filariasis, health workers visited their households, trained patients and family members on leg hygiene, provided patients with a kit for home-based care, and followed up for two months to support proper leg hygiene. In 2017, 99 patients were being followed by 34 health centres. Care and treatment of lymphoedema/elephantiasis have been fully integrated into the health system and is available in all categories of health facilities, with training programmes established for health personnel. Public health personnel visit health stations every two years to assess the availability and quality of services provided to people affected by lymphatic filariasis.

The Pikulthong royal project has been running in Narathiwat since 1985. This project also had the function of surveillance and research on lymphatic filariasis. Collaboration with academic institutes, such as Prince of Songkla University, Mahidol University and Chulalongkorn University, was aimed at conducting research to improve control measures. From 1996 to 2019, they carried out 55 studies. The famous studies that affected elimination of lymphatic filariasis were: "Treatment of Mf in domestic cats with ivermectin", "Test kit for detecting antibodies to *B. malayi"*, and "Effects of a combination of DEC and albendazole on the prevalence of soil-transmitted helminthiases". The results of research were applied as control measures, such as mass treatment in cats during the day with ivermectin, based on blood surveys using antibodies to *B. malayi* test kit. Apart from parasite research, they also implemented the community participation-approach model for improved compliance and trust of the people in an area of unrest, Narathiwat.

8.3 Challenges to Eliminating Lymphatic Filariasis

Although Thailand has eliminated lymphatic filariasis as a public health threat by focusing on interrupting indigenous transmission, the country's extensive border with Myanmar offers opportunities for the migration of the disease into Thailand. Up to

3 million Myanmar migrants are living in Thailand, and the state in Myanmar with the greatest number of migrants to Thailand (Mon State) is endemic for lymphatic filariasis. In response to the risk of migration of cases to Thailand, the country provides a single dose of DEC for all migrants during their mandatory medical check-up and yearly renewal of residence [4]. Local health centres are also encouraged to treat the immigrant population. In general, studies have found low levels of infection among immigrants to Thailand and little evidence that local people have been affected [1].

The presence of multiple strains of lymphatic filariasis necessitated different approaches in some cases. For example, the persistence of *B. malayi* prevalence above elimination thresholds, even following multiple rounds of MDA, required additional rounds of MDA. In addition, the presence of *B. malayi* infection in cats prompted mass treatment of cats in Narathiwat province.

8.4 Lymphatic Filariasis Elimination: Key Elements of Success

The success of the lymphatic filariasis elimination programme in Thailand is an excellent example of how strong political combined with a robust health-care system can help achieve elimination goals. It was visionary of Thailand to prioritize first LF control and then elimination, even though the problem was restricted to a small geographical area and to relatively smaller population groups. The political commitment to address this neglected tropical disease (NTD) is also reflected in continued financial support to the programme, which was mostly funded through domestic resources. The country took care to ensure the technical soundness of its approach to lymphatic filariasis. Its national elimination programme was specifically geared to implement validated disease control strategies recommended by the Global Programme to Eliminate Lymphatic Filariasis. The partnership with WHO was critical for sourcing technical expertise and knowledge at various stages of the elimination programme. The Organization also helped in arranging key supplies such as albendazole through its SEA Regional Office.

Rigorous surveillance functioned as a cornerstone of the country's efforts. Periodic surveys identified endemic settings, guided MDA interventions, confirmed the success of these interventions, and identified settings where additional follow-up interventions were required. Trained volunteers provided house-to-house interventions, verifying that each household member took treatment.

Communities have served as key partners of the national efforts to eliminate lymphatic filariasis. Community mobilization was an important element of the elimination strategy. An information, education and communication campaign supported MDA implementation in all endemic subvillages. The campaign explained the rationale for the lymphatic filariasis elimination programme and why the MDA campaign was essential. In high-burden provinces, major events were held to coincide with the

MDA rounds in April each year, garnering substantial electronic and print media coverage. Additionally, in some villages in areas of unrest in Narathiwat, night surveys for *B. malayi* by health officers could not be carried out. Health volunteers were trained to do thick blood films at night.

8.5 Moving Forward: Lessons Learnt

Thailand is firmly committed to sustaining the elimination of lymphatic filariasis through a structured pathway for surveillance. The Regional Programme Review Group recommended continuing control activities for soil-transmitted helminthiases (STH) in the areas at risk as well as a health facility survey every 2 years from 2017 in all areas with patients of lymphatic filariasis. Targeted surveillance will also continue every 2 years in all previous ten endemic provinces with a coverage of 10% of total implementation units (IUs) in each province [5]. Screening of migrants from Myanmar will continue, as will efforts by the health system to manage morbidity and prevent disability among people affected by lymphatic filariasis. It has developed a strong post-validation surveillance plan, which includes human and entomological surveys to detect residual foci of infection, if any, and to treat residents in such foci to completely eliminate the infection and interrupt residual transmission. This is aimed at taking care of small transmission foci that exist in southern Thailand, as well as suspected transmission through domestic cats. Surveillance will cover 10–20% of IUs with evidence of relatively high prevalence in the past. Either the entire population of the identified IUs or specific groups of people, such as pregnant women or outpatients, will be assessed for infection.

An elaborate plan for surveillance is in place to prevent the possibility of lymphatic filariasis resurfacing through migrants coming from Myanmar with which Thailand shares a long border. Lymphatic filariasis is endemic in some of the border districts in Myanmar and there is a constant flow of people from these areas to Thailand. Under the surveillance plan, the practice of screening immigrants from Myanmar for *W. bancrofti* infection will continue. They will be assessed for antigen prevalence or provocative Mf mosquitoes will be collected from among the households of immigrants and *C. quinquefasciatus* mosquitoes dissected to find whether these are infected.

Additional investigations will be undertaken, if necessary, on the basis of the outcomes of ongoing surveillance surveys. Each individual detected with antigen, antibody or an Mf-positive result will be treated with a full course of DEC. The plan is considered as one of the best models for post-validation surveillance, especially where migrant populations are involved. In the SEA Region, Thailand could serve as an example for countries seeking to eliminate NTDs such as lymphatic filariasis.

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Chapter 9
Trachoma Elimination in Nepal: Bringing Light, Preventing Darkness

Mahendra P. Shrestha, Sailesh Kumar Mishra, and Jos Vandelaer

Abstract The World Health Organization on 22 November 2018 felicitated Nepal for eliminating trachoma as a public health problem. Nepal is the first country in the WHO South-East Asia Region to eliminate trachoma as a public health problem. In Nepal, trachoma was the second leading cause of preventable blindness and was endemic in many areas of the country, where prevalence rates were as high as 23% in several districts. In 2002 the National Trachoma Program (NTP) was launched with the goal of eliminating trachoma from Nepal. Later, the NTD integrated programme of RTI/ENVISION also came on board to support the NTP. The country's success underscores the wisdom of WHO's SAFE (Surgery for trichiasis, Antibiotics to clear infection, Facial cleanliness and Environmental improvement to limit transmission) strategy for trachoma elimination. The Programme adopted an integrated approach with Nepal Netra Jyoti Sangh at the helm of the surgical component, MoHP overseeing mass drug administration (MDA) of antibiotics, and water, sanitation and education partners delivering the "F" and "E" components of SAFE. Nepal has demonstrated that carefully planned strategies, implemented with the involvement of all technical and social stakeholders, can lead to success in eliminating NTDs such as trachoma. The template of trachoma can be applied to the control and elimination of diseases where the underlying determinants are similar. It also points to the pivotal role a strong rural health system can play in addressing NTDs in remote underdeveloped areas inhabited by poor communities.

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_9

9.1 Background

Classified as a neglected tropical disease (NTD) by WHO, trachoma is the leading infectious cause of blindness worldwide. It is endemic to poor communities in Africa, Asia, Central and South America, Australia and the Middle East [1]. Globally, 1.9 million people suffer visual impairment due to trachoma and 3.2 million people need surgery to correct trichiasis. The total number of people living in trachoma-endemic districts the world over is 137 million [1].

Like several communicable diseases, trachoma is prevalent among some of the poorest communities in endemic regions and countries. It thrives in unhygienic and crowded settings with inadequate or poor facilities for sanitation and water supply. The disease is caused by infection with the bacterium *Chlamydia trachomatis*. It is transmitted through contact with infective eye or nose discharges. Eye or nasal discharge can be transmitted directly from person to person or through flies, which may have been in contact with the eyes and noses of infected people. The flies that contribute to its transmission lay their eggs on human feces left exposed. Poor hygiene increases the availability of eye discharge and encourages breeding of flies.

Among communities in endemic areas, infection is particularly common in young children of preschool age. Since the disease is communicable and transmitted through personal contact, it can spread within families and communities. Women have almost twice the risk of going blind from trachoma than men. Those affected do not become blind soon after infection because the disease manifests gradually. An early sign of trachoma is itching in the eye, which slowly develops into an inflammation. This could cause scarring of the upper eyelid and turn it inwards, resulting in the eyelashes scratching and scarring the cornea bit by bit—a process known as trichiasis. Eventually, this causes full and irreversible blindness.

Trachoma is not life-threatening but it is capable of causing lifelong impairment if not treated in time. Once the disease reaches the stage of trachomatous trichiasis, the only recourse available to prevent blindness is surgery. Since it mostly occurs in poor settings, disability caused due to trachoma adds to the economic burden of already poor households.

9.2 Efforts to Eliminate Trachoma

The global efforts to eliminate trachoma began in 1996, with WHO launching the Alliance for the Global Elimination of Trachoma by the year 2020 (GET2020) [2]. A four-pronged strategy was advocated for elimination of trachoma—the SAFE strategy (Surgery for trichiasis, Antibiotics to clear infection, Facial cleanliness, and Environmental improvement to limit transmission)—along with strengthening of national capacity in epidemiological assessment, monitoring, surveillance and resource mobilization [3]. Two years later, the World Health Assembly passed a resolution to eliminate trachoma as a public health problem globally [4].

In 2014, the South-East Asia (SEA) Region of WHO identified elimination of NTDs as a Flagship Priority Programme of the Regional Director, Dr Poonam Khetrapal Singh. Since then, concerted efforts have been made in all endemic countries in the Region to eliminate trachoma as a public health problem. In May 2018, WHO validated Nepal as having eliminated trachoma as a public health problem, making it the first country to achieve this milestone in the SEA Region [5]. Globally, WHO has validated only five other countries for having eliminated trachoma as public health problem—Cambodia, Lao People's Democratic Republic, Mexico, Morocco and Oman. Six other countries claim to have achieved elimination goals: China, Gambia, Ghana, Islamic Republic of Iran, Iraq and Myanmar. Nepal's success shows that elimination of trachoma is inexpensive, simple and highly cost-effective.

9.3 Beginning of the Elimination Journey in Nepal

Trachoma first emerged as a serious eye disease and a major cause of blindness in Nepal after a national blindness survey undertaken in 1981. The survey, conducted by the Ministry of Health and WHO during 1979–1980, was the first activity of the Nepal Blindness Prevention and Control Project.

The nationwide study, called the Nepal Blindness Survey, revealed that the most prevalent potentially blinding ocular disorder was trachoma. It was considered to be the primary aetiology in an estimated 848,759 cases of ocular disorder and a secondary problem in an additional 61,075 cases. In total, an estimated 909,834 persons or 6.5% of the Nepalese population suffered from trachoma. Of them, an estimated 58,329 persons were found with trichiasis or lid deformities resulting from active trachoma [6]. The survey also found that the occurrence of trachoma and its major blinding sequelae (trichiasis, entropion and corneal opacities) was clustered in certain geographical areas and among certain population groups. For instance, the largest number of trachoma cases were found in the Far Western terai districts and 60% of them among three of the 75 ethnic groups—the Chhetri, Magar and Tharu.

The findings of the survey were shocking and served as a wake-up call, prompting the initiation of steps to address the problem of preventable blindness in the country. Trachoma was identified by the government as a public health concern. A non-governmental organization, Nepal Netra Jyoti Sangh (NNJS), which was established in 1978 by a group of social workers, health activists and doctors, extended a helping hand and actively began control measures. The objective behind founding this organization was to work towards promoting comprehensive eye care services to communities in rural areas.

In 1990, NNJS initiated community-based trachoma control programmes in endemic areas. Population-based prevalence surveys were carried out in five of Nepal's districts in 1996. These efforts led to a reduction in trachoma prevalence in endemic areas but a lot remained to be achieved to effectively control this cause of preventable blindness.

9.4 Elimination Strategy and Implementation

In 2002, NNJS and the Ministry of Health and Population (MoHP) launched the National Trachoma Programme (NTP) with the objective of eliminating trachoma from all the 20 endemic districts in Nepal by 2017. SAFE was identified as the key strategy to be implemented to achieve this goal. It was rolled out in five endemic districts to begin with. The NNJS network, consisting of 18 eye hospitals, 80 eye care centres and 38 district branches spread across the country, was successfully leveraged to reach out to the community for trachoma control in endemic areas. District hospital staff were mobilized to conduct district-level trachoma rapid assessments (TRAs) as well as to collect baseline and impact data. The prevalence data obtained from surveys were utilized for making necessary changes in the control strategies and rolling out SAFE. In 2005, the NTP was expanded to all trachoma-endemic districts in the country [7].

Keeping in mind the elements of SAFE, different partners were roped in for different components of the strategy. While NNJS and the MoHP jointly implemented the parts of the strategy relating to provision of antibiotics and conducting surgeries for trichiasis, the Department of Water Supply and Sewerage (DWSS) was taken on board to improve environmental conditions to limit transmission. The DWSS was supported by the International Trachoma Initiative (ITI) and RTI International/ENVISION. The Programme adopted an integrated approach with NNJS at the helm of the surgical component, MoHP overseeing mass drug administration (MDA) of antibiotics, and water, sanitation and education partners delivering the "F" and "E" components of SAFE.

9.4.1 Assessing the Burden

The first blindness survey conducted in 1981 had found that trachoma was the second-leading cause of blindness after cataract. After the NTP was launched in 2002, TRAs and prevalence studies were conducted all over Nepal to assess the extent of trachoma. Given the geographical diversity of districts across the country, a two-pronged mapping strategy was deployed. For districts suspected to be endemic for trachoma, a TRA was carried out and if the active trachoma level was found to be less than 10%, no additional mapping was done. And if active trachoma cases exceeded 10%, the TRA was followed by a more elaborate population-based survey. Such surveys were done in five districts between 1996 and 2001. After the launch of the NTP in 2002, TRAs were conducted in all 75 districts. The purpose of this exercise was to identify districts where SAFE interventions could be taken up on a priority basis. Based on the findings of these TRAs, population-based prevalence surveys were conducted in 27 districts [6].

Further, the population-based survey findings helped NNJS and NTP identify 20 endemic districts out of 75 districts. The full SAFE strategy was implemented in

19 districts that had more than 10% of baseline prevalence of follicular trachoma in the 1–9 years age group. In one district (Baitadi), the baseline follicular trachoma prevalence was 4.5% but the figure in several clusters within it was more than 10% [6].

9.4.2 Medical Interventions

Under the NTP, two medical interventions—MDA and surgery for trichiasis—were key elements of the strategy.

Mass administration of the antibiotic azithromycin, coupled with counselling, referral of patients and promotion of hygiene practices, helped in ensuring that trachoma transmission was interrupted. MDA involved treating the entire population of a district with azithromycin. In order to make MDA successful, it was critical to ensure drug supplies, mobilize communities and ensure distribution of the drug through social and health workers.

MDA was rolled out with the help of different agencies who handled tasks assigned to them. In order to generate awareness about MDA and convince communities, help was enlisted from local community leaders. The Ministry of Education prepared educational material on trachoma and disseminated the same among communities. The task of NNJS was to impart training to over 10,000 social volunteers on how to educate and motivate people to participate in MDA so that the target of trachoma elimination could be achieved.

At the district level, overall coordination of MDA was with the district health administration. District public health supervisors were first trained for NTP work. They then took up training of those in-charge of health posts and subhealth posts in specific tasks such as management of distribution sites, dosages and techniques for recording MDA treatment. At the next level, health officials of the health posts and subhealth posts trained female community health volunteers. Each distribution team consisted of one health post in-charge, an assistant and two female community health volunteers. A total of 20,000 female community health workers were trained to administer MDA in 20 districts.

MDA was rolled out with adequate planning. District health officers fixed dates for MDAs and rolled out promotion activities through FM radio as well as house visits by female community health workers. After this, village development committees organized the task of administering the drug over nine days, one day in each ward of a village. The drug was administered by health workers, usually at a central place designated for the purpose. Between 2005 and 2014, a total of 14.7 million doses of azithromycin were administered throughout the country.

The second major medical intervention under the SAFE strategy was conducting surgeries to prevent blindness due to trachoma for those already infected in their childhood. Repeated episodes of trachoma infection in childhood can lead to scarring of the conjunctiva. Continuous rubbing of the eyelashes against the eyeball, over a period of time, can cause trachomatous trichiasis. The condition causes extreme

discomfort and progressive loss of vision. In such cases, the only option left to prevent total blindness is surgery.

Conducting surgeries on a large scale required identification of persons who needed surgery as well as a cadre of trained surgeons. In the first stage, training was imparted to eye health staff in endemic districts to enable them to conduct counselling and outreach activities for patients with trichiasis. Over 5000 female community health workers were trained in identifying and referring patients with trichiasis for surgery. For conducting surgeries, ophthalmic assistants were trained as per the WHO guidelines. All these activities ensured that a good number of people with trichiasis could be identified for surgery. In total, over 29,000 trichiasis surgeries were conducted under the NTP. Over 70% of these surgeries were done in eye surgery camps held between 2003 and 2010.

9.4.3 Focus on Cleanliness

The success of the NTP hinged on both medical interventions as well as promotion of personal hygiene and environmental cleanliness. The "F" and "E" in the SAFE strategy—Facial cleanliness, and Environmental improvement to limit transmission—played a pivotal role in achieving the desired results of the NTP. Both personal hygiene, facial cleanliness in particular, and environmental cleanliness are critical for interrupting trachoma transmission. In order to inculcate habits to keep the faces of children clean, the NTP focused on communication for behaviour change [8]. This was done through specially designed information and education material that aimed at promoting the right hygiene practices. Posters and brochures were developed to educate people on how trachoma spreads and how cleanliness can help interrupt its transmission. These materials were made available at all health posts and were used by health workers to educate people in endemic areas. Specific training material on different aspects of MDA was developed for female community health workers and local health supervisors. Information on precautions to be taken to prevent trachoma was also spread through FM radio in the endemic districts. The MoHP worked with the Ministry of Education to have modules on trachoma included in the curriculum for grades 1 to 5.

Along with promotion of personal hygiene practices and awareness drives, the NTP worked on ensuring clean surroundings in villages. To address the lack or shortage of toilets and water supply in trachoma-endemic districts, the NTP collaborated with the DWSS, Division of Environmental Sanitation and Water, Sanitation and Hygiene (WASH) partners. The DWSS, which spearheaded the initiative to make Nepal open-defecation free, worked to provide access to water and toilets, and also concentrated on behaviour change. The Department constructed over 7000 toilets in individual households and 2000 in schools in trachoma-endemic districts from 2002 to 2003 onwards.

9.4.4 Surveillance

As a critical part of the elimination process, surveillance activities were undertaken to assess the progress towards fulfilling the criteria set by WHO for elimination of trachoma as a public health problem. The elimination goal was to achieve a prevalence of less than 5% of active trachoma (trachomatous inflammation—follicular), which is treatable with antibiotics, in children aged 1–9 years, in each previously endemic district. The second criterion was to reduce the prevalence of trachomatous trichiasis, which requires eyelid surgery, to less than 0.2% in people aged 15 years and older in each previously endemic district.

Using WHO's simplified system for grading clinical trachoma, impact surveys were conducted after completion of the required rounds of MDA in endemic districts. In every district, data from 1000 children (1–9 years) and 2000 adults (aged over 15 years) were collected to assess the impact of MDA and surgery. Every district had to reduce prevalence to less than 5% for it to qualify for stoppage of MDA rounds. The surveys were repeated after two years to see if the requisite prevalence rates were still below the limit, as part of the surveillance strategy. In addition, independent research studies conducted in some endemic areas also confirmed that districts that had previously been highly endemic had little evidence of recent clinical disease, *Chlamydia trachomatis* infection, or serological evidence of trachoma, suggesting that epidemiological control had been achieved [9]. The surveillance surveys carried out at 2 and 4 years after MDA in two districts showed no evidence of re-emergence of trachoma. The survey also showed attainment of a goal of trachomatous trichiasis of less than 1/1000 population.

Pre-validation surveillance surveys were conducted in 2017 to see if there was any re-emergence. The entire country was mapped for trachoma, and all the endemic districts for successful implementation of the SAFE strategy. Following this, a dossier claiming elimination of trachoma as a public health problem was submitted to WHO in 2018. Nepal was thus certified as trachoma-free in May 2018 [3].

9.5 Overcoming Obstacles

The road to elimination of trachoma as a public health problem in Nepal was paved with challenges that the country overcame with the help of unique solutions.

Rolling out any disease-specific strategy in a country such as Nepal poses challenges because of its geographical location. Reaching out to rural communities in the mountainous regions in the north, along with communities in the plains in the south, was a challenging task. As much as 83% of the country's population lives in rural areas, many of them in remote regions that are covered with snow during the winters. Along with the geographical challenge is the fact that about a quarter of the population in Nepal lives below the poverty line and less than 40% of the total population has access to safe sanitation. These ground realities had to be kept in mind

while designing and implementing strategies to tackle trachoma, which is a disease that breeds in unhygienic conditions and resource-poor settings.

Overcoming these challenges required not just a technical or health response but an integrated and holistic response involving governmental and non-governmental partners in the development sector. The MoHP roped in all concerned ministries to address tasks such as provision of toilets and water supply, creation of education and awareness. Political support came in the form of resource acquisition, support for nationwide mapping surveys and vector control efforts. Efficient administrative coordination among all government agencies, and national and international partners played a critical role in the success of trachoma elimination strategies. The presence of a robust and elaborate health infrastructure in rural areas ensured that all targets could be achieved and delivery of drugs and educational material took place as intended.

Yet another unique factor for the success of the trachoma strategy was social mobilization and ownership of the programme by a non-government agency, NNJS. Through the 1990s, NNJS pioneered community-based trachoma control and implemented the same in endemic areas. This significantly reduced prevalence but much was still to be achieved for elimination. The opportunity came in the form of the NTP launched by the MoHP and NNJS in 2002. When this happened, more partners such as the RTI International/ENVISION and ITI also came on board, with NNJS driving implementation on the ground. It successfully handled tasks such as training of health-care personnel for MDA and ophthalmologists for conducting sight-saving surgeries.

It is also noteworthy that trachoma-related work in rural areas continued despite Maoist insurgency, which disturbed normal life between 1996 and 2006 [7]. Basic infrastructure such as roads and electricity supply deteriorated during the civil war, but health managers and workers ensured that work under the elimination programme such as distribution of drugs remained on track.

9.6 Post-Elimination Challenges

Nepal has demonstrated that carefully planned strategies, implemented with the involvement of all technical and social stakeholders, can lead to success in eliminating NTDs such as trachoma. The template of trachoma can be applied to the control and elimination of diseases where the underlying determinants are similar. It also points to the pivotal role a strong rural health system can play in addressing NTDs in remote underdeveloped areas inhabited by poor communities. However, challenges remain in the post-elimination era. The health system needs to be in a state of preparedness in order to be capable of identifying and managing new cases of trachomatous trichiasis.

Some of the root causes of trachoma—unhygienic conditions and lack of total sanitation in rural areas, which serve as a breeding ground for vectors—continue to

be development challenges in Nepal. In order to ensure that Nepal remains trachoma-free, rigorous efforts will have to continue in the environment and sanitation sectors, including appropriate disposal of human waste. The inculcation of facial hygiene and cleanliness will require continuous efforts at awareness generation, education and behaviour change. This cannot be a one-time exercise. On the technical side, regular assessment studies and surveys will have to be continued to make sure trachoma does not return as a public health problem.

Nepal's success in eliminating trachoma as a public health problem could serve as a model for other countries that are grappling to end trachoma, as the deadline for global elimination of trachoma nears. Trachoma remains a global challenge: an estimated 232 million people living in trachoma-endemic districts are at risk. Over 21 million have active trachoma and about 7.3 million require surgery for trachomatous trichiasis [10]. The advantage of investing resources in addressing the underlying determinants of trachoma, such as personal and environmental hygiene, is that it can pay dividends in controlling other neglected diseases as well.

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Chapter 10
Sri Lanka Marches Ahead and achieves Elimination of Mother-to-Child Transmission of HIV and Syphilis

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Abstract In November 2019 Sri Lanka become the third country in the WHO South-East Asia Region to be validated for elimination of mother-to-child transmission (EMTCT) of HIV and congenital syphilis. The programme for prevention of mother-to-child transmission (PMTCT) of HIV was started in 2002. In 2018, the performance of the EMTCT programme met all and even exceeded 95% of the targets for ante-natal care attendance, early testing and treatment for both HIV and syphilis. Prevalence among infants was well below the required target of 2%, including at the national level as well as the lowest-performing districts. Key factors that helped Sri Lanka to achieve elimination include quick updating of evidence-based guidelines, a comprehensive approach to prevent infections among women, strong multisectoral coordination, and adequate financial support. Ultimately, it is strong political commitment and a strong national programme for provision of high-quality health care to all citizens in the country, coupled with a strong primary health care infrastructure. Integration of HIV care into existing STI services in the country and an all-inclusive approach under universal health care have been a strong factor in reaching out to people living with HIV. Keeping HIV prevalence low has been an important factor in preventing HIV infection among women. Sri Lanka's achievement once again demonstrates the country's commitment to public health and builds on the strong foundation of primary health care services that it laid several decades ago.

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*, SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_11

10.1 Background

According to recent estimates, there are nearly 37.9 million people living with HIV [1]. Nearly 1.7 million people were newly infected in 2018. Over the years a remarkable reduction in new infections has been observed globally, (Fig. 10.1) but still 1.7 million new infections occurred in 2018 [1].

The UN General Assembly Special Session on HIV/AIDS in 2011 adopted a "Political Declaration on HIV/AIDS: Intensifying our Efforts to Eliminate HIV/AIDS" and one of the key component of the Declaration was to "commit to working towards the elimination of mother-to-child transmission of HIV by 2015 and substantially reducing AIDS-related maternal deaths" [2]. As a follow up to this, during the High-Level Meeting in 2016, the Joint United Nations Programme on HIV/AIDS (UNAIDS) and US President's Emergency Plan on HIV/AIDS (PEPFAR) report "on the fast track to an AIDS-free generation" [3] documented that there has been a dramatic reduction in new HIV infections among children in the African region from 2009 to 2015 [3]. The Declaration called for a commitment to achieve zero new HIV infections, zero AIDS-related deaths and zero discrimination, which would provide the basis for implementation of an innovative and evidence-based strategies to support ending AIDS epidemic by 2030. Through this Declaration, countries are requested to take necessary steps to eliminate mother to child transmission of HIV and strengthen services for mothers living with HIV including lifelong ART services (EMTCT) [3].

Dual elimination of MTCT of HIV and syphilis has been identified as a priority by the global health community. WHO launched the initiative for the elimination of congenital syphilis [4] in 2007 and, in 2011, added the target to reduce new pediatric infection of HIV by 90% [5]. In 2014, the global guidance for validation of EMTCT of HIV and syphilis was developed. [6] In 2015, Cuba was certified by WHO as the

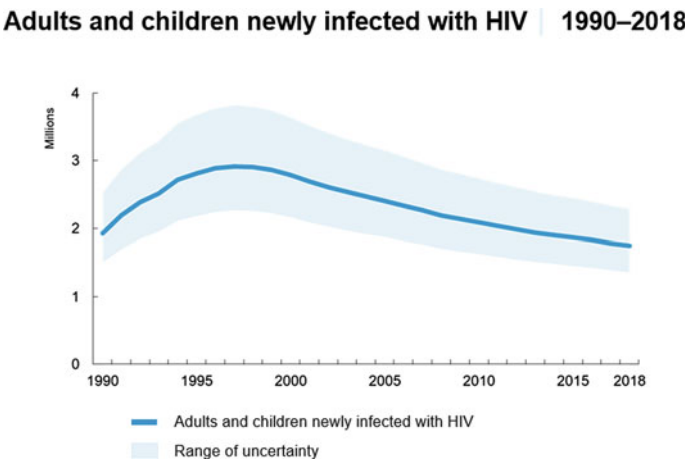

Fig. 10.1 Decline in new HIV infections. *Source* Global HIV and AIDS statistics [1]

first country which achieved elimination of MTCT of HIV and syphilis [7]. Thailand was validated for EMTCT of HIV and syphilis in 2016 [8].

Validation of EMTCT of HIV and syphilis in Thailand was an inspiration for other developing countries to work on EMTCT globally and in the SEA Region.

10.2 Sri Lanka Takes up the Challenge

10.2.1 HIV Scenario and EMTCT of HIV

In 1986, the first person with HIV infection was diagnosed in Sri Lanka and, by the end of 2018, 3195 HIV cases were reported. Sri Lanka is identified as a country with low prevalence for HIV. According to the estimates there are 3500 (3100–4000) adults living with HIV as of 2018 and number of new infections estimated for the same year was less than 200 [9].

In 1990 the first pregnant woman diagnosed with HIV infection in Sri Lanka was reported. The programme for prevention of mother-to-child transmission (PMTCT) of HIV was started in 2002. During the first few years, this programme was implemented at the district general hospitals in Gampaha, Kalutara and the De Soyza hospital in Colombo as a pilot project. PMTCT programme has been improved over the years including development of guidelines based on the latest WHO recommendations.

In the year 2013, an important decision was taken to amalgamate the PMTCT programmes for HIV and syphilis under one theme as elimination of mother-to-child transmission (EMTCT) of HIV and syphilis programme. The National STD/AIDS Control Programme (NSACP) along with Family Health Bureau (FHB) which is responsible for maternal and child health services decided to scale up antenatal HIV and syphilis testing services across the country to cover the entire country by 2016. By end 2018, HIV testing coverage among pregnant women increased to 95.9%. (Fig. 10.2). EMTCT services were offered free of charge as part of the maternal care package.

In spite of increasing HIV testing coverage among pregnant women, the percentage of HIV positive pregnant women identified has declined over the years (Fig. 10.3). The number of pregnant women tested and found positive for HIV has not shown marked change over the years (Fig. 10.4).

As a mode of transmission, MTCT was responsible for <1% of cases in 2018. In the birth cohorts of the years 2017 and 2018, no infants have been diagnosed (Fig. 10.5). This was the basis for the country to ask for validation as the global criteria were met.

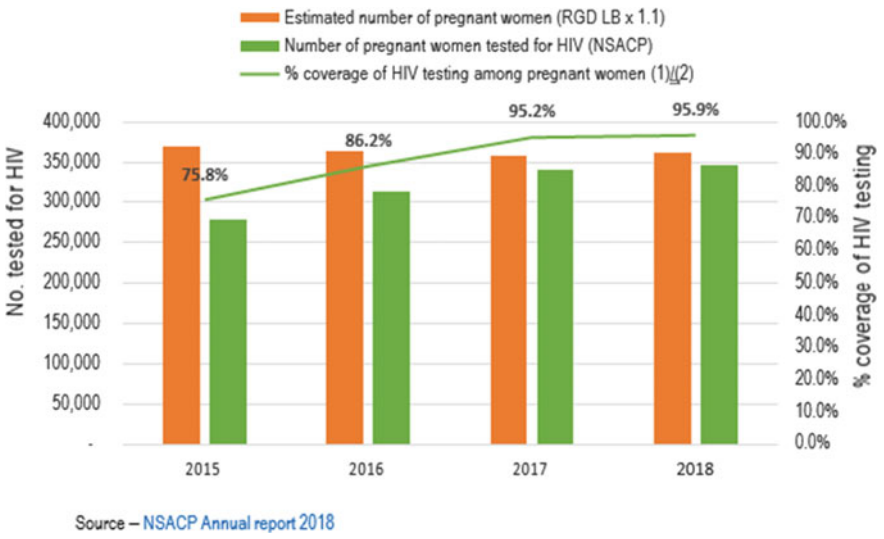

Fig. 10.2 Coverage of HIV testing among pregnant women

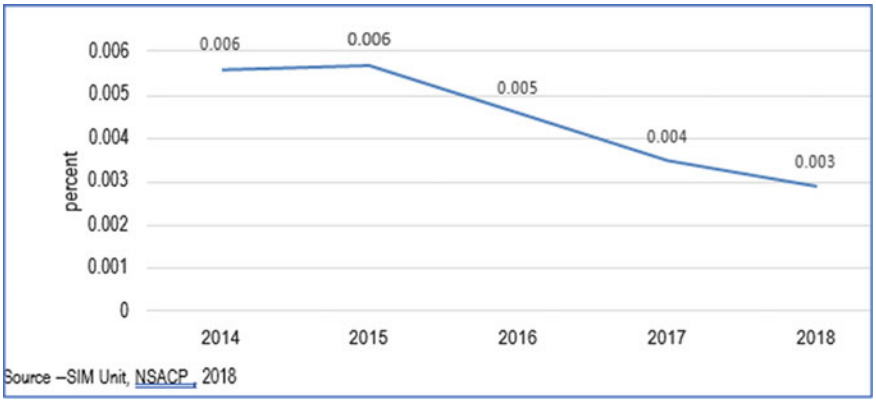

Fig. 10.3 HIV prevalence among pregnant women

10.2.2 Syphilis Scenario and EMTCT of Syphilis

Universal syphilis screening for pregnant women was introduced in Sri Lanka several decades back in 1952. Since then all pregnant women who attended antenatal care (ANC) services were tested for syphilis. In 2018, 96.4% of pregnant women have attended ANC services in the government sector at least once during pregnancy and of them, 99.3% were tested for syphilis (Fig. 10.6).

In the year 2018, the number of pregnant women diagnosed with syphilis was 29 with a prevalence of 0.08 per 1000 (Fig. 10.7), well below the targets required by

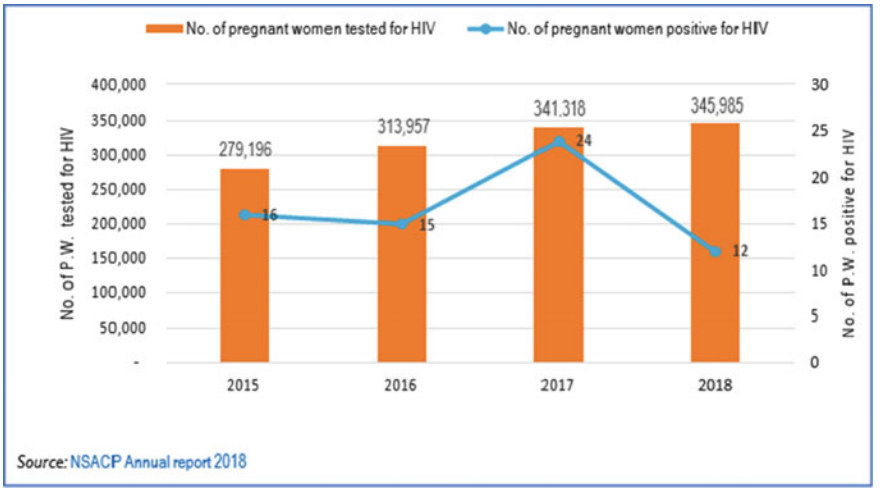

Fig. 10.4 Number of HIV-positive pregnant women

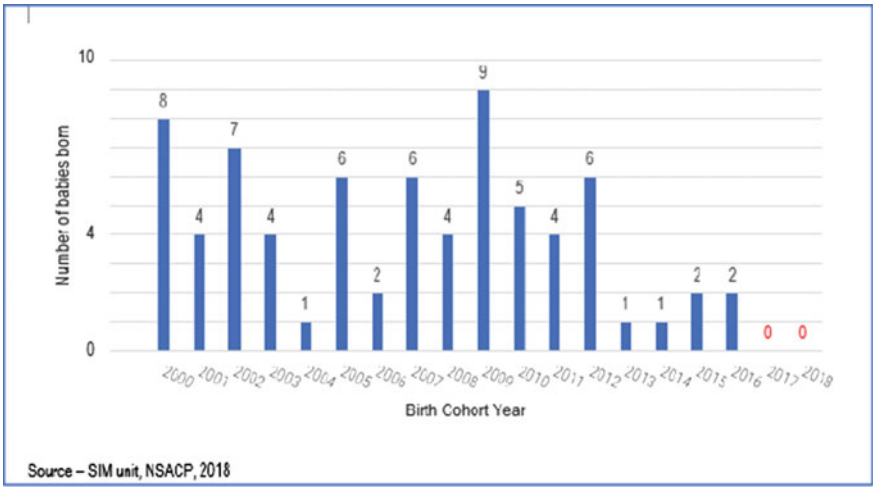

Fig. 10.5 Cases of MTCT of HIV, according to the birth cohort, 2000–2018

the global guidelines [4].

In the year 2018, there were 16 deliveries reported among women living with HIV and 36 deliveries among women with syphilis. All pregnant women with HIV received EMTCT services according to guidelines including antiretroviral treatment and delivered uninfected healthy children. Among pregnant women with syphilis, 97% were treated appropriately reducing the annual rate of congenital syphilis to 1.5 per 100 000 live births. Process indicators have improved, with coverage of ANC attendance being 97.5% in 2017 and 96.4% in 2018. The HIV screening coverage

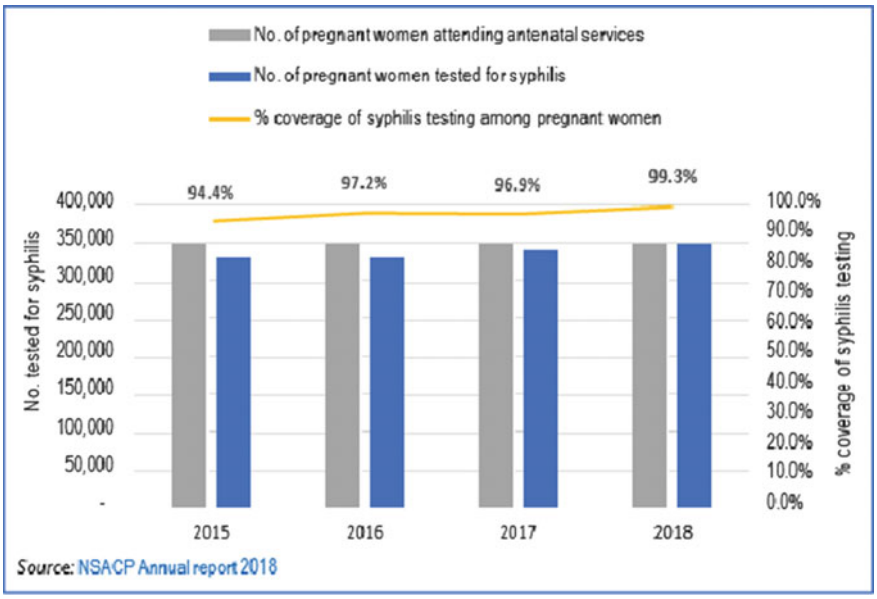

Fig. 10.6 Coverage of syphilis testing among pregnant women, 2015–2018

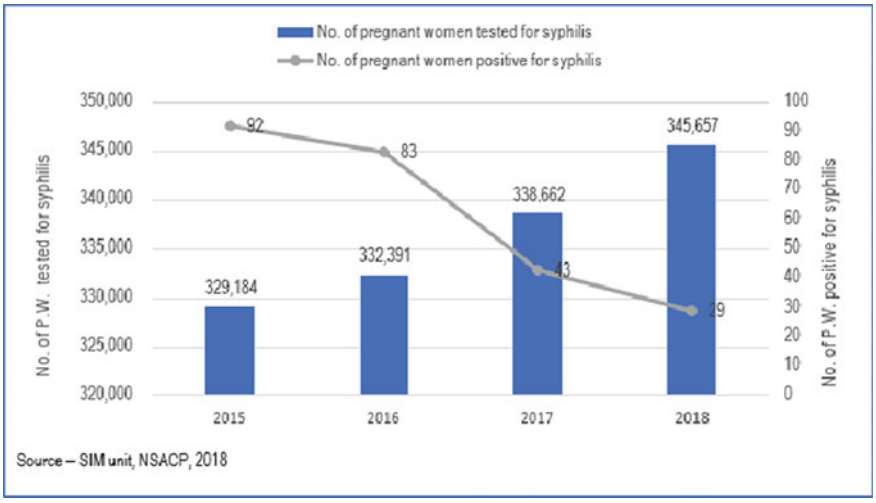

Fig. 10.7 Number of pregnant women newly diagnosed with syphilis and the number of pregnant women tested for syphilis, 2015–2018

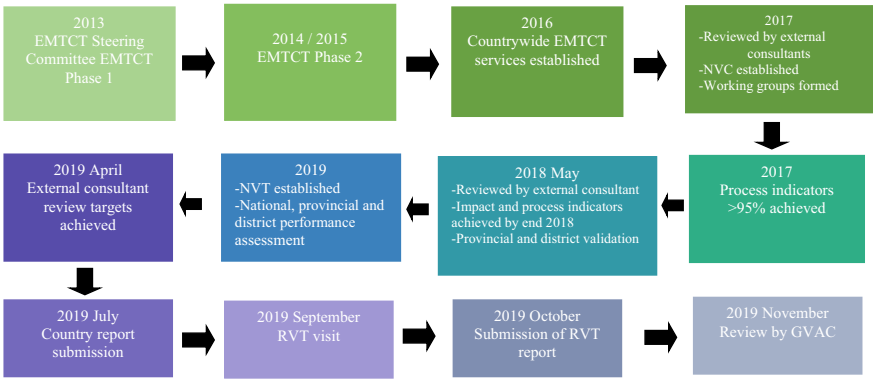

Fig. 10.8 Timelines of the validation process

of pregnant women was 95.2% in 2017 and 95.9% in 2018. Similarly the screening coverage for syphilis has increased to 96.9% in 2017 and 99.3% in 2018.

The performance of the EMTCT programme met all and even exceeded (on some indicators) 95% of the targets for ANC attendance, early testing and treatment for both HIV and syphilis. All pregnant women diagnosed with HIV were linked to HIV care services including lifelong ART and most have shown satisfactory viral suppression close to delivery. The prevalence among infants was well below the required target of 2%. These were achieved at the national level as well as the lowest-performing district.

Once the programme achieved these targets and collected all the required data, they followed the global guidance document from WHO (2017) by establishing a national validation team (NVT), on-site visit and review by the regional validation team (RVT) followed by a review by the Global Validation Advisory Committee (GVAC) [10]. The timelines are summarized in Fig. 10.8.

10.3 Key Factors that Helped Sri Lanka Achieve Elimination

Some key features that helped Sri Lanka achieve elimination are listed below but these are not exhaustive. Ultimately, it is strong political commitment and a strong national programme for provision of high-quality health care to all citizens in the country, coupled with a strong primary health care infrastructure. Integration of HIV care into existing STI services in the country and an all-inclusive approach under universal health care have been a strong factor in reaching out to people living with HIV (PLHIV). Keeping HIV prevalence low has been an important factor in preventing HIV infection among women and consequently there were very few HIV-positive pregnant women and virtually no transmission. The major factor which contributed

to this achievement was the multidisciplinary approach involving the governmental, non-governmental and international partners as well as the community and PLHIV organizations. The dedication and commitment of many stakeholders at the national, provincial and district levels under the guidance of the FHB and NSACP of the MoH and active participation of key populations, PLHIV and NGOs made it possible to reach the targets within few years.

10.3.1 Strong Public Health Services

Sri Lanka has shown significant improvements in health-related indicators over the past few decades despite the low national income and low level of health expenditure.

Sri Lanka reported an MMR of 1964 per 100 000 live births in 1947. This has gradually reduced over the past few decades and in 2017, the MMR was 36 per 100 000 live births [11]. Similarly a steady decline has been noticed in neonatal, perinatal, infant and child mortality over many decades. These achievements can be attributed to the improved public health related infrastructure, appropriately trained health work force and control of many communicable diseases including malaria. In addition, the changes in social policies mainly that provide free health and free education can be identified as major contributors to these developments.

The public health sector of the country can be categorized broadly in two areas:

- community health services dealing mainly on preventive health;
- curative care services ranging from primary care to specialized care.

There are 48 national-level curative health-care institutions and 1070 provincial health-care institutions.

The National STD AIDS Control Programme provides technical support on HIV and STI services to 33 district STD clinics distributed islandwide (Fig. 10.9).

The EMTCT of HIV and syphilis in Sri Lanka was built on strong foundations of MCH and STI services that have developed over several decades. The success of the programme was based on many reasons including commitment of the government, allocating resources, engaging key stakeholders and regular monitoring of the activity. Early screening for HIV and syphilis and appropriate management were promoted by the circulars issued by the MoH for the public and private sectors.

PMTCT of HIV programme was established in 2002 and has improved services over the years. The guidelines for the management of pregnant women with HIV infection have been improved in 2008, 2011 and 2016 according to the WHO recommendations [12–14].

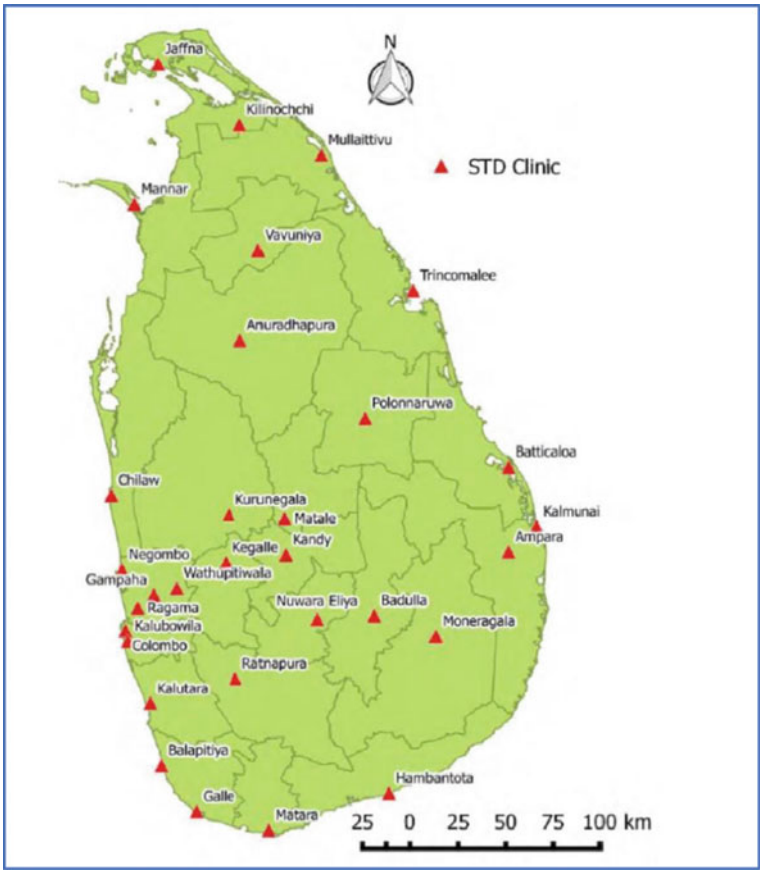

Fig. 10.9 Network of STD clinics in Sri Lanka

10.3.2 Quick Updating of Guidelines Based on Emerging Evidence

Constant updating of guidelines based on emerging evidence has been a key factor in this success. Sri Lanka introduced a short-course zidovudine (AZT) regimen for PMTCT of HIV in 2002 based on the Bangkok study findings. AZT monotherapy was started at 28 weeks of gestation for the HIV-positive mother and for her infant syrup AZT was given starting at birth for a period of six weeks. In 2004 the PMTCT regimen was improved to AZT+single-dose nevirapine (NVP) (WHO option A) and in 2009 Triple ARV therapy (WHO option B) was introduced based on the recommendations of WHO. Lifelong triple ARV therapy was initiated in 2013 (Fig. 10.10).

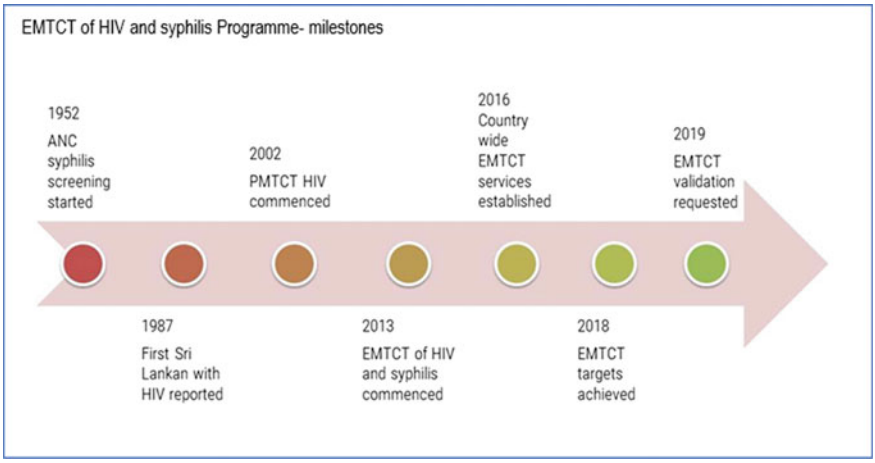

Fig. 10.10 EMTCT of HIV and syphilis programme: milestones

10.3.3 A Comprehensive Approach to Prevent Infections Among Women

All four prongs (P1–P4)[1] of the EMTCT strategy have been successfully implemented throughout the country through well-coordinated STI and MCH services. The services are provided not only for pregnant women but their partners and children as well. Services are extended to key populations, adolescents and others at risk of STI/HIV. According to the data available at NSACP a rapid decline of bacterial STI over several decades is observed and this reflects the success of STI and HIV prevention services. All these improvements have contributed to fewer women having infection during pregnancy. Keeping women negative is an important component of PMTCT besides medical intervention (ART) for those who become positive. The care continues beyond delivery through the cascade till the time the infant is found to be negative.

10.3.4 Multisectoral Coordination Was the Key to Elimination

A well-coordinated mechanism between the FHB and NSACP at the central level and through the MoH and STD clinics at the district level covering all districts prevented loss to follow up at any stage. EMTCT services are fully integrated within the MCH

[1] Primary prevention of HIV among women, prevention of unintended pregnancies among women living with HIV, prevention of HIV from women infected with HIV to her baby, and appropriate services for women with HIV and their families.

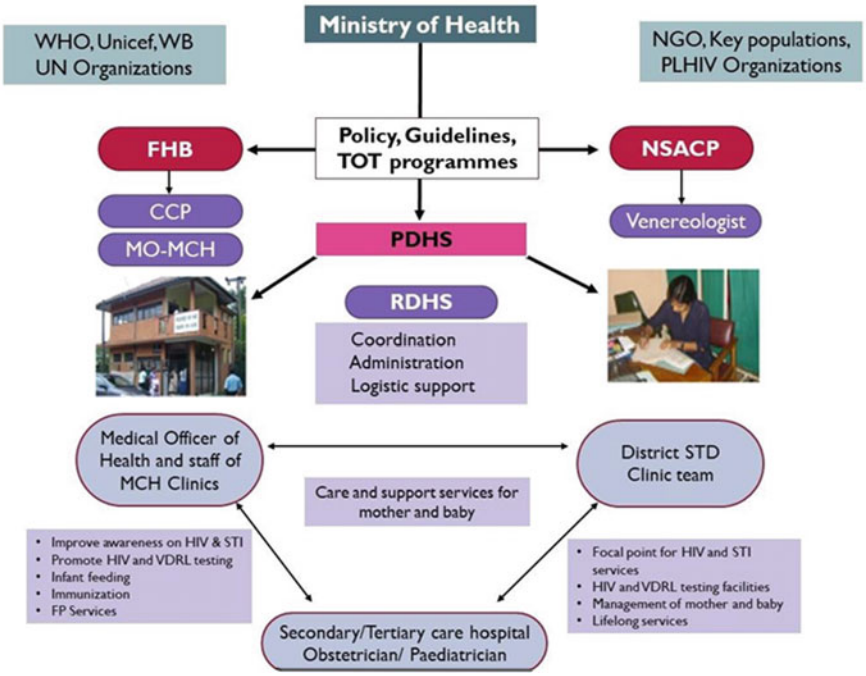

Fig. 10.11 Stakeholders in the EMTCT of HIV and syphilis programme. CCP: consultant Community Physicians; MCH; maternal and child health; MO-MCH: medical officer, maternal and child health; FHB: Family Health Bureau; NSACP: National STD/AIDS Control Programme; PDHS: Provincial Director of Health Services; RDHS: Regional Director of Health Services; STD: sexually transmitted disease; TOT: training of trainers; WB: World Bank

services. Two central institutions NSACP and FHB work closely at the national level and this link extends to the district level through district teams responsible for STI and MCH services. At the community level, the STD clinic and the medical officer of health unit reaches the community through public health staff. These services are supported by the obstetric and paediatric units of the secondary and tertiary care institutions under the guidance of the provincial and district authorities. (Fig. 10.11).

This multidisciplinary approach is the main reason behind the success of the EMTCT of HIV and syphilis programme in Sri Lanka.

10.3.5 Sound Financial Support

The EMTCT programme is funded entirely through government of Sri Lanka. UN agencies such as UNICEF and WHO have supported through technical support and facilitating advocacy, training and monitoring of the programme. Global Fund to Fight AIDS, Tuberculosis and Malaria provides support for the programmes for key

populations and for management of PLHIV. In Sri Lanka government spending on health is financed mostly by the treasury and less than 10% is funded by multilateral agencies, international organizations and bilateral aid.

All these factors also hold the key to continued success of the programme in the years to come on the way to the Sri Lanka target of ending AIDS by 2025, ahead of the global target of 2030. The RVT that visited Sri Lanka felt that the EMTCT programme is strong as a result of being adequately backed by technical, financial and human resources. However, the team felt that for sustainability of the elimination achieved, Sri Lanka needs to focus on the following areas.

1. Sustain multisectoral coordination and collaboration at both the national and subnational levels on a priority basis.
2. Ensure sustained universal access to high-quality decentralized EMTCT services (including at the primary health care level).
3. Address structural and implementation gaps in the areas of programme management, laboratory quality improvement, strategic information, human rights and community engagement.
4. Develop a clear transition plan to ensure sufficient domestic resources to sustain the EMTCT and key population programmes.
5. Sustain high-level political commitment and regularly monitor programme implementation.

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Chapter 11
Leveraging Health System Gains Towards Eliminating Mother-to-Child Transmission (EMTCT) of HIV and Syphilis: How Maldives Became the Second Country in WHO South-East Asia Region to Achieve This Feat

Ibrahim Nishan Mohamed, Abdul Hameed, Abdulla Muaaz Adam, and Shushil Dev Pant

Abstract Maldives eliminated mother-to-child transmission of HIV and syphilis in 2019, joining the first few countries in the world to ensure a generation free of these deadly diseases. Maldives was the second country in the WHO South-East Asia Region to achieve this feat, after Thailand. Maldives has a low-level HIV epidemic with very few known cases of HIV infection among Maldivian citizens living in the country. The elimination of mother-to-child transmission (EMTCT) programme exceeded the 95% targets set for process indicators, in particular, ANC coverage, testing for HIV and testing for syphilis. Maldives' success is attributed to its proactive, persistent and long-term public health measures, initiated even before the first case of HIV infection was detected in the country in 1991. The country's AIDS Control Programme, launched in 1987, prioritized creating awareness, preventing HIV transmission with a focus on the at-risk population, while also providing quality care, support and treatment to people living with HIV/AIDS and syphilis. A unique feature of the country's AIDS control programme has been the total integration of all health services, including preventive services, into the general health system. Prevention of mother-to-child transmission has been a major component of the National Strategic Plan for Prevention and Control of HIV/AIDS 2014-18. All public and private hospitals and health centres in the country offer a range of health services, such as universal access to antenatal care and screening for HIV and syphilis. These

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*, SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_12

concerted and consistent efforts had ensured low transmission of HIV and syphilis for several years.

11.1 Background

The Republic of Maldives has a unique geography with 1192 coral islands that are grouped as a chain of 26 atolls. Dispersed over 187 of these small islands is the population of 402 071. While 51 of these islands have less than 500 people, only four islands have a population more than 5000. More than 65% of the population lives in or close to the capital city in Greater Malé region. Maldives has made significant progress in human and social development over the past decades, moving from low- to upper-middle-income status. For the past two decades, the tourism sector has accounted for nearly 19.9% of the gross domestic product (GDP) [1]. The total number of tourist arrivals for the year end of 2019 were 1.7 million, a 14.7% increase on the previous year [2].

A four-tier referral system is followed for health-care service delivery in Maldives. A public health unit has been established in each atoll and island health facility to provide basic services, like immunization, directly observed treatment, short-course (DOTS) for tuberculosis (TB), health awareness and advice, and reproductive and child health services. The island-level health facilities refer those patients who require more advanced or specialized care to higher-level health facilities in the atolls, regions and central levels. The health system in Maldives faces several challenges, including due to geographical and extreme weather-related events. Despite such challenges, through a primary health care approach, high-level commitment to health, sustained high investment of more than 9% of GDP for health [3] and systematic reforms to the health sector, Maldives ensured significant progress towards improving the health of its people.

11.2 How EMTCT is Organized Within Maldives' Health System

The Health Protection Agency (HPA) is the central public health agency of the Government of Maldives. The Director-General of Public Health leads the HPA. Mandated by the Public Health Act of 2012 [4], HPA functions as a department within the Ministry of Health (MoH) and has five divisions—Public Health Preparedness and Surveillance; Communicable Disease Control; Population and Reproductive Health; Environmental and Occupational Health and Health Promotion and Chronic Disease Control; and a Public Health Inspectorate.

The National HIV Control Programme is placed within the Communicable Disease Control Division and is responsible for developing programmes for those

at high risk, collection of programmatic data and providing services for patients, including antiretroviral (ARV) drugs. The Programme has also developed and trained people to provide voluntary counselling and testing (VCT) services and coordinates the provision of VCT services across the country. The National Strategic Plan for the Prevention and Control of HIV/AIDS (2014–2018) [5] guides national efforts to maintain the low prevalence of HIV in Maldives. The AIDS programme is fully integrated within the health system, including preventive services for PLHIV. Equity and rights-based approaches helped ensure universal health coverage enabled by a universal health insurance system. In addition to HIV, the programme also coordinates activities for prevention of sexually transmitted infection (STI), including reporting and standards of treatment. Since elimination of mother-to-child transmission (EMTCT) is a cross-cutting issue, EMTCT work is assigned within HPA to a working group from the HIV programme and the maternal and child health (MCH) programme and includes heads of Communicable Disease Control and Population Health divisions as well as the senior leadership of HPA. Prevention of MTCT of HIV and syphilis infection is given special attention within the reproductive health programme. This mechanism for overseeing the EMTCT work at field and HPA levels lays a strong foundation for elimination work.

11.3 Leaping to EMTCT from a Springboard of Maternal and Child Health Services

Maldives has a strong health system, particularly the MCH services. Over the past few decades, the health status of people in Maldives has improved significantly. Life expectancy was 75 years for females and 73 years for males in 2016 [6]. There is at least one health facility in every inhabited island in Maldives. In each of these island-level health facilities, health-care provision is ensured by at least a qualified doctor, nurse and public health worker. Other than an outpatient department (OPD) and pharmacy, a delivery room and inpatient beds are part of a minimum infrastructure in these facilities. Services for reproductive health issues and STIs are inbuilt in these facilities.

As a result of its health system investments, Maldives has demonstrated significant progress in reducing maternal and child mortality rates. The infant mortality rate had dropped significantly to 8 per 1000 live births by 2014 [7], with most of the infant deaths occurring in the neonatal period (Fig. 11.1). Similarly, the maternal mortality ratio (MMR) in Maldives had also fallen from 69 per 100 000 live births in 2006 to 44 per 100 000 live births in 2016 [7]. The declining trends of HIV and syphilis in Maldives are depicted in Fig. 11.2 and 11.3, respectively.

According to the Maldives Demographic Health Survey, 2016–2017 [8], nearly all mothers register in ANC services in the first trimester itself, give birth at a health facility, and all deliveries are assisted by skilled attendants or providers. Existing policies and organizational structures in the country support good integration of health

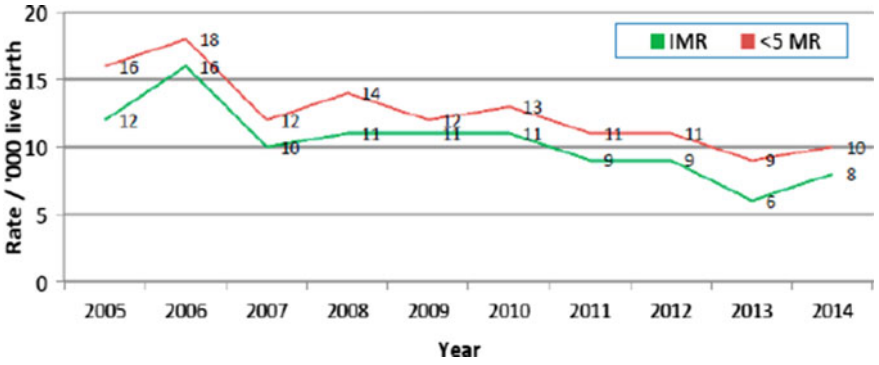


Fig. 11.1 Infant mortality rate (IMR) and under-five mortality in Maldives, 2005–2014. *Source* Maldives health profile, 2016

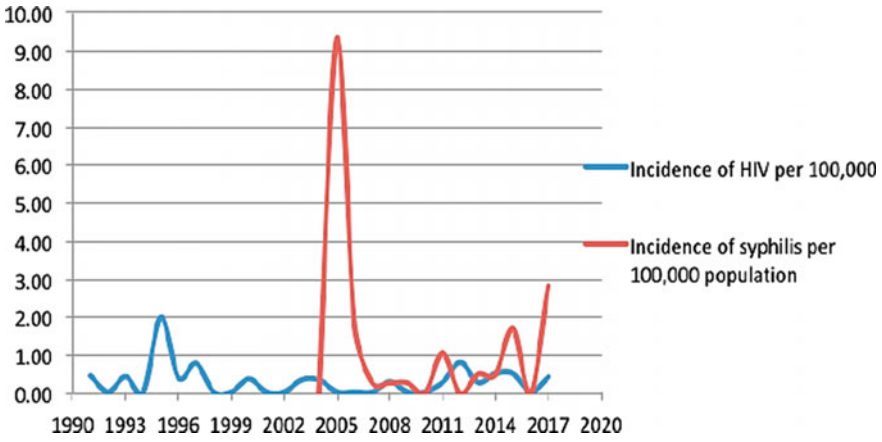


Fig. 11.2 Incidence of HIV and syphilis per 100 000 population in Maldives. *Source* National programme data, HPA, as presented in the National Validation Team (NVT) report

services and, in particular, reproductive health and HIV services. Functional linkages also exist between public and private health facilities. Despite some variability in how antenatal care (ANC) services are organized at different service delivery levels, and how screening is conducted, overall coverage was noted to be very high. Of the estimated 7000 annual pregnancies in Maldives, 98% attend ANC, and deliver in hospital [8].

Maldives was gearing up preparedness to deal with HIV at least four years before the first person tested positive for HIV in 1991. Since then, the number of new infections has consistently stayed low and there is very low prevalence of HIV. Since Maldives conducts nearly 100% of deliveries in institutional settings, they indicated readiness and, as advised, constituted a National Validation Committee (NVC) for EMTCT of HIV and Syphilis in 2015 [9].

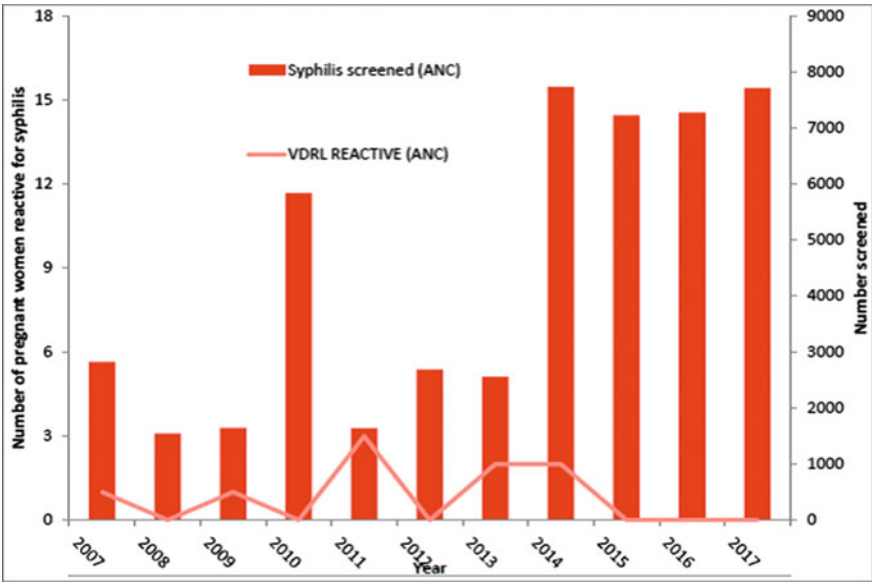


Fig. 11.3 Syphilis screening and declining syphilis positivity trends among antenatal care (ANC) attendees, 2004–2017. *Source* National programme data (monthly surveillance report) as presented in the NVT report

After verification of the data and its sources, the NVC analysed it against the EMTCT global criteria and submitted a formal request along with the Committee's report to the Regional Director of the WHO Regional Office for South-East Asia in August 2018 to facilitate the validation process for Maldives. Accordingly, a Regional Validation Team (RVT)—an independent body of experts—was convened by the Regional Validation Secretariat (RVS), supported by the Regional Office. The RVT undertook its review mission to Maldives during 8–14 September 2018 and submitted their report to the RVS on 23 September 2018.

The mandate of the RVT was to look at progress according to global guidelines for validation of elimination of mother-to-child transmission of HIV and syphilis [10]. As such, several issues pertaining to EMTCT efforts in Maldives featured in the RVT mission, including strength of the health system, populations covered, epidemiology of HIV and syphilis, and the quality and comprehensiveness of programme responses to HIV and syphilis. Sustainability of EMTCT being one of the main areas under consideration, the RVT also assessed the availability of data systems for monitoring of ongoing EMTCT, as well as broader HIV and syphilis prevention efforts and early identification of problems.

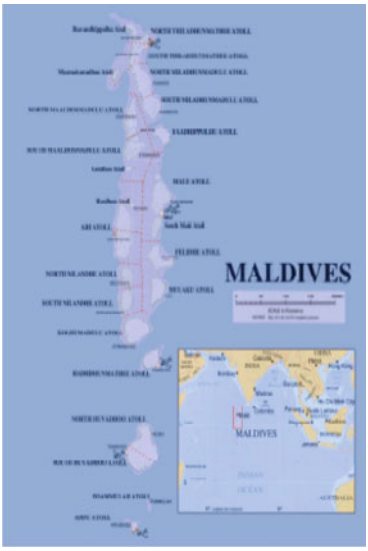
The validation process was well deliberated over 4 years and is depicted in Table 11.1.

Table 11.1 Timelines of the validation process in Maldives

Dates	Activities
November 2015	NVC was formed with a few members representing important areas and first meeting held (decision, plan and time line endorsed)
December 2016	Four national validation teams formed (Date, Programme management, Laboratory and Human rights)
January 2017	Second meeting of the NVC held to review progress and provide guidance
February–March 2018	National data audit conducted in 20 Atolls
1 August 2018	NVC meeting to endorse the final draft national report
6 August 2018	Formal request to the Regional Director, WHO Regional office for South-East Asia to facilitate the validation process
8–14 September 2018	Regional validation team mission to Maldives
23 September 2018	Regional validation team report submitted to Regional validation secretariat
12 June 2020	Review by GVAC and validation

11.4 Addressing Challenges by Capitalizing on Opportunities

1. *Overcoming health challenges due to geographical diversity.* The population of Maldives is small but is geographically dispersed over the archipelago, raising considerable logistical and organizational hurdles for the delivery of health services to all its inhabitants. The Government of the Republic of Maldives has taken on this challenge and put in place an extensive physical health infrastructure that reaches all the inhabited islands. A strong commitment to universal health coverage (UHC) came up through the introduction of the *Aasandha* national health insurance system in 2012, which ensures that free health care is available to meet most of the health needs of Maldivian citizens [11]. Good links have also been developed between the public and non-public health-care systems towards this objective.



***Aasandha* ó Maldives National Health Insurance system**

Aasandha, the universal health insurance scheme, under the Health Insurance Act, provides free medical services to all Maldivian citizens. This scheme covers common health conditions for all nationals. The national ID card is used to access services. At inception, the scheme applied an MVR 100 000 annual coverage limit for each person. There are no copayments or deductibles. However, this limit/cap was scrapped in 2014. Several private facilities empanelled with *Asandha* provide health-care services *both in Maldives and overseas*. It also covers the cost of transport for emergency referrals. In such cases, transport is provided for the patient, bystander and medical escorts.

2. *Collecting and collating paper-based data across the country.* Another major challenge was the lack of an electronic database that records all deliveries; HIV and syphilis testing of mothers; and testing for infants born to positive mothers. At the behest of the national programme, the WHO Country Office, with support from the Regional Office, developed a system for 100% verification of data obtained from different sources. Accordingly, field visits were conducted to all public health facilities in the country to observe ANC/postnatal care (PNC) recording and reporting mechanisms and verify data sent to HPA at the central level. A sample of ten ANC cards from currently pregnant women was verified during each field visit by visiting the women at home. Complete (100%) screening for HIV and syphilis of these women was confirmed. ANC/PNC records for randomly selected months of 2016 were counterchecked against laboratory registers. Records from individual institutions were counterchecked with the vital registry system (VRS) data made available by the MoH.
3. *Inadequate external quality assurance for diagnostics.* Other challenges encountered in the roadmap towards EMTCT included issues related to the external quality assurance (EQA) of laboratory testing; and policy on mandatory testing of foreign nationals as a condition for entry, employment and residence, and subsequent deportation of those found to be HIV positive. Working in close coordination with WHO and other partners, the MoH in Maldives ensured that required decisions and actions were adopted on each of these issues. It was decided to work closely with the Ministry of Economic Development to review the migrant policy in Maldives. The MoH also decided to provide continued access and availability of essential services to all migrants, including pregnant women. Further, it was also agreed that Maldives would work closely with key populations on prevention and testing issues.

4. *Lack of public health definitions for surveillance of congenital syphilis.* The MoH also worked towards making minor adjustments in case definition to align with global guidance; improving the capacity of health-care providers at decentralized levels; adolescents' access to HIV and STI testing and care without parental consent, especially if they are pregnant; and involvement of people living with HIV in Maldives, to include key populations and migrants within the ambit of HIV- and STI-related services. Maldives was able to enrol in the US Centers for Disease Prevention and Control (CDC)-based EQA process and get the quality assurance certified.

11.5 Key Highlights of Maldives' Successful Validation of EMTCT

Maldives had resolved to achieve dual EMTCT of HIV and syphilis as one of the public health priorities that it pursued with great commitment. These commitments were reflected in a number of global plans, strategies and targets that relate to achieving the EMTCT goals. These include the Sustainable Development Goal (SDG) targets of ending preventable deaths of newborns and children under 5 years of age, ensuring universal access to sexual and reproductive health-care services and achieving UHC, and the 2016 global health strategies on HIV and STIs. Member States have adopted these strategies and have committed to work towards achieving the goals of eliminating new HIV infections among infants by 2020 and congenital syphilis as a public health threat by 2030.

Maldives has a low-level HIV epidemic with very few known cases of HIV infection among Maldivian citizens living in the country. Similarly, the prevalence of syphilis has been low and is steadily declining in the country. Seven out of the 11 (64%) Maldivian residents living with HIV in the country are believed to have acquired the infection abroad. In terms of overall targets for EMTCT, the RVT observed that achievements reported by the Maldives' EMTCT programme meet the criteria specified for global certification of EMTCT for the required timeframes—i.e. one year for meeting the target for impact indicators and two years for meeting the target for process indicators.

The EMTCT programme exceeded the 95% targets set for process indicators, in particular, ANC coverage (98% for both 2016 and 2017); testing for HIV (98% for both years); and testing for syphilis (100% for both years). Since almost all pregnant women attend public sector ANC services, often on multiple occasions, and testing for HIV and syphilis is routinely offered to all of them in the ANC setting, rates of MTCT for both diseases are well below the global elimination targets—consistently less than 2 per 100 000 live births for HIV and less than 50 per 100 000 live births for syphilis. The elimination parameters were also met at the lowest performing unit as per guidelines. The RVT did not find any evidence of geographical or population-based inequities in the delivery of PMTCT services, with consistently high levels of coverage with essential PMTCT interventions at all the sites visited, despite income

and other disparities reported. The key recommendations to maintain the validation are given below:

1. Strengthen the package of services for EMTCT of HIV and syphilis, including the regulatory framework for laboratories.
2. Expand capacity for the delivery of a full package of care, treatment and support for people living with HIV to ensure viral suppression and well-being among all affected persons (those who are infected as well as their partners, families and caregivers).
3. Strengthen the package of services for most-at-risk populations and expand service delivery options in collaboration with civil society organizations and communities.
4. Develop the capacity of HPA to collect and analyse strategic information to inform programme planning.
5. Put in place a comprehensive policy with respect to the health needs and rights of migrant workers.

The Global Validation Advisory Committee (GVAC) in June 2019 observed that the findings of the NVT and RVT and our review confirmed that the impact and process indicators for the validation of EMTCT of HIV and syphilis had been met, with no case of vertical infection reported during the past 2 years.

11.6 Sustaining the Achievement of EMTCT—The Way Forward for Maldives

The validation reflects the strong political commitment of the Government of Republic of Maldives, efforts by health workers coupled with active engagement of community, and sustained support by WHO.

Current investments in PMTCT of HIV and syphilis in Maldives have been significant and well-directed. The efforts were built on a robust network of reproductive health services. However, in order to sustain its EMTCT status, additional efforts are required in Maldives, particularly in primary prevention. This would provide additional protection against the possibility of HIV infection among women. If new infections continue to occur among women of childbearing age, it can potentially lead to transmission to their infants in case of late detection or unsuccessful treatment in pregnant women. Primary infections in women can also occur during pregnancy, delivery or breastfeeding.

The fertility rate in Maldives is low at 2.1 per woman and is expected to further decline in coming years. However, demographic trends indicate that in the immediate future, the number of young people under 25 years and the number of women in the reproductive age group (15–49 years) is steadily increasing. The need to maintain high coverage and uptake of antenatal services is key to the way forward. Similar attention is also required in the areas of laboratory systems and health management

information systems. The reforms towards addressing human rights-related barriers in access to services must continue as well.

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Chapter 12
Leprosy: Accelerating Towards a Leprosy-Free World

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Abstract Leprosy was eliminated as a public health problem (EPHP) globally in 2000. Even after two decades over 200 000 cases are detected annually, clustered in certain populations and locations (India and Indonesia accounted together for 67.4%) and of them 9% were children and several with new disabilities. Human impact is amplified by the stigma caused by disabilities. Neglected Tropical Diseases (NTD) roadmap is prepared aiming at interruption of transmission of NTDs including leprosy and is grounded on the principles of equity, fairness and a commitment to the most vulnerable. Backed by evidence, multidrug therapy (MDT) was introduced in 1980s; the focus shifted from control to elimination. WHA resolution (1991) encouraged countries to expand MDT to reach EPHP. By 2000, registered prevalence reduced by 86% and EPHP was reached globally and after 10 years in SEA Region. EPHP gave wrong impression of eradication among policy makers and health staff which resulted in scaling back efforts in eliminating leprosy. MDT, a game-changer was inadequate to end transmission. Since 2006, the global leprosy strategies envisioned interruption of transmission through early detection, prevention with chemoprophylaxis and ending discrimination. This calls for concerted efforts in research, diagnostics, therapies, prevention, disability care and social support with equal emphasis on biomedical, social and environmental initiatives. Such an integrated approach alone can help us root out leprosy from the region

12.1 Background

The number of countries and communities affected by neglected tropical diseases (NTDs) has gradually shrunk over the past few decades. Yet some of these diseases still remain a health challenge in many countries and will not be eliminated without

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P. K. Singh (ed.), *Elimination of Infectious Diseases from the South-East Asia Region*,
SpringerBriefs in Public Health, https://doi.org/10.1007/978-981-16-5566-1_10

focused and intense efforts. It is ironical that NTDs still dodge elimination, despite being preventable and mostly treatable. Past experience has shown that the mere availability of drugs and therapies is not sufficient to end diseases as long as efforts remain fragmented or are not sustained, and there are gaps in research to understand the disease. Leprosy, which was eliminated as a public health problem globally in 2000 and by 2010 in all countries in the SEA Region, is a prime example of this dichotomy. Despite elimination as a public health problem, leprosy continues to occur and cause disabilities in large number of people at subnational levels in some countries of this Region. In 2019, 143,787 new cases of leprosy were reported from the Region.

Even though NTDs claim far fewer lives than AIDS or tuberculosis, their impact on the lives of those affected and their families is devastating. Most of them can cause deformities and disabilities as well as result in loss of livelihood and income to people afflicted with these diseases. The human impact is amplified by the fact that these diseases lead to stigma, prejudice and discrimination, primarily due to the fear of the physical deformities they cause. The Sustainable Development Goals (SDGs) framework, adopted by the United Nations at the end of the Millennium Development Goals (MDGs) period in 2015, has provided a new opportunity and stimulus to end NTDs such as leprosy. Elimination of NTDs will be a litmus test for the SDG Agenda, which is grounded in the principles of equity, fairness and a commitment to the most vulnerable [1].

The scourge of leprosy is age-old, and evidence of its occurrence goes back to pharaonic times in Egypt, though the discovery of *Mycobacterium leprae* or *M. leprae* as the causative organism for leprosy in humans was first made in 1873 [2]. Leprosy is an insidious disease—it is communicable, has a long incubation period, disproportionately affects people living in poor environmental conditions, can potentially lead to physical deformities and disabilities, which in turn become a cause for social stigma and discrimination. The deformities can disable the persons affected for life, particularly those in the productive age group. Leprosy is one of the most important causes of peripheral neuropathy, and about 10% of the patients develop permanent nerve damage leading to lifelong disability. Follow-up needs to be done after completion of treatment to prevent disabilities or detect relapse. For those disabled due to leprosy, rehabilitation care is needed. SDG target 3.3 stresses on ending NTDs by 2030 by reducing the number of people requiring interventions against NTDs. These diseases, particularly leprosy, are a biomedical as well as a societal challenge, requiring integrated strategies to pin them down. Leprosy affects some of the most marginalized and poor communities and population groups in the world.

12.2 The Emergence of Multidrug Therapy

The incubation period of leprosy is 2–7 years and, in some cases, can even be longer. It can be diagnosed through clinical examination. Point-of-care tests are generally

not available, except for skin smears (and that too not everywhere). However, the bacillus is susceptible to antibacterial drugs. This has helped in tackling leprosy so far. The history of the fight against leprosy is very old, but concerted leprosy control efforts began in the 1940s with the emergence of sulfone derivatives initially and then the parent compound, dapsone, as a potent antibacterial drug. Dapsone made ambulatory treatment of leprosy possible and it was administered as monotherapy to millions of patients for decades.

Dapsone changed the face of leprosy globally. It could be given orally, needed no equipment and had a long shelf-life so there were minimal logistic problems. While dapsone benefited a large number of patients, it was a slow-acting bacteriostatic drug and took several years to render lepromatous patients bacteriologically negative. It was observed that compliance to treatment was poor and in patients who had not taken regular treatment, clinical improvement and bacterial clearance were low even after several years of treatment. A study in southern India in the 1960s showed that 40% of irregularly treated lepromatous cases were found bacteriologically positive even after 10 years of dapsone therapy [3]. Around the same time, reports of resistance to dapsone also surfaced, though recognition of the problem of resistance was slow. Meanwhile, clinical trials showed the effectiveness of two more drugs—clofazimine and rifampicin—which began to be used as auxiliary drugs for the treatment of patients who were intolerant or unresponsive to dapsone [4].

After nearly two decades of dapsone being the only leprosy drug available, enthusiasm about it waned due to several reasons. Leprosy control efforts slowed down or proved ineffective in many countries as dapsone began losing its usefulness due to the problem of resistance. By the early 1980s, a general lack of enthusiasm for leprosy control had developed in many countries because of the poor results with dapsone. Although more potent anti-leprosy drugs had become available by then, the existing programmatic information and guidelines had not been fully updated to include them in national control programmes. Against this backdrop, WHO Study Group on Chemotherapy of Leprosy for control programmes made a landmark recommendation introducing multidrug therapy (MDT) regimen to control leprosy; this was a combination of three drugs, with rifampicin as the backbone of the combination. The Scientific Working Group on Chemotherapy of Leprosy (THELEP) followed up with large clinicals trials, which provided the necessary evidence and helped in the evolution of MDT in the 1980s. The clinical trial results firmly positioned MDT as the frontline treatment for leprosy in all endemic countries.

The emergence of MDT as a formidable weapon against leprosy encouraged WHO to shift the focus from control to elimination of leprosy. The fortieth World Health Assembly having noted the commitment of Member States to eliminate leprosy as a public health problem, passed a resolution to eliminate leprosy as a public health problem as part of the goal of health for all by the year 2000, in view of "the significant progress made in recent years in leprosy treatment, including the use of new drugs in multidrug therapy, which has made leprosy treatment far more effective". In 1991, WHO and its Member States committed themselves to eliminate leprosy as a public health problem, a registered prevalence of less than 1 case per 10 000 population by 2000.

MDT was rolled out in endemic countries and coverage reached 55.7% by October 1990. Compared to monotherapy, MDT had several advantages, that made it acceptable among national health services and patients. These factors were: fixed duration of treatment; low level of toxicity and treatment-related side-effects; low relapse rates acceptance of clofazimine in spite of the (reversible) skin discolouration it produced; and significant reduction in the frequency and severity of reactions. In addition, MDT resulted in considerable increase in number of people with early symptoms of leprosy seeking treatment on their own. This contributed to a decrease in the number of new cases with visible deformities as well as improved compliance to multidrug therapy [5]. At the same time, other factors like higher cost of the three drug regimen, MDT compared to dapsone treatment, availability of MDT, particularly clofazimine and diverse views of experts about optimal duration of treatment affected acceptance and roll-out of MDT in several countries [4].

12.3 Elimination Strategies

The elimination strategy steered by WHO in 1991 following World Health Assembly (WHA) resolution and implemented by Member States hinged on faster and wider coverage of MDT in all endemic areas [6]. Shortening the treatment duration from several years to two years with MDT was pivotal to wider acceptance and faster roll-out of the new treatment regimen. Two epidemiological measures of leprosy were stressed upon—the number of new cases detected over a given period and the number of patients registered for treatment a given point of time serving as a parameter to measure prevalence. The second number was critical as elimination as a public health problem was to be measured based on this factor (registered prevalence of less than 1 patient per 10,000 population).

The prevalence trend between 1985 and 1999 showed a decline, with the reduction rate dropping. Prevalence rate decreased by 86%, which was attributed to shortened treatment duration, high cure rates and improved acceptance of MDT. The rate of detection, however, remained stable with minor peaks between 1996 and 1998, explained by intensified case-finding interventions under elimination campaigns and expansion of geographical coverage of leprosy services. Of the 122 leprosy endemic countries in 1985, 108 had reached the goal of elimination as a public health problem by 2000 [7]. More than 10 million patients had been cured with MDT by the end of 1999 [8].

At the beginning of 2000 [9], a total of 641 091 leprosy cases were registered for treatment and 678,758 new cases were detected (as reported by 91 countries). Just a year before the target date of elimination as a public health problem, the prevalence at the global level was around 1.25 per 10,000 population. Leprosy remained a public health problem in 24 countries situated mainly in the tropical belt. The bulk of the registered and newly detected cases lived in the top 11 endemic countries, which represented 92% of new cases detected and 89% of prevalence of leprosy globally. It was clear that the prevalence rate in the top 11 endemic countries remained 4.1

per 10,000 population and elimination of leprosy as a public health problem was not reached in some counties by 2000, despite intensified efforts by national programmes [9].

India accounted for 73% of global new cases and 67% of the prevalence [9]. Prevalence had decreased by 83% since 1985 and had remained stable since 1995. The distribution of leprosy disease in India is quite uneven with prevalence at the state level ranged from 15 per 10,000 population in Bihar state to less than 1 per 10,000 in 10 states. 46% of registered cases and 51% of global new cases in five states of India, i.e. Bihar, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal. This also informed the magnitude of the challenge and the need for implementing intensified elimination strategies [9].

Despite this evidence that leprosy was a challenge in many areas, and many countries were endemic for leprosy, WHO in May 2001 announced that leprosy had been eliminated as a public health problem at the global level. Registered prevalence rate was <1 per ten thousand people in only 24 out of 122 countries. Population of all countries, including those reported even one case of leprosy was included in the denominator for calculating global prevalence [10].

While the goal of elimination of leprosy as a public health problem was attained at the global level in 2000, it took another decade for the SEA Region to achieve the goal at the regional level (reaching the prevalence rate below 1 per 10,000 people). But even this elimination was not complete. Although all the 11 countries met the technical benchmark for elimination as a public health problem at the national level, new cases continue to occur in large numbers in high endemic areas in these countries and in certain population groups. India and Indonesia continue to report over 10,000 new leprosy patients annually, accounting together for 67.4%% of newly diagnosed and reported cases globally [11].

Available evidence shows that the use of the shorter MDT regimen has been able to reduce the registered prevalence of leprosy, but transmission continued in the community. The proportion of patients with visible deformities or disabilities and proportion of children among new cases was high detected was at least 9% over the past decade. Between the years 2001–2014, prevalence has shown a significant decrease, by 73% in the Member countries of South-East Asia Region. However, during the period between 2010 and 2014, the new case detection rate, plateaued. In addition, new cases with visible deformities (grade 2 disabilities of G2D) have increased indicating delay in detecting cases and treating all cases early, this would, which would be consistent with continued transmission of infection [12]. It Delayed detection is likely to have greater effect on *M. leprae* transmission than the type of treatment provided according to the modelling studies [13]. A plausible explanation for the decrease in new case detection is that reaching the target of elimination of leprosy as a public health problem in 2000 led to a wrong impression among health system managers and policy-makers that elimination of leprosy as a public health problem amounted to eradication—an impression that led to a scaling back or abandoning of efforts to stop transmission of infection [14].

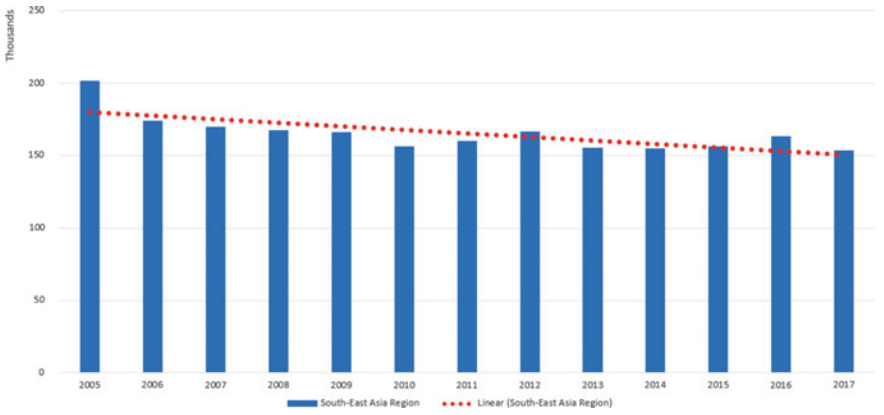

Fig. 12.1 Trends of new cases detected globally for the past ten years, by WHO Region

After nearly two decades of reaching the goal of elimination of leprosy as a public health problem, still more than 200 000 new cases are detected every year worldwide. New case detection globally showed a gradual decrease by 2% annually (Fig. 12.1).

Cognizant of these trends, there was a strategic shift in the post-elimination approach to tackle leprosy—from "elimination as a public health problem" to "reduction in disease burden". Targets have been defined in terms of a new parameter—reduction in G2D—along with decrease in new cases through early detection, treatment with MDT and resultant decreased transmission. The Global Leprosy Strategy (2016–2020) envisions a leprosy-free world with zero transmission of infection, zero disability due to leprosy and zero discrimination. The goal is to "further reduce the global and local leprosy burden", while the targets for 2020 are to reduce number of children diagnosed with leprosy and G2D to zero; the rate of newly diagnosed leprosy patients with G2D to less than 1 per million population; and zero countries with discriminatory legislations against leprosy patients [15].

The Global Strategy also prioritizes early detection of cases to prevent disabilities, among children detection among population at risk in communities and high endemic pockets and aims to improve coverage of leprosy services and access to population at risk like contacts and marginalized people. Key actions of Global Leprosy Strategy 2016–2020 include screening of household and social contacts of persons affected by leprosy, exploring new treatment regimens, enhanced participation of communities in detection of new cases and improving compliance to treatment completion, effective communication strategies. All the actions to be implemented on a strong mission mode were meant for accelerating progress towards elimination of leprosy.

Persistent detection of new leprosy cases in children indicates the continued transmission of infection. Timely detection of patients can help interrupt transmission in the community and prevent new patients with disabilities [1].

Stopping discrimination against persons affected by leprosy by repealing or amending discriminatory laws and policies is an urgent priority. Persons affected

by leprosy often face discrimination at home, in workplace and in society. Discrimination negatively impacts early detection of cases access to diagnosis, treatment outcomes or care, as well as affects their role in the society's societal functioning. Stigma is one of the important causes of delayed diagnosis, Persons with suggested signs of leprosy hesitate to seek treatment for the fear of discrimination and contribute to transmission of the infection within families and communities. Therefore, it is important to end discrimination against persons affected by leprosy. Persons affected by leprosy are often poor living in underserved areas, and they sometimes experience ostracization and loss of employment and income, depression and loss of income. They need to be reached and provided with access to services.

12.4 Lessons Learnt

The paradigm shift from control to elimination was mainly propelled by the success of MDT in the 1980s and 1990s. In order to measure progress towards the target of elimination as a public health problem, prevalence was selected as the key parameter.

Implicit in the elimination strategy was the notion that, prevalence of leprosy would gradually decrease and the disease would gradually disappear once the disease prevalence reaches a stage of less than one case per 10,000 population provided that all patients were cured with full MDT treatment [4]. Going by the yardstick of prevalence rate, substantial progress has been reported—the prevalence dropped from 12 million in 1985 to 0.6 million in 2002 [7, 10].

However, the prevalence for a disease like leprosy—with a long incubation and ability to cause disability—was not a good parameter to measure progress towards elimination in the epidemiological sense. Since prevalence of a disease represents the number of people getting treatment at a given point in time, prevalence figures are subject to operational factors such as length of treatment and schedule of drugs. For instance, if the duration of administering MDT is reduced from 24 to 12 months, it will halve the registered prevalence figure for that population group. Similarly, those receiving a six-month course of MDT during a calendar year may not figure in the prevalence data as only those on the register on 31 December will be counted while calculating prevalence figures. Instead of prevalence rate, the new case detection rate is considered a better indicator of progress. This explains why the leprosy burden in India continued to be high even as prevalence rates went down or plateaued. The figure (less than 1 per 10,000 people) itself was based on the hypothesis that at this level, transmission in the community would be interrupted. The benchmark underestimated the fact that the long incubation period of leprosy could mean that an infected person may have transmitted the disease to others before being treated.

Cases of relapse and treatment drop-out were not adequately addressed during MDT roll-out to achieve elimination in India. Relapsed patients who were skin smear positive for acid-fast bacilli after stopping treatment were not registered immediately for treatment causing a delay in starting chemotherapy. There is possibility that these patients might have spread infection to healthy individuals in the community [16].

A large number of patients were recorded as drop out from regular treatment for various reasons. Some of them either did not take treatment completely until there was clinical worsening of the disease or approached private practitioners who might have not treated with appropriate anti-leprosy treatment. Hence, patients lost to follow up may have transmitted the infection to healthy people in the community till they were registered again for MDT or a suitable anti-leprosy treatment under the National Leprosy Programme (NLP) [16].

Besides introduction and dissemination of a therapy—MDT—and maintaining registers of patients given this treatment (for calculating prevalence figures), the elimination strategy enunciated in 1991 placed little emphasis on other key elements such as surveillance, early detection, disability prevention and rehabilitation, steps to address stigma and discrimination, advocacy and awareness creation, community participation, basic and operations research, and so on. MDT programme activities include rapid enquiry survey, i.e. visiting households to educate people about the early signs of leprosy, examining people coming forward with early signs of leprosy and confirming those with the cardinal signs of leprosy. All the cases detected were treated with MDT as per WHO recommendations. Advocacy was needed to repeal laws that discriminated against leprosy patients in matters such as travel, grant of driving license, etc. Some of these laws were repealed only in 2011 by Bangladesh and in 2016 by India. Work is in progress to repeal or amend laws or legislations that allow discrimination on the basis of leprosy in Nepal, Sri Lanka and other countries of the Region.

Disease elimination frameworks are important from the point of view of their ability to galvanize governments, national health systems, civil society and people into action to achieve the targets. In situations of competing priorities, diseases with elimination targets can attract the necessary attention and funding from policy-makers and politicians. Generally, elimination agendas backed by international agencies such as the UN and WHO help to give a much-needed profile to a particular health problem at country level. The same philosophy was perhaps behind the "elimination by 2000" agenda for leprosy. However, leprosy is a complex disease with a long incubation period, resultant physical deformities, stigma and need for rehabilitation. That is why an elimination agenda solely driven by chemotherapy as the core strategy and prevalence rates as an indicator did not yield the desired results.

The declaration in 2001 of the elimination of leprosy as a public health problem had a further negative impact on tackling the disease in endemic countries. The technical definition of "elimination as a public health problem", i.e. a registered prevalence of less than 1 case 10,000 population, was not properly communicated to policy-makers, service providers, politicians and the media. They perhaps interpreted elimination as per the technical definition to be the end of leprosy or absence of cases. This may have had a negative impact on implementation of the leprosy programme, funding and research related to leprosy.

A negative fallout of the "elimination" was premature integration of dedicated leprosy control programmes within general health systems. While it may have expanded access to diagnostic and treatment services, this may have overlooked the special needs of leprosy treatment, care and rehabilitation. In India, for instance, the

National Leprosy Eradication Programme (NLEP) was integrated with the general health services after attainment of the prevalence of less than 1 per 10,000 in December 2005. This was done without a surveillance system for leprosy in place for early detection and registration of all new cases with MDT to break the chain of transmission of infection in the community. The long incubation period of leprosy means that there could be many individuals in the population incubating the disease for many years before they present themselves as patients. Due to the lack of a surveillance mechanism, particularly in endemic pockets, transmission of infection continued in the community [16]. In some countries, abandoning dedicated control programmes also meant loss of technical expertise and understanding of local epidemiology. Leprosy-related services may suffer following integration in areas where the general health system is not adequately staffed or health centres are not available.

In India, the G2D rate among newly detected cases did not show a decline in proportion with the decrease in its incidence during the 2005–2015 period. This was due to greater reliance on passive case detection methods such as voluntary reporting, which resulted in later detection of leprosy cases in the community. Such untreated cases perpetuated transmission and led to patients coming with G2D at the time of diagnosis. The trend could be reversed with new initiatives such as leprosy case detection campaign, which involved door-to-door surveys [16].

Contact tracing can be considered as the low hanging fruit of active case-finding. It involves reaching out to the family or social contacts of all patients and screening them for leprosy. Active case-finding contributes to achieving an earlier diagnosis and is thus an effective way of reducing disability in patients with leprosy and curbing the transmission of *M. leprae*. India in 2016 introduced active house-to-house survey in the form of the Leprosy Case Detection Campaign, which resulted in the identification of 31,666 active leprosy cases in the community, of which 3755 cases were in the paediatric age group. In 2017, the survey covered 290 million people in 197 districts, resulting in the identification of 19,303 persons with leprosy. The campaign covered every district that had reported a prevalence of one case per 10,000 population in the past three years [17].

Once leprosy was formally declared "eliminated as a public health problem", important sources of funds for research, such as the Bill and Melinda Gates Foundation, decided not to fund leprosy research because leprosy was not perceived as an important problem [10]. Leprosy, which in first place, was neglected when it came to research, was further denied the potential benefits of research.

Overall, misinterpretation of "elimination as a public health problem" achieved in 2005, combined with neglect of a targeted approach and lack of urgency, resulted in complacency with respect to in implementing leprosy programme activities, mobilizing resources for the programme and continuing research on how to further reduce the disease burden. Course correction in elimination campaigns could have been undertaken after wider consultation with all stakeholders, taking into account evidence emerging from whatever data were available or research that was conducted.

12.5 The Road Ahead

The biggest challenge facing national leprosy programmes in endemic countries in the SEA Region is to interrupt the transmission of *M. leprae* infection in the community and ensure zero disability cases among children. This calls for concerted efforts on all fronts—research, diagnostics, new therapies and prevention (chemo- and immunoprophylaxis), addressing social and environmental factors and partnerships. Elimination strategies can become robust and effective only when guided by evidence. MDT was a game changer but now it is clear that it alone is not sufficient to reach the goalpost of minimizing and finally ending transmission as well as disease burden.

In order to eliminate leprosy in the real sense, fundamental research is needed to fill the gaps in understanding of transmission and risk factors of *M. leprae*. Only then can effective diagnostics and newer therapies and vaccines be developed to halt its transmission. Research is urgently needed to find new tools for targeted screening; develop innovative strategies for prevention of the disease such as post-exposure prophylaxis to individuals at risk of infection; transmission models and investment cases for elucidation of new pathways to interrupt *M. leprae* transmission; and ways to reduce disability [18]. At present, clinical evaluation is used, which can detect the disease rather than latent infection. Bacteriological assays cannot reliably distinguish between asymptomatic infection and leprosy disease. Available serological tests are sensitive in patients with a reasonably high bacterial load (patients with multibacillary leprosy), but much less so for patients with paucibacillary leprosy, for whom T-cell-based and molecular polymerase chain reaction (PCR) tests are needed for diagnosis [18]. Sensitive and specific point-of-care tests are needed to achieve early diagnosis of infection and disease.

Antileprosy drugs are administered as chemoprophylaxis for contacts of patients. Moreover, there is fear of resistance developing should they be used incorrectly. On the other hand, specific vaccines are capable of inducing a long-lasting immune response to prevent future infections, since it is known that 90% of people infected with *M. leprae* mount a protective immune response to the bacillus. BCG at birth is effective at reducing the risk of leprosy; therefore, its use should be maintained at least in all leprosy high-burden countries or settings (good quality of evidence) [19]. Clinical trials have been completed or are under way for several new vaccines based on *Mycobacterium indicum pranii, Mycobacterium vaccae*, *Mycobacterium habana*, killed *M. leprae* and BCG. Such vaccines could become an additional tool in the final push against leprosy.

When MDT was introduced, it was not emphasized that treatment should go beyond administration of pills. MDT services should cover efforts to prevent disability such as training patients in self-care, fostering compliance and counselling. Prevention and management of disability is the core of leprosy treatment, as visible disability is the cause of stigmatization of leprosy patients. Therefore, disability-related services are vital for reducing stigma.

The strategies for leprosy elimination will have to lay equal emphasis on biomedical initiatives such as vaccines and diagnostics, surveillance and contact tracing, as well as those to address social and environmental factors. Such an integrated approach alone can help us root out leprosy from the Region.

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