

Review Article

Can Southeast Asia eradicate yaws by 2010? Some lessons from the Yaws Eradication Programme of India

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ABSTRACT

Yaws has traditionally been known as a skin disease that affects people living in hilly, remote and inaccessible areas. Despite the availability of successful treatment and yaws control programmes worldwide since 1948, yaws is endemic in a number of countries, probably because it is not considered a priority disease for eradication. The presence of a disease that is eradicable in a community can be taken as a sign of 'backwardness' and an indicator of inappropriate public health efforts.

Yaws is endemic in 3 countries of the South-East Asia (SEA) Region of WHO—Indonesia, India and Timor-Leste. The WHO SEA Regional Office has set a target for yaws eradication from the region by year 2010. Yaws eradication is at various stages in these countries. India has reported no cases for the past 3 years and has declared elimination. In the other 2 countries yaws eradication programmes are in their infancy and achieving the WHO regional goal appears impossible. However, if lessons are learnt from the Yaws Eradication Programme in India and an externally funded, technically well supported, vertical programme is started immediately in Indonesia and Timor-Leste, the target would not be difficult to accomplish.

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INTRODUCTION

Eradication has become a 'catch phrase' among the international community since the eradication of smallpox in 1980,^{1,2} because it removes the agent from the environment and signifies the ultimate victory of public health. The future targets identified for eradication include polio, guinea worm disease, measles and yaws.^{3,4} Most of the successes in eradication have been achieved for diseases that directly or indirectly affect the skin. The eradication of smallpox and guinea worm disease in large parts of the world, and the limited areas that are endemic make guinea worm disease a candidate for eradication.

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Yaws, a little known endemic treponematosis, is a contagious, non-venereal skin infection of human beings caused by *Treponema pertenue*, a subspecies of *T. pallidum*.⁵ The disease is limited to hilly, remote and inaccessible areas as people there have little access to healthcare services and live in poor hygienic conditions. It is curable by single-dose treatment of penicillin and has been known to exist in India since 1887. It is transmitted by person-to-person contact and affects the exposed parts of the body. It manifests as recurring skin lesions and scar formation. The late stage is associated with deformities and destructive bone lesions.

Though worldwide efforts to control and eradicate yaws started as early as 1948, it continues to exist in many developing countries.^{6,7} Insufficient funding and a lack of priority are the probable reasons for its continued existence. Yaws is still endemic in many countries of Asia, Africa, Europe and the Americas.^{9–21}

A review of the literature on yaws was done to understand the efforts related to the eradication of yaws globally, specifically India, to evolve a strategy for eradicating yaws from the South-East Asian Region of WHO. The literature search was performed on PubMed using the MeSH terms India, yaws, Southeast Asia and eradication. There were 38 relevant articles and the original full texts of 29 of these articles could be obtained. Cross-referenced articles were also used for the article search in the library. Comprehensive data collection was done from other sources, i.e. WHO South-East Asia office including their local libraries and internet resources. Using these methods, 45 articles related to yaws, both from indexed and non-indexed journals, and some articles and textbooks on eradication, were used to prepare this review.

THE PROBLEM

Yaws affected more than 50 million people in about 30 countries and in most continents^{21,22} before 1948.² Over the past 5 decades, cases have been routinely reported from all continents located between the Tropics of Cancer and Capricorn.¹⁴ The most severely affected countries were the Ivory coast, Ghana, Togo, Trinidad and Tobago, Indonesia,^{7,9–13} Ecuador,^{1,23} Malaysia,¹⁴ India¹⁵ and Vanuatu.¹⁸

The discovery of penicillin in the late 1940s and its proven effectiveness in the treatment of yaws led to anti-yaws campaigns in the 1950s.^{21,22} These campaigns were jointly organized by WHO and UNICEF. Between 1952 and 1969 this treatment

programme was very successful in decreasing the prevalence of endemic treponematoses (yaws, pinta, and endemic syphilis) throughout the world. Yaws was eradicated from many countries and ceased to exist as a public health problem in others after these campaigns. Small foci of active disease were still present in 1970 when these control programmes entered the surveillance phase.²²

This success led to dismantling of the mobile teams involved in the programme,^{22,24} and the programme lost its importance. Hardly any efforts were made to incorporate the control programme for yaws in the primary healthcare system. Poor active case finding and treatment were the reasons attributed to the resurgence of yaws. This was a common phenomenon in western and central Africa and to a lesser extent in Asia and the Americas²².

YAWS IN THE WHO SOUTH-EAST ASIA REGION

The WHO South-East Asia Region comprises 11 countries, 3 of which are endemic for yaws (India, Indonesia and Timor-Leste).^{23,25} In India, yaws was first reported in 1887^{26,27} and was endemic in many parts in the 1940s.²⁶ India implemented a yaws control programme from 1952 to 1964. During this phase the prevalence rate decreased from 15% to <0.1% in many areas.^{28,29} An independent assessment by WHO²⁸ found cases only in Andhra Pradesh. In 1977, a resurgence of yaws was reported from Madhya Pradesh. Further surveys reported cases from other states also.²⁹⁻³¹ In 1996, India launched the Yaws Eradication Programme and the last case of yaws in India was reported in 2003.^{6,27} During 2004–06, independent appraisals reported no cases from any part of India.²⁷ In September 2006, India declared that yaws had been eliminated.

Indonesia was a part of the international efforts to control yaws in the 1950s. A resurgence of the disease was seen in the late 1970s leading to the launch of a 'crash programme' by the Indonesian government.²⁵ The programme continued from 1980 to 2000 without making any dent in the problem. The causes of failure were reported to be lack of focus and inadequate resources. In 2003, Indonesia reported 4012 cases of yaws.^{25,32}

The third endemic country in this region is Timor-Leste, a newly independent country without a properly functioning healthcare system. The exact number cases of yaws is not known but is estimated to be more than 1000. Yaws is endemic in 6 out of 13 districts and Timor-Leste had no control programme in place till early 2005.²⁵

Why yaws is a candidate for eradication

The endemicity of a disease for which an effective treatment is available can be considered as an indicator of a poorly functioning health system and ineffectiveness of public health measures in that region. Yaws has been considered a disease^{3,33} amenable to eradication because man is the principal reservoir, patients with early lesions are the main sources of infection, there has been a progressive decline in the number of reported cases over the years, direct contact with secretions of skin lesions is the main mode of transmission, no insect vector is involved, intimate and prolonged contact is needed for person-to-person spread, effective single-dose curative treatment is available which is safe and operationally feasible. The disease is restricted to a few primitive tribal communities; a few neglected foci do not cause epidemics and do not spread to other areas. Mass campaigns aimed at examination of the entire population to detect and treat patients and contacts have greatly reduced

the prevalence and transmission of the disease.^{17,34}

Social determinants can play an important role in the control and eradication of a disease, i.e. improvement in personal hygiene, literacy, sanitation, community awareness of the disease. The availability of effective treatment especially at no cost and improved socioeconomic conditions facilitate reduction of transmission.¹⁸ Hence, the disease fits into the approach of the eradication process.^{34,35} However, some experts disagree^{7,36} based mainly upon the 'Dahlem criteria'³⁷ for disease eradication. As per these criteria, yaws eradication is biologically and technically not feasible, there is no consensus on a positive cost-benefit of eradication and the criteria do not find yaws a suitable candidate for getting enough societal and political support for eradication.^{5,37}

Despite this, a number of countries have succeeded in eradicating the disease. The main reason for a decrease in the efforts to eradicate yaws was that it was not considered a public health problem, even in endemic areas. Consequently, yaws control and eradication programmes lost their sense of urgency and financial support. Later on, experts favoured the view that countries must consider their own epidemiological situation and resources, and decide between effective control and eradication.³

Considering the above facts, a number of endemic countries have already set their own targets to control or eradicate the disease. India had a target of eradicating yaws by 2005 in its national health policy. WHO SEARO has set a target of yaws eradication by 2010 as a regional priority.³²

EPIDEMIOLOGY

Aetiological agent

T. pertenue, the causative organism of yaws, is around 20 m in length.³⁸ It resides in the epidermis of skin lesions, lymph nodes, spleen and bone marrow,³⁹ and does not survive outside the body. It is the oldest known treponematoses, and probably originated in Africa. There is no difference in the serological tests or response to antibodies between *T. pallidum* and *T. pertenue*.⁴⁰ However, the difference in their pathological properties is probably due to alleles known as tprD3.^{41,42}

Transmission

Yaws is a communicable disease transmitted by direct person-to-person contact and man is the only reservoir.^{16,42} The disease may relapse 2–3 times during the first 5 years of infection and may serve as a cause of new infection.²² The source of infection is usually secretions from the skin lesions. Fomite transmission has been reported but congenital and transplacental transmission is not known to occur.

Host factor

Men are slightly more affected by yaws than women.⁴³ While some studies have reported that young children are more vulnerable, other studies have contradicted these findings.²⁰ Studies from India have not reported any significant difference in the age groups affected.⁶

Environmental factors

Yaws occurs in hilly, remote and inaccessible terrains,¹¹ and in forest areas where the climate is hot and humid.⁴⁴ A high humidity level for a long duration and an average rainfall per year of at least 40 inches are considered favourable for transmission of the disease.^{11,44} Tribal communities and forest

areas where close person-to-person contact occurs, associated with poor personal hygiene, overcrowding, bad housing, low standards of living are factors that facilitate the spread of yaws.^{11,16,45}

CLINICAL FEATURES

Yaws has been classified into four stages.^{23,32,44,46}

Primary stage (mother yaws)

These skin lesions appear at the site of inoculation after an incubation period of 3–5 weeks.^{22,47} They usually heal without leaving any scar are generally extragenital and occur on the exposed parts of the body. Within 3–6 weeks, a generalized eruption appears consisting of large, yellow, crusted granular eruptions often resembling condyloma lata of secondary syphilis.^{16,18,45} The primary lesions are highly infectious and there is oedema and cellular infiltration, usually mononuclear, which is most marked around the blood vessels. The spirochaete can be easily isolated from chronic granulomatous lesions. A papilloma is the most common presentation.^{40,48}

Secondary stage

It occurs during the next 5 years, when mucous membranes, periosteal and bone lesions may develop, subside and relapse at regular intervals. These may or may not leave any scar. Ulceration can occur at moist mucosal surfaces but otherwise the lesions remain dry. Some scars are very thin and get easily infected secondarily. These are caused by widespread dissemination of the primary lesions and are almost similar to the primary lesions.^{16,45}

Latent stage

During this phase there are no symptoms but relapses may occur, leading to fulminant disease.

Tertiary lesions

This stage is associated with deformities and destructive lesions. Frequent secondary infection leads to tissue destruction compounded by hypersensitivity. The lesions may heal with fibrosis. These may affect any part of the body including the palms and soles where they are known as ‘crab yaws’.

Most deformities are attributable to bone infections. The bones are usually affected in secondary and tertiary lesions. Secondary lesions are usually multiple and associated with pain. They may heal completely or may result in periosteal thickening and fibrosis. The affected bones may develop pathological fractures because they become architecturally weak and soft, resulting in bending of the bones. Yaws may become secondarily infected leading to visibly unpleasant looks if the facial bones are involved or sinuses form.

After 5–10 years, 10% of untreated patients develop destructive lesions involving the bone, cartilage, skin and soft tissues, similar to the lesions of tertiary syphilis. However, cardiovascular and neurological abnormalities almost never occur in yaws.⁶

Diagnosis

Yaws is usually diagnosed based on clinical findings and a history of living in an endemic area. Serodiagnostic tests for venereal syphilis are used to diagnose yaws.⁶ Non-treponemal test (e.g. rapid plasma reagent [RPR], Venereal Disease Research Laboratory [VDRL]) results are positive in all the stages, except

in the very early stages.⁴² Confirmatory treponemal tests (e.g. *Treponema pallidum* haemagglutination [TPHA], microhaemagglutination *Treponema pallidum* [MHA-TP], fluorescent *Treponema* antibody absorption [FTA-ABS]) are not practical in remote areas. Dark-field examination of early lesions are positive for *T. pertenue*.^{6,21}

Biopsy of late lesions may be needed to show the characteristic histopathological findings of papillomatous epidermal hyperplasia, focal spongiosis and intra-epidermal microabscesses. Treponemes are found in the epidermis.^{24,48}

TREATMENT

A large number of cases are those of latent yaws. The simultaneous treatment of clinically apparent cases along with their likely contacts is considered a critical factor for interrupting transmission of the disease.⁵

Long-acting penicillins are the drugs of choice for patients and their contacts,^{8,25,46} although resistance has been reported in some areas.⁴⁹ For adults, a single intramuscular injection of 1.2 million units of injectable penicillin G aluminium monostearate (PAM) is given and to children <10 years of age 0.6 million units; this cures the disease and makes the patient non-infectious within 24 hours. Penicillin is contraindicated in those with a history of hypersensitivity to the drug. Based on the level of seropositivity among children, suggested targets for community treatment are given in Table I. Tetracycline, erythromycin and doxycycline are alternative drugs for the treatment of those who have hypersensitivity to penicillin (Table II).

To interrupt transmission, the mass treatment approach should be followed by periodical screening of children (6 months–19 years).

Prognosis

The prognosis for early yaws, if treated on time, is excellent. Tissue damage, which occurs in late yaws, is irreversible.^{22,25}

CONTROL EFFORTS IN INDIA

The first recorded efforts for the control of yaws were worldwide. Asia and countries of Southeast Asia were also a part of these efforts. In India, initial efforts were made during 1952–64 in the endemic states of Madhya Pradesh, Orissa, Andhra Pradesh,

TABLE I. Treatment plan by endemicity of disease in the area^{22,25,38}

Endemicity	Plan
High (>10%)	Total mass treatment (TMT)
Moderate (5%–10%)	Active cases, their contacts and all children <15 years Juvenile mass treatment (JMT)
Low (<5%)	Active cases and their contacts in households, schools and workplaces. Selective mass treatment (SMT)

TABLE II. Oral treatment for yaws^{22,25,38}

Drug	Dose
Tetracycline	500 mg twice daily to adults and 250 mg to children over 8 years for 15 days
Erythromycin	500 mg twice daily to adults and 8 mg/kg/body weight to children over 8 years and smaller doses for children below 8 years for 15 days
Doxycycline	100 mg twice a day for 15 days to adults and 2.5 mg/kg/body weight in 2 divided doses to children over 8 years

Tamil Nadu and Maharashtra. These led to a dramatic decrease in the number of cases.⁵⁰ During 1965–96, there were no major attempts to control the disease. In 1996, the Government of India launched the Yaws Eradication Programme with the aim of making India disease-free by 2000.

Yaws Eradication Programme (YEP) in India

The Yaws Eradication Programme was started as a pilot project in the Koraput district of Orissa in 1995–96, 10 years after it was first proposed.²⁷ After the initial assessment, the programme was extended to all 49 districts in 10 states of India where yaws had been reported in the past.²³ The National Institute of Communicable Disease (NICD), New Delhi is the nodal agency for planning, guiding, coordinating, monitoring and evaluating the programme.^{6,38}

The programme was and is being implemented by the state directorates of health services in the affected states, utilizing existing health services and manpower.³⁸ Other departments such as tribal affairs contribute the necessary expertise to implement the programme.

The objectives of the programme were (i) to interrupt the transmission of yaws followed by (ii) achieving the goal of yaws eradication by 2005 (i.e. no seroreactivity to RPR/VDRL in children <5 years of age).^{6,23,27}

To identify cases by local health workers, a simple case definition based on clinical features was devised as laboratory facilities were limited in the affected areas (*see* Box). The simple case definition was used so that even a layman could report cases. Over-reporting of possible cases was targeted so that all possible cases were treated.

The strategy to implement the programme was well designed and multi-staged. A 1-day training for medical officers working in endemic areas was organized; they in turn trained field staff. Manpower development, case finding, simultaneous treatment of cases and contacts, and information, education and communication (IEC) activities were the main modes of approach. Active case finding was done by paramedical workers by routinely visiting households in the affected areas and providing the affected persons and their contacts with proper treatment. Coloured disease recognition cards and health education materials were provided to paramedical workers to facilitate the identification of cases. Active search by field workers was done twice a year. Anti-yaws teams were deployed in some endemic areas with poor health delivery systems. Injection benzathine

penicillin was given to cases and those who were allergic were treated with oral erythromycin for 15 days.

Success of the programme

Before the start of the programme, India reported almost 1000 cases annually. In the initial phases, the programme led to an improved surveillance system and the number of cases remained static for the first 3 years. Since 2000, there was a constant decrease in the number of cases. In 2003, cases were reported from only 2 districts. No case has been reported for the past 3 years (2004–06).^{23,27,32}

Monitoring

Multi-level monitoring was done under the Yaws Eradication Programme. At the central level, task forces formed by the Ministry of Health and Family Welfare monitored the programme. Independent appraisals were also done biannually. The latest appraisal done between December 2005 and April 2006 found no positive cases in the affected districts. The appraisal teams comprised senior public health persons, clinicians and dermatologists, assisted by local health officers and state health directorates. Blood samples collected from suspected cases were found negative on laboratory testing.

Serosurveillance

For serosurveillance among children <5 years old a target of 150 samples from a single district was chosen. A district was taken as one unit and areas in these districts were selected on the basis of percentage of the tribal population, approachability of the area and poor immunization coverage (<60%). Difficult-to-reach areas were covered first and blood samples were collected by heel or finger prick method in children <5 years old in 2 containers. The RPR card test was used to test the seroreactivity of these samples as this test is field-friendly and easily available. Positive cases were revalidated by the TPHA test.²⁷

Situation in Indonesia and Timor-Leste

Indonesia was the first country in the region to start a yaws control programme in 1912.⁵ In 1950, a treponematoses control project was developed which was simplified in 1952 and called the Treponematoses Control Project Simplified (TCPS). This successfully reduced the prevalence rate of yaws from 16.2% in 1950 to 4.1% in 1956. Yaws control activities continued till 1980 when a 'crash programme' was started. The scale of the programme was limited due to the paucity of funds and yaws remained endemic in many areas till 2003.²⁵ Timor-Leste had no programme in place for yaws control till early 2005. Later in 2005, an integrated project for control of lymphatic filariasis, soil transmitted helminthiasis and yaws was started. The programme is in its infancy.

DISCUSSION

Yaws has sometimes been termed as epidemiologically unsuitable for eradication. The reasons for this are (i) untreated cases are infectious for months and years, (ii) latent cases are frequent, (iii) acquired immunity is only partial, and (iv) there is no vaccine available.³ Some experts, on the basis of the Dahlem criteria, feel that it is not feasible to eradicate yaws.^{5,37} A number of countries have defied these concepts and are free of the disease. India has achieved elimination and will probably achieve eradication soon. This experience can be replicated in other resource-poor countries and regions.

Definitions used in the Yaws Eradication Programme in India^{8,24}

CASE

A person with the history of residence in an affected area (present or past) presents with

1. Ulcer with scab,
2. Bone and joint pains especially in the night,
3. Palmar and plantar thickening (hyperkeratosis) and,
4. History of any such lesion in past 5 years.

Elimination: Interruption of transmission of yaws in the country (i.e. nil reporting of the cases) for 3 years.

Eradication: No seroreactivity to RPR/VDRL among children <5 years old in yaws-affected areas for more than 3 years.

India made several attempts since 1952 to control and eradicate yaws but these efforts were not successful till recently.^{23,27} The success of the current programme can be attributed to sincere and coordinated efforts, well supported by funding. Past experiences show that an eradication programme should be supported by sufficient funding and commitment. Any shortfall in such efforts leads to failure of eradication of the disease. In the past most programmes failed due to a sense of complacency at the final stage of control or eradication.^{22, 23} It is disheartening that it took the Indian government almost 10 years to organize the first workshop on yaws eradication in 1987 at the start of the eradication programme.²⁷ Other countries that aim to eradicate yaws should aim at faster planning and programming to achieve successful eradication.

Past experience shows that yaws has never been perceived as an important public health problem even in endemic countries and thus control/eradication programmes lost their sense of urgency and financial support.^{23,25,51} A time-bound approach is the most appropriate method for the success of any such programme. If yaws is to be eradicated from Indonesia and Timor-Leste at the earliest, their programmes need to have a good infrastructure and surveillance mechanism with time-bound targets.

The programme in India also benefited from the inputs of experts who were involved at various stages.⁵¹ The continuous modifications and mid-term corrections in strategy, based on the experts' suggestions contributed to the success of the programme. One such finding early in the implementation was that field workers scheduled their visit to the designated area as per their convenience and that of the tribal people, who leave the village before sunrise and come back after sunset. This led to cases being missed. A local health worker or volunteer who knew the people and their activities and was a part and parcel of the tribe was an apt and successful solution.⁵¹

To address the fear of re-emergence of yaws, experts suggest that before declaring yaws to be eradicated in India, organized and coordinated searches should be made in the states bordering neighbouring countries where yaws has been reported, such as Myanmar.^{23,51}

Most eradication programmes in the past have taken more than the expected time to reach completion. The target of yaws eradication in the South-East Asia Region by 2010 can only be achieved if we start immediately. Rescheduling of targets would only damage the programme strategy. This is more pertinent now as countries have the necessary expertise for yaws eradication and only the managerial aspects need to be worked out.

Yaws has remained endemic in a limited number of resource-poor countries, in which the affected areas have poor health facilities. Experience shows that it can be eradicated from these parts of the world. Unfortunately, when diseases such as tuberculosis, malaria, HIV and others with a higher morbidity and mortality get priority, yaws gets neglected. Moreover, there is a lack of political will among wealthier nations not directly affected by yaws to eradicate the disease. If a little more attention is given to yaws and some funds are made available for this purpose in the coming years, large parts of the world can be made yaws-free soon.

WHO has estimated that a yaws eradication programme in the SEA Region needs about US\$ 6 million in funds.²⁵ This is much less than the expenditure on any health programme (The US Government was investing more than US\$ 50 million annually

to maintain a polio-free status in 1990).⁷ The required funds need to be made available at the beginning of the programme for these efforts to be successful.

To start a vertical yaws eradication programme, countries such as Timor-Leste, which has a weak healthcare delivery system, would need full external support from the beginning to the end.

CONCLUSION

When eradication is becoming the future of public health, a yaws-free WHO South-East Asia Region would not only be a morale booster for health personnel but would also pave the way for the eradication and control of other diseases in this Region, which is affected by many health problems. The keys to success are appropriate technical knowledge, political commitment and sufficient funding. The economic benefits resulting from the eradication of yaws are likely to be large. Yaws eradication can be achieved in Indonesia and Timor-Leste by applying the model of the Indian Yaws Eradication Programme. This disease, which is totally curable, should not be allowed to cripple the lives of people any more.

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