



# Neglected Tropical Diseases of Public Health Importance in India: Current Status and the Way Ahead

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## Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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## ABSTRACT

**Introduction:** In global health, critical challenges have erupted from infectious diseases, including the emergence and re-emergence of old and new infectious diseases. This is directly attributed to rapid human development including massive demographic changes, increasing population, and environmental degradation to name a few. Despite tremendous advances in the health of its citizens who live below the poverty line, India bears a disproportionately high burden of neglected tropical diseases with over half of the 20 WHO classified neglected tropical diseases at endemic levels. In a global fight against these diseases, India occupies a unique place as a country that despite being deeply affected by these devastating and deadly illnesses, also holds solutions on how innovation might eliminate these ancient maladies.

**Aims and Objectives:** The present article reviews the common neglected tropical diseases of India, their magnitude and current status with respect to interventions for their control, challenges in the path of their elimination and the comprehensive all-inclusive approaches that can be adopted to curb the tropical disease burden of the Indian sub-continent.

**Methodology:** The present study is literature review. PubMed, EMBASE and Scopus databases were searched using the key words "neglected tropical diseases", "infectious diseases", "treatment of tropical diseases" and their MeSH terms in any possible combination using the logical operators "AND" and "OR". The reference list of all the studies was screened to identify other studies of interest. The search was reiterated until July 2021.

**Results:** Though the progress towards elimination of neglected tropical diseases is already underway, a concerted strategy is needed to assist the elimination efforts for these diseases. An all-inclusive policy to foster research and innovation in drug discovery, diagnostics, and vaccine development in neglected tropical diseases is lacking. There is also an absence of structured training of healthcare workers to improve their skills and capacity in disease management in endemic and disease prone areas.

**Conclusion:** To obtain the high objective of improving health and reducing vulnerabilities, it is important that healthcare workers and professionals from other backgrounds bind together to broaden the perspectives that are needed to address. There is a call for a comprehensive policy for neglected diseases research in India to foster drugs, diagnostics, and vaccine innovation, critical for evolving needs for elimination programs.

**Keywords:** Neglected tropical diseases; elephantiasis; leishmaniasis; endemic; helmenthiasis; regulatory pathways; surveillance.

## 1. INTRODUCTION

Neglected Tropical Diseases (NTDs) are a multifarious group of communicable diseases that are common in tropical and subtropical conditions in 149 countries of the world (Table 1). These diseases are called neglected because they generally afflict the world's poor and historically have not received as much attention

as other diseases. The World Health Organization (WHO) states that these group of diseases affect more than a billion of people globally, mostly in developing countries and cost huge drainage of funds each year. Populations living in poverty, with inadequate sanitation and in close vicinity with infectious vectors and domestic animals and livestock are the ones worst affected.

**Table 1. List of Neglected Tropical diseases and their causal organisms by Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO)**

S. No.	Name of the disease(NTD)	Causal Organism	Vector
1.	Buruli Ulcer	<i>Mycobacterium ulcerans</i>	
2.	Chicken Gunia	Chicken Gunia virus (CHIKV)	<i>Aedes aegypti</i> mosquito
3.	Chagas disease	<i>Trypanosome cruzi</i>	<i>Triatoma infestans</i> (kissing bug)
4.	Cysticercosis	Four stereotypes of virus (DENV)	<i>Aedes aegypti</i> and <i>Aedes albopictus</i> mosquitoes
5.	Dengue fever	Viruses of Flaviviridae family, Flavivirus genus	<i>Aedes aegypti</i> mosquito
6.	Dracunculiasis ( Guinea worm disease)	<i>Dracunculus medinensis</i> worm	
7.	Echinococcosis	Larval stages of cestodes (Tapeworms) of genus Echinococcus	
8.	Fascioliasis	<i>Fasciola hepatica</i> (liver fluke)	
9.	Food borne Trematodiasis	Trematode worms (flukes)	
10.	African Trypanosomiasis (sleeping sickness)	<i>Trypanosoma brucei gambiense</i> or <i>Trypanosoma brucei rhodesiense</i>	Tse – tse fly
11.	Leishmaniasis (kala- azar)	<i>Leishmania donovani</i>	<i>Phlebotomus argentipes</i> (sand fly)
12.	Leprosy	<i>Mycobacterium leprae</i>	
13.	Lymphatic filariasis	<i>Wuchereria bancrofti</i> (filarial)	

S. No.	Name of the disease(NTD)	Causal Organism	Vector
14.	Mycetoma	worm), <i>Brugia malayi</i> and <i>Brugia timori</i> Filamentous bacteria (actinomycetoma) or fungi (eumycetoma) found in soil and water	
15.	Onchocerciasis (river blindness)	<i>Onchocerca volvulus</i> (nematode)	Black flies
16.	Rabies	RNA virus belonging to genus <i>Lyssavirus</i> transmitted by bite of rabid animals	
17.	Schistosomiasis	Trematode worms(blood flukes) of the genus <i>Schistosoma</i> . Snails act as carrier.	
18.	Helminthiasis	Intestinal nematodes- 1. <i>Ascaris lumbricoides</i> (roundworm). 2. <i>Trichuris trichiura</i> (whipworm). 3. <i>Nectar americanus</i> and <i>Ancylostoma duodenale</i> (hookworm Sps.)	
19.	Yaws	<i>Treponema pertenue</i> (spirochete)	
20.	Trachoma	Bacteria <i>Chlamydia trachomatis</i>	

“NTDs impact the lives of over 1 billion people in low – income and middle – income countries (WHO). Emerging infectious diseases and re-emerging infectious diseases can arise due to a multitude of factors and influences and must be addressed dynamically by diverse sectors of society; these include public health, medicine, environmental science, animal health, food safety, economics, and public policy stakeholders” [1].

“Currently, India bears the highest absolute burden of more than 11 major NTDs, except NTDs that require unique insect vectors or snail hosts (e.g. Schistosomiasis, Onchocerciasis, human African Trypanosomiasis and Chagas disease), India leads the world in terms of total number of cases for each of the major NTDs as defined by the WHO” [2]. “Being the world’s second most populous nation, India itself accounts for nearly 18% of the world’s population. Therefore, the nation harbors a significant NTD burden” [3]. Based on most current available data of WHO in 2020, just over half of the population of India were affected by NTDs with respect to three diseases namely, elephantiasis, blinding trachoma, and intestinal worms. With a population of 1.400 billion, India has the highest NTD burden for these three diseases in the world with around 752 million people requiring preventive chemotherapy (PC)

for at least one NTD in 2020. In the year 2020, India had the highest burden for elephantiasis with around 457 million people requiring PC. Further, in the same year India also had the highest burden for intestinal worms with around 436 million children requiring PC.

India also has the 5<sup>th</sup> largest economy in terms of total gross domestic product (GDP), and several diseases stand out for their divergent impact on the health of its citizens. For example, according to the Global Burden Disease study conducted in 2016, India bears almost half of the world’s prevalent cases of visceral leishmaniasis, dengue and visual impairment from trachoma. Also, approximately one-third of the world’s cases of leprosy, lymphatic filariasis (LF), cysticercosis, and incident cases of rabies exist in India. Furthermore, India also reportedly accounts for roughly one- fourth of the world’s ascariasis and hookworm cases. Although no specific information about some other NTDs such as amoebiasis or giardiasis are provided, it is possible that India’s high ranking extends beyond the diseases currently considered NTDs by WHO. Moreover, the NTD disease – burden in India is un- evenly distributed, with more focus on areas where numbers of socio-economically poor populations are exceedingly high, be it urban or rural areas.

“It is imperative to state that though in recent years India has successfully eliminated certain infectious diseases such as guinea worm, trachoma, and yaws” [4,5,6] yet, the neglected diseases such as leishmaniasis, filariasis, leprosy, snakebite, and soil transmitted helminth infections still pose a challenge. There are persistent challenges in the implementation of new technologies and major research gaps. Covid 19 hugely impacted NTD programs across the globe. It halted disability saving surgeries such as sight – saving procedures for the chronic stages of trachoma. It halted mass treatment programs, reducing the number of treatments to levels not seen since 2012. It significantly reduced case detection for diseases such as sleeping sickness, where quick and accurate detection is of prime importance for effective treatment. It hugely impacted the countries reaching elimination, thus requiring a concerted effort to scale up programs to recover from these impacts. WHO analysis indicates that NTD programs have been among the health services most frequently affected by the pandemic. Furthermore, the economic shocks due to the pandemic resulted in over a third of direct donor funding towards NTDs programs being removed with little or no warning. This meant millions of donated medicines risked expiry in warehouses across the world and has seriously impacted the ability of NTD programs to recover from the pandemic.

## 2. METHODOLOGY

The present study is a literature review. PubMed, Scopus and EMBASE databases were searched with supplemental researches with Google Scholar. The key words used were: “neglected tropical diseases”, “neglected tropical disease burden”, “infectious diseases”, “treatment of tropical diseases”, and “elimination of infectious diseases” and their MeSH terms in any possible combination using the logical operators “AND” and “OR”. The reference list of all the studies were screened to identify other studies of interest. The search was reiterated until July 2021.

## 3. CURRENT SCENARIO

The WHO has recommended five interventions to overcome NTDs. These are:

- *Preventive Chemotherapy(PC)* - The coordinated use of anthelmintic and

antimicrobial medicines along with complementary public health interventions is the mainstay of WHO recommended strategy of providing preventive chemotherapy to treat populations at risk of selected NTDs.

- *Innovative and intensified disease management* - The strategy comprises of ensuring universal access to early diagnosis and prompt treatment; improving surveillance and integrating passive surveillance into health-services provision; accelerating efforts towards elimination and eradication by intensifying core interventions; implementing supportive components such as, fostering collaboration, community engagement.
- *Vector ecology and management* - This strategy focuses on developing and promoting guidelines based on the principles and approaches of integrated vector management, including judicious use of pesticides
- *“Water, sanitation and hygiene, called WASH* - Many of the pathogens that cause NTDs thrive where water and sanitation are inadequate. Proper sanitation and hygiene is important in controlling schistosomiasis and soil-transmitted helminthiasis” [7,8,9].
- *Veterinary public health services* - This is specifically relevant to the zoonotic diseases viz. echinococcosis, taeniasis, cysticercosis, rabies, and food borne trematodiasis which are transmitted from vertebrate animals to humans and vice-versa. To overcome these diseases an inclusive multi-sectorial program including veterinary, water, sanitation and hygiene is needed. Hence, an appropriate coordination, communication and partnership is essential among the sectors responsible for human health, animal health and environmental health.

“An all – inclusive policy to foster research and innovation in any drug discovery, diagnostics, and vaccine development in NTDs is lacking. The National Health Policy of 2017 which was set on an ambition to stimulate innovation to meet health needs and ensure that new drugs are affordable for those who need them the most” [10], does not specifically tackle neglected diseases.

“Another such scheme of 2018 known by the name of “National Policy on Treatment of Rare

Diseases”, includes infectious tropical diseases and identifies a need to support research on treatments of rare diseases. It has not yet prioritized diseases and areas of research funding or how innovation would be supported” [11,12].

“However. there has been development of a new treatment regimen for visceral leishmaniasis – liposomal amphotericin B ( AmBisome ). A single intravenous infusion of liposomal amphotericin B was found to be effective in treating visceral leishmaniasis” [13] and “is now recommended as first line treatment in the national program in India” [14]. “But, with the reports of cases of resistance to miltefosine and liposomal amphotericin B, there is a call for new drug regimens to be developed periodically to overcome resistance. Though Indian labs have developed highly sensitive, specific and heat stable diagnostic probes such as rk39 and rkE16, their sensitivity is more variable in sample sets from East Africa and South America” [15]. “Still another diagnostic probe has been developed in India but has not yet been commercialized” [16]. “Financial support provided by the Japanese Global Health Innovative Technology Fund has played a vital role in the vaccine program” [17] “against visceral leishmaniasis and vaccines are in different stages of development” [18,19,20].

#### 4. WAY AHEAD

“Though the progress towards elimination of STDs is already underway, a concerted strategy is needed to assist the elimination efforts for NTDs. There is a need for a well - established comprehensive scheme on neglected diseases that paves the way for greater funding and mechanisms to support research and innovation. A unified program on neglected diseases encompassing research and elimination measures is likely to have a greater impact in prioritizing the matter in the health agenda and streamlining efforts towards disease elimination. Creating an enabling environment for research and innovation will be crucial if India is to achieve the target set in the sustainable development goal to end epidemics of neglected tropical diseases by 2030” [21,22,23].

There is a need to earmark a proportion of public funds for neglected diseases research and innovation [24] and for translational research to support product development. It is also essential to develop mechanisms to facilitate priority

regulatory pathways for innovations in neglected diseases. Further, by strengthening the existing integrated disease surveillance program, a comprehensive national survey database for neglected diseases can be created to monitor trends across the country.

The application of molecular diagnostics at point of care combined with information technology is the future for vigorous surveillance. The emerging areas of genomics, transcriptomics and proteomics research can provide a better understanding of the modes of infection and treatment options. More drug and vaccine targets can be identified which would provide impetus to biotechnological research and industry. Innovation will also be facilitated by creating common repositories of biological samples and other materials accessible to researchers, industry and regulators.

“Training workshops of healthcare workers in endemic and high risk areas is the key to improve health workers' skills and capacity in disease management” [25,26,27]. “The Clean India Mission ,called “Swachh Bharat Abhiyan”, launched by the Government of India can prove to be an important campaign which can together with other elimination programs such as those connected to safe drinking water, waste disposal and basic sanitation will make the elimination of NTDs sustainable” [28].

#### 5. CONCLUSION

A potent program of research exclusively dedicated to understand, prevent, and treat NTDs in a better way is essentially important. There is need to conduct and support the study which would lead to important new discoveries about the microbes that cause NTDs, the identification of targets for potential new drugs and vaccines, and the development of blueprints for controlling the organisms / vectors that transmit NTD- causing agents to humans. An institutional mechanism to prioritize, coordinate and monitor research output, including on neglected diseases, is needed. This would allow policy makers, funders, researchers, and patient groups to identify areas of public investment and existing gaps and suggest improvements [29,30]. Partnerships involving major donor agencies, charitable organizations, NGOs, government leaders, pharmaceutical companies, and other stakeholders are crucial in the fight against NTDs and enabling access to treatment for millions of

people worldwide. The pandemic drew the world's attention towards the importance of strengthening health systems, particularly at the community level stressing upon the action needed to strengthen health systems and resilience within the communities.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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