

Neglected Tropical Diseases: From Disease-Specific Control to Integrated Elimination and Universal Health Equity

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Abstract: Background: Neglected tropical diseases comprise a heterogeneous group of infectious and non-infectious conditions that predominantly affect populations living in poverty and with inadequate access to water, sanitation, housing, health care and social protection. Although major advances have been achieved through preventive chemotherapy, intensified case management, vector control and improved sanitation, more than one billion people remain affected. **Objective:** This narrative review critically examines the contemporary burden, determinants and control of neglected tropical diseases, evaluates progress towards the World Health Organization 2030 targets, and discusses recent global and Indian developments, implementation challenges and research priorities. **Key findings:** In 2024, approximately 1.4 billion people required interventions against neglected tropical diseases, representing a 36% decline from 2010. More than 880 million people received treatment for at least one disease, largely through mass drug administration. By the end of 2025, 58 countries had eliminated at least one neglected tropical disease. Nevertheless, progress remains uneven. Dengue incidence has risen sharply, several skin-related and zoonotic diseases remain underdiagnosed, and gains against transmission are threatened by conflict, climate change, weak surveillance and declining international financing. India has achieved elimination of trachoma as a public health problem and substantial reductions in kala-azar, while lymphatic filariasis and leprosy remain important challenges. The evidence indicates that drug-based programmes are effective but insufficient without primary health-care integration, morbidity management, water and sanitation, vector control, One Health action and sustained post-elimination surveillance. **Conclusion:** Neglected tropical disease programmes have demonstrated that elimination is feasible, but success requires decades of sustained political commitment and community participation. The next phase must move beyond treatment coverage towards interruption of transmission, prevention of disability, social inclusion and resilient surveillance.

Keywords: Neglected tropical diseases; preventive chemotherapy; disease elimination; One Health; health equity; India.

INTRODUCTION

Neglected tropical diseases (NTDs) are a diverse group of conditions caused by viruses, bacteria, protozoa, helminths, fungi, ectoparasites and toxins. The current World Health Organization (WHO) portfolio includes 21 diseases or disease groups, ranging from lymphatic filariasis, onchocerciasis and soil-transmitted helminthiasis to leprosy, dengue, rabies, snakebite envenoming, mycetoma and noma.[1] Their inclusion within a common policy framework is based less on shared biology than on shared neglect: they disproportionately affect people living in poverty, attract limited commercial research investment and frequently remain invisible within health statistics.

NTDs are often chronic, disfiguring and disabling rather than rapidly fatal. Lymphoedema, hydrocele, blindness, nerve damage, skin deformity and chronic pain may persist long after infection has been

treated. The resulting stigma, reduced mobility, school absence and loss of employment reinforce poverty. Women, children, migrants, tribal communities, agricultural workers and people living in remote or conflict-affected settings often bear the greatest burden.

Global progress has nevertheless been substantial. In 2024, approximately 1.4 billion people required NTD interventions, 36% fewer than in 2010. Between 2015 and 2021, the estimated burden declined from 17.2 million to 14.1 million disability-adjusted life-years, while mortality fell from approximately 139,000 to 119,000 deaths.[2] More than 880 million people received treatment for at least one NTD in 2024, primarily through preventive chemotherapy. By the end of 2025, 58 countries had eliminated at least one disease.[2]

These achievements coexist with persistent and emerging threats. Dengue cases increased to more than 14 million in 2024, several diseases remain severely underreported, and progress in water, sanitation, financial protection and gender-disaggregated surveillance has stagnated.[2] This review examines the evolving NTD agenda and argues that the next stage of progress requires a transition from vertically organized campaigns towards integrated, equity-oriented and resilient health systems.

The NTD Concept: Strengths and Limitations

Grouping highly diverse conditions under the NTD label has generated political attention, coordinated pharmaceutical donations and shared advocacy. It has also supported common delivery strategies, particularly mass drug administration, integrated vector management and community-based surveillance.

However, the grouping can obscure major differences in transmission, diagnosis and control. Soil-transmitted helminthiasis can be addressed through periodic deworming and sanitation, whereas leprosy requires individual diagnosis and multidrug therapy. Rabies control depends strongly on dog vaccination and post-exposure prophylaxis, while snakebite prevention and management require safe agricultural practices, accessible antivenom and emergency care.

The NTD list should therefore be viewed as a policy and equity framework rather than a uniform clinical category. Integrated delivery is valuable when diseases share populations, platforms or interventions, but forced integration may weaken disease-specific expertise. Effective programmes must combine common health-system functions with technically appropriate disease-specific strategies.

Burden and Distribution

More than one billion people are estimated to be affected by NTDs, while many more live in areas requiring preventive interventions.[2] The burden is concentrated in tropical and subtropical regions of Africa, Asia and Latin America, but the traditional geographical boundaries are becoming less stable because of migration, urbanization, environmental change and vector expansion.

Disease burden estimates should be interpreted cautiously. Several NTDs are not routinely notifiable, diagnostic capacity is limited and affected populations may have poor access to health services. Chronic disability, stigma, mental distress and productivity loss are incompletely captured by conventional disability-adjusted life-year estimates. Conditions such as scabies, tungiasis, fungal NTDs, noma and snakebite envenoming remain particularly undercounted.

Aggregate trends can also conceal divergent disease trajectories. Visceral leishmaniasis, trachoma, lymphatic filariasis and human African trypanosomiasis have declined in many settings. In contrast, dengue has expanded rapidly, assisted by urbanization, population mobility, inadequate water management and favourable climatic conditions. Cutaneous leishmaniasis has increased in conflict-affected areas, while zoonotic and vector-borne risks remain sensitive to ecological disruption.

Social and Environmental Determinants

NTDs are often described as diseases of poverty, but poverty is not merely a background characteristic. It directly shapes exposure, diagnosis and outcome. Inadequate housing increases contact with mosquitoes, sandflies and triatomine bugs. Poor sanitation facilitates soil-transmitted helminths, schistosomiasis and trachoma. Unsafe occupations increase exposure to snakebite and zoonotic infections, while delayed access to care worsens disability.

Water, sanitation and hygiene interventions are therefore central to sustainable control. Drug administration can temporarily reduce parasite prevalence, but rapid reinfection occurs when transmission environments remain unchanged. The slow expansion of safe water and sanitation in many endemic settings is one reason why repeated treatment remains necessary.

Gender also influences risk and access. Women may experience delayed diagnosis because of restricted mobility or decision-making power. Disfiguring disease may affect marriage prospects, social participation and economic security. Men may have greater occupational exposure to snakebite or vector habitats. Routine programmes rarely collect sufficiently detailed gender-disaggregated data to identify these differences.

Climate change is modifying vector distribution, seasonality and disease suitability. Temperature and rainfall affect mosquito and sandfly development, while drought may increase household water storage and vector breeding. Floods, conflict and displacement interrupt drug distribution and surveillance. Climate change does not act independently, however; its effects are mediated through housing, infrastructure, governance and health-system capacity.

Major Intervention Strategies

Preventive chemotherapy

Preventive chemotherapy involves periodic administration of safe medicines to entire eligible populations or defined risk groups without individual diagnosis. It is used for lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminthiasis and trachoma.

Mass drug administration has achieved extraordinary scale. Soil-transmitted helminth programmes reached approximately 502 million people in 2024, while more than 170 million people received ivermectin annually for onchocerciasis in both 2023 and 2024.[2] Medicine donations have made these programmes financially feasible.

Coverage figures, however, may overstate effective treatment. Tablets distributed are not necessarily swallowed. Fear of adverse effects, low perceived risk, migration, absenteeism and poor communication reduce compliance. Systematic non-participation is more important than average coverage because repeatedly missed individuals can sustain transmission.

Directly observed treatment, community engagement and independent coverage evaluation are therefore essential. Programmes must also distinguish between controlling morbidity and interrupting transmission. Repeated chemotherapy can substantially reduce disease without necessarily eliminating infection.

Intensified disease management

Diseases such as leprosy, visceral leishmaniasis, human African trypanosomiasis, Buruli ulcer, Chagas disease and mycetoma require individual diagnosis and treatment. Early detection prevents complications but is hindered by low clinical suspicion, limited laboratory access and stigma.

As disease incidence declines, diagnosis becomes paradoxically more difficult. Frontline workers encounter fewer cases, clinical skills decline and false-positive results become proportionately more common. Elimination programmes therefore require sensitive diagnostic algorithms, referral expertise and quality assurance.

Morbidity management must continue even after transmission targets are reached. Patients with lymphoedema, hydrocele, leprosy-related disability or trichiasis need surgery, rehabilitation, self-care training and psychosocial support. Declaring elimination without maintaining these services risks abandoning people already affected.

Vector control

Vector control includes insecticide-treated materials, indoor residual spraying, environmental management, larval-source reduction and improvement of housing. Its effectiveness depends on local vector behaviour and insecticide susceptibility.

Dengue illustrates the limitations of conventional vector control. Household container treatment and insecticide spraying may suppress mosquitoes temporarily but have often failed to prevent large epidemics. Community-wide environmental management, reliable water supply, waste management, surveillance and emerging biological methods are increasingly important.

New approaches such as *Wolbachia*-infected mosquitoes have reduced dengue incidence in selected trials and programme settings. Their transferability, cost, community acceptance and long-term ecological performance require continuing assessment.

Water, sanitation and hygiene

The WHO road map explicitly recognizes water, sanitation and hygiene as a cross-cutting intervention. Facial cleanliness and environmental improvement were essential to trachoma elimination, while safe water and sanitation reduce transmission of several helminthic diseases.

WASH programmes must extend beyond infrastructure counts. A constructed toilet that is unusable or a water point that functions intermittently may provide little protective benefit. Behaviour, maintenance, gender safety, water quality and sustained use should be measured.

Veterinary public health and One Health

Many NTDs involve animal reservoirs or environmental transmission. Rabies elimination requires mass dog vaccination, access to post-exposure prophylaxis and surveillance. Echinococcosis, taeniasis, foodborne trematodiasis and zoonotic leishmaniasis require collaboration between human health, veterinary, food-safety and environmental sectors.

WHO's One Health framework encourages countries to integrate surveillance, prevention and programme design across these sectors.[3] The concept is compelling, but implementation is frequently weakened by separate budgets, unclear accountability and incompatible information systems.

Table 1. Major NTD Groups, Health Consequences and Priority Public Health Responses

NTD or disease group	Main transmission or exposure	Principal health consequences	Current control approach	Persistent challenges and priorities
Lymphatic filariasis	Mosquito-borne filarial parasites	Lymphoedema, elephantiasis, hydrocele, disability and stigma	Mass drug administration, vector control and morbidity management	Systematic non-compliance, persistent transmission, incomplete disability care and need for post-MDA surveillance
Soil-transmitted helminthiasis	Eggs or larvae in contaminated soil	Anaemia, malnutrition, impaired growth and reduced school performance	Periodic deworming, sanitation and hygiene	Reinfection, inadequate sanitation, limited adult surveillance and uncertainty regarding long-term functional outcomes
Trachoma	<i>Chlamydia trachomatis</i> , spread through contact and flies	Recurrent infection, trichiasis, corneal damage and blindness	SAFE strategy: surgery, antibiotics, facial cleanliness and environmental improvement	Post-validation surveillance, residual trichiasis and sustained WASH
Leprosy	Prolonged close exposure to <i>Mycobacterium leprae</i>	Skin lesions, nerve injury, deformity, disability and stigma	Early case detection, multidrug therapy, contact screening and disability prevention	Delayed diagnosis, child cases, antimicrobial resistance, stigma and reduced clinical expertise
Visceral leishmaniasis	Sandfly-borne <i>Leishmania</i> parasites	Fever, wasting, splenomegaly, anaemia and death if untreated	Early diagnosis, effective treatment, vector control and surveillance	Post-kala-azar dermal leishmaniasis, HIV coinfection, underdiagnosis and risk of resurgence
Dengue and other arboviral NTDs	<i>Aedes</i> mosquitoes	Febrile illness, haemorrhage, shock and death	Integrated vector management, clinical care, surveillance and vaccination in selected settings	Rapid urban spread, climate sensitivity, insecticide resistance and weak outbreak prediction
Rabies	Bite or saliva exposure from infected	Almost invariably fatal encephalitis after symptom	Dog vaccination, wound care, post-exposure	Cost and access to immunoglobulin, fragmented human-

	mammals, usually dogs	onset	prophylaxis and surveillance	animal programmes and underreporting
Snakebite envenoming	Venomous snakebite	Paralysis, bleeding, kidney injury, tissue necrosis, amputation and death	Rapid referral, appropriate antivenom and supportive care	Delayed transport, variable antivenom effectiveness, weak surveillance and occupational risk
Scabies and other skin NTDs	Close contact, mites, fungi or environmental exposure	Itching, secondary bacterial infection, chronic lesions and stigma	Case treatment, integrated skin surveys and, in some settings, mass ivermectin	Underreporting, diagnostic overlap, recurrent transmission and limited specialist services
Taeniasis and cysticercosis	Foodborne and faecal-oral transmission involving pigs	Seizures and neurological disability	Sanitation, meat inspection, treatment and veterinary interventions	Fragmented One Health coordination and poor diagnostic access

Progress Towards the 2030 Road Map

The WHO NTD road map for 2021–2030 aims to reduce by 90% the number of people requiring treatment, reduce NTD-related disability-adjusted life-years by 75%, eliminate at least one NTD in 100 countries and eradicate dracunculiasis and yaws.[1]

Progress has been strongest where effective tools, sustained donations and dedicated programmes have converged. A review of 50 countries that had eliminated at least one NTD found that country ownership, long-term political commitment, combined intervention strategies and international partnerships were recurring features of success.[4] Elimination commonly required two decades or more, challenging the expectation that short project cycles can deliver durable results.

The current trajectory remains insufficient for several 2030 targets. Progress has slowed in reducing vector-borne mortality, expanding WASH coverage, preventing catastrophic expenditure and improving surveillance completeness.[2] Financing is increasingly uncertain as donor priorities shift. Dependence on donated medicines is valuable but creates vulnerability and may underinvest in diagnostics, workforce and morbidity care.

Public Health Significance

NTD control is fundamentally an equity intervention. The people most affected are often those least represented in political decisions and health-system planning. Successful control improves more than infection indicators: it can preserve vision, mobility, schooling, employment and social participation.

NTDs also provide a test of universal health coverage. A health system cannot be considered universal if people with leprosy reactions, snakebite, lymphoedema or visceral leishmaniasis cannot obtain timely diagnosis and care because they live far from specialist facilities.

Economic consequences are substantial at household level. Travel, repeated consultations, lost wages and long-term disability can produce catastrophic expenditure even when medicines are free. Financial protection should therefore be assessed alongside disease incidence and treatment coverage.

Recent Advances

Recent years have brought advances in diagnostics, therapeutics, vaccines and surveillance. WHO prequalified new medicine formulations and active pharmaceutical ingredients and advanced target product profiles for priority NTD diagnostics.[2] Rapid diagnostic tests have transformed visceral leishmaniasis and human African trypanosomiasis programmes, although performance varies by region and disease prevalence.

Triple-drug therapy with ivermectin, diethylcarbamazine and albendazole can accelerate microfilarial clearance in eligible lymphatic-filariasis settings. Updated WHO guidance places greater emphasis on adult infection surveys, persistent-transmission assessment and post-validation surveillance.

Digital mapping, mobile reporting and geospatial modelling can identify untreated populations and environmental risk. Artificial intelligence may assist image interpretation and outbreak forecasting, but

algorithms trained on limited populations risk poor generalizability. Digital innovation should strengthen field surveillance rather than replace laboratory confirmation and community engagement. The addition of noma to the WHO NTD portfolio in 2023 has increased attention to a devastating disease associated with severe poverty, malnutrition and inadequate oral health care. Its inclusion also illustrates how political recognition can precede robust burden data.

Indian Perspective

India carries a diverse NTD burden, including lymphatic filariasis, leprosy, visceral leishmaniasis, dengue, rabies, soil-transmitted helminthiasis, snakebite and several skin NTDs. The epidemiology varies substantially across states and districts, making subnational planning essential.

A major recent achievement was WHO validation of India's elimination of trachoma as a public health problem in October 2024.[5] The achievement followed decades of implementation of surgery, antibiotics, facial cleanliness and environmental improvement. Post-validation surveillance remains necessary because elimination as a public health problem does not mean complete disappearance of infection or trichiasis.

India has also made remarkable progress against kala-azar. Cases declined by approximately 98% between intensified control activities in 1992 and 2021.[6] The programme has emphasized early diagnosis, single-dose liposomal amphotericin B, indoor residual spraying and active case detection. Remaining risks include post-kala-azar dermal leishmaniasis, HIV coinfection, migration and reduced vigilance as incidence falls.

Lymphatic filariasis remains a larger unfinished agenda. India uses annual mass drug administration and has expanded triple-drug therapy in eligible districts. Progress in Bihar during 2026, where three districts stopped mass drug administration after passing transmission assessment, demonstrates that interruption is achievable even in historically high-burden settings. However, India still had 350 endemic districts across 20 states and union territories as of May 2026.[7]

Leprosy continues despite national elimination at the aggregate prevalence threshold having been achieved in 2005. New cases, child cases and grade-2 disability indicate continuing transmission and delayed diagnosis. National averages obscure high-burden districts. Active case detection, contact examination, post-exposure prophylaxis and anti-stigma interventions must be sustained.

India's vertical programmes have developed substantial operational experience, but stronger integration with Ayushman Arogya Mandirs could improve case detection, morbidity care and surveillance. Integration should preserve specialist knowledge and dedicated accountability rather than simply transferring responsibilities to an already burdened primary-care workforce.

Challenges and Limitations

NTD evidence is constrained by underdiagnosis, inconsistent reporting and limited population-based surveillance. Declining case numbers may reflect genuine control, reduced detection or both. Mass-treatment coverage is frequently administrative and may not represent ingestion.

Elimination thresholds are pragmatic public health benchmarks rather than biological endpoints. After validation, imported cases, residual reservoirs or environmental changes can re-establish transmission. Programmes often lose funding and expertise precisely when sensitive surveillance becomes most important.

Drug resistance is another concern. Widespread preventive chemotherapy creates selection pressure, although the extent of clinically significant resistance varies. Treatment efficacy and molecular markers require monitoring.

Social stigma remains inadequately addressed. Biomedical cure may not restore employment, marriage prospects or community acceptance. Mental-health and rehabilitation services should be incorporated into NTD programmes.

Finally, the portfolio remains unevenly researched. Diseases with large pharmaceutical markets attract innovation, while mycetoma, noma, snakebite and several fungal NTDs have few diagnostics or treatments. Research funding should reflect disease burden and equity rather than commercial return.

Future Directions

The first priority is to strengthen surveillance as disease prevalence declines. Routine health information systems should be linked with community reporting, laboratory confirmation and geospatial analysis. Post-elimination surveillance requires stable domestic financing rather than temporary external projects.

Second, integrated skin-NTD platforms can improve detection of leprosy, scabies, fungal disease, Buruli ulcer and cutaneous leishmaniasis through shared training and referral. Integration should be evaluated for diagnostic accuracy and patient outcomes.

Third, preventive chemotherapy must be accompanied by WASH, vector control, veterinary action and social protection. High treatment coverage without environmental improvement risks indefinite dependence on repeated campaigns.

Fourth, morbidity management should become a measurable programme outcome. Indicators should include access to hydrocele surgery, lymphoedema care, rehabilitation, assistive devices, trichiasis surgery and psychosocial support.

Fifth, research should prioritize field-ready diagnostics, shorter treatments, heat-stable medicines, effective antivenoms and tools for detecting residual transmission. Trials should include children, pregnant women and populations with comorbidities who are often excluded.

Finally, communities affected by NTDs should participate in programme governance and research priority setting. Community engagement is not merely a mechanism for improving drug uptake; it is a matter of rights and accountability.

CONCLUSION

Neglected tropical diseases represent both a biomedical challenge and a visible marker of social exclusion. Global programmes have produced major gains through preventive chemotherapy, disease-specific treatment, vector control and partnerships. The reduction in people requiring intervention and the increasing number of countries achieving elimination demonstrate that sustained action works.

Yet progress remains fragile and uneven. Dengue is expanding, several conditions remain poorly measured, and disability and stigma receive less attention than infection prevalence. Drug distribution alone cannot overcome unsafe housing, poor sanitation, weak primary care and inadequate financial protection.

India's elimination of trachoma and progress towards kala-azar and lymphatic-filariasis elimination are important public health achievements. Sustaining them will require sensitive surveillance, rapid response to residual transmission and continuing services for affected people. Leprosy, dengue, rabies, snakebite and other NTDs demand equally sustained attention.

The next phase of the NTD agenda must move beyond counting tablets and cases. Success should mean that transmission is interrupted where feasible, disability is prevented or treated, affected people are free from stigma, and no community is neglected because it is remote, poor or politically invisible.

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