

## ARTICLE

## The global burden of neglected tropical diseases

Jessica S. Herrera,<sup>1</sup> Carlos Franco-Paredes,<sup>2</sup> and José Ignacio Santos-Preciado<sup>3</sup>

### ABSTRACT

The neglected tropical diseases (NTDs) consist of a group of chronic, debilitating, and poverty-promoting parasitic, bacterial, and viral and fungal infections that are widespread among people in poor rural or peri-urban communities living in tropical or subtropical areas. However, due to population mobility, diseases such as Chagas disease can be diagnosed anywhere on the globe. The NTDs are disabling, disfiguring and deadly diseases impacting more than one billion people worldwide. They also impair physical and cognitive development, cause adverse pregnancy outcomes, and limit adult productivity in the workforce. The global burden of disease associated with the NTDs is comparable to other infectious diseases such as that of malaria or tuberculosis. Controlling or eliminating NTDs represents an affordable opportunity to improve the health of poor communities, which may ultimately promote social development.

**Key words:** global burden, neglected, poverty.

### INTRODUCTION

Over the past few decades much attention has been paid to the “big three” infectious diseases—HIV/AIDS, tuberculosis, and malaria—by the global health community, international donors, nongovernmental organizations, and public health agencies. However, through the newly established Global Network for Neglected Tropical Diseases along with updated guidelines for drug administration for these diseases issued by the World Health Organization (WHO), there is growing interest in launching integrated approaches to reduce the burden of tropical diseases. The historical neglect from vaccine producers, pharmaceutical industry, international community, and governments is slowly evaporating. We currently recognize that this

group of chronic infections is highly prevalent, disability-inducing, and poverty-promoting; thus, they are currently considered as neglected tropical diseases (NTDs).<sup>1</sup>

#### Global Burden of NTDs

This group of chronic, debilitating, and poverty-promoting parasitic, bacterial, viral, and fungal infections are among the most common causes of illness of the poorest people living in developing countries (Table 1).<sup>1</sup> Their control and elimination is now recognized as a priority for achieving United Nations Millennium Development Goals and targets for sustainable poverty reduction.<sup>2,3</sup>

These bacterial and parasitic infections are widespread among people in poor, rural communities, the majority of whom live on less than USD\$2 per day. NTDs are disabling, disfiguring and deadly diseases impacting more than one billion people worldwide. NTDs impair physical and cognitive development, cause adverse pregnancy outcomes, and limit adult productivity in the workforce.<sup>4</sup> The social determinants of becoming ill with NTDs include socially determined failures such as widespread illiteracy, malnutrition, poor living conditions, unemployment, and the overall failure of ownership relations in the form of entitlements (Figure 1).<sup>2,5</sup> In turn, in a vicious cycle of destitution and dispossession, NTDs produce disability, disfigurement, stigma, and premature mortality. They are responsible for billions of dollars in lost wages, trapping the poor in a cycle of poverty and disease.

<sup>1</sup> University of Washington School of Medicine, Seattle, Washington, USA

<sup>2</sup> Hospital Infantil de México Federico Gómez, México, D.F., México; Rollins School of Public Health, Emory University, Atlanta, Georgia, USA

<sup>3</sup> Unidad de Medicina Experimental, Facultad de Medicina, Universidad Nacional Autónoma de México, México, D.F., México

Funding: None

Competing Interests: None

Received for publication: 1-24-11

Accepted for publication: 2-8-11

**Table 1.** The major neglected tropical diseases

NTDs	Causal agent	Treatment
Kala-azar (visceral leishmaniasis)	<i>Leishmania donovani</i> complex ( <i>L. infantum</i> , <i>L. chagasi</i> )	Pentavalent antimonials, Amphotericin B compounds
African sleeping sickness (African trypanosomiasis)	<i>Trypanosoma brucei rhodesiense</i> , <i>Trypanosoma brucei gambiense</i>	Eflornitine, Melarsoprol, Suramine, Pentamidine
Chagas disease (American trypanosomiasis)	<i>Trypanosoma cruzi</i>	Benznidazole, Nifurtimox
Schistosomiasis (Bilharziasis)	<i>Schistosoma mansoni</i> , <i>S. haematobium</i> , <i>S. japonicum</i> and other <i>Schistosoma</i> spp.	Praziquantel
Lymphatic filariasis (elephantiasis)	<i>Wuchereria bancrofti</i> and <i>Brugia malayi</i>	Diethylcarbamazine, Ivermectin, Doxycycline*
Onchocerciasis (river blindness)	<i>Onchocerca volvulus</i>	Ivermectin, Doxycycline*
Dracunculiasis (Guinea worm)	<i>Dracunculus medinensis</i>	Interruption of cycle with behavioral changes and use of filters to drink water
Soil-transmitted helminthiasis	Ascariasis (roundworm), Trichuriasis (whipworm), Necator and uncinariasis (hookworm), Strongyloidiasis ( <i>Strongyloides stercoralis</i> )	Albendazole, Mebendazole, Ivermectin
Leprosy	<i>Mycobacterium leprae</i>	Dapsone, Rifampin, Clofazimine, Steroids**
Buruli ulcer	<i>Mycobacterium ulcerans</i>	Surgical debridement, skin grafting, and some evidence of benefit of antimicrobial therapy
Trachoma	<i>Chlamydia trachomatis</i>	Azithromycin

NTD, neglected tropical disease.

\*Used to treat endosymbiotic gram-negative bacteria *Wolbachia*.

\*\*Steroids for leprosy reactions (reversal reaction or erythema nodosum leprosum).

### Burden of NTDs in Latin America and the Caribbean

NTDs in Latin America and the Caribbean account for 8.8% (1.5 million to 5 million) of the disability adjusted life years (DALYs) of the total global burden.<sup>6</sup> The NTDs in the Americas are concentrated not only within pockets of intense poverty but also among selected vulnerable populations, especially indigenous populations and communities of African descent. In some areas, women and children may be considered neglected populations due to their limited access to health and social support services (Figure 2).

There is also growing evidence that populations in civil conflict areas are disproportionately impacted by

NTDs. Other vulnerable groups impacted by poverty and heavily affected by NTDs include peri-urban slum dwellers. As an example, in Guatemala and southern Mexico, indigenous groups suffer from some of the highest rates of soil-transmitted helminth infections in the Americas as well as high rates of onchocerciasis and Chagas disease.<sup>6</sup> Similarly, the indigenous people of Bolivia and Peru experience high rates of fascioliasis and cysticercosis, whereas those in Colombia are at elevated risk for leishmaniasis, Chagas disease, and yellow fever and in Brazil, high levels of soil transmitted helminth infections and subsequent growth stunting. In addition to indigenous populations, poor communities of African descent, such as those found



**Figure 1.** Use of highly contaminated water for human consumption in southern Sudan. Many cases of dracunculiasis, Buruli ulcer, malaria, leptospirosis, onchocerciasis, and schistosomiasis are associated with use of stagnated water. (Photo by Carlos Franco-Paredes).



**Figure 2.** People living in floating houses in flooded areas in a tributary river to the Amazon River in Iquitos, Peru. Stagnated water is both their source of life (fish to eat, water to drink, cook, bathe, and wash clothes and dishes) as well as their source of demise by promoting diseases such as leptospirosis, dengue, malaria, intestinal parasitosis, bacterial gastroenteritis, and cholera.<sup>2</sup> (Photo by Carlos Franco-Paredes).

in parts of the Caribbean, Central America, and Brazil, suffer from high prevalence rates of NTDs, especially hookworm infection, lymphatic filariasis, onchocerciasis, and schistosomiasis. Hookworm infection and schistosomiasis are major contributors to anemia, increased maternal morbidity, and low birth weight in newborns.<sup>6,7</sup>

The epidemiology of many NTDs such as Chagas disease is shifting due partly to urbanization, migration patterns of the rural poor, and an increase in urban poverty.<sup>7</sup> Demographic trends suggest that the urbanization of poverty will continue: if poverty rates remain unchanged, by 2015 two-thirds of the poor in the region will be living in cities, which may impact transmission patterns of some NTDs including Chagas, leptospirosis, dengue, visceral leishmaniasis, and other infections.<sup>2,4,8</sup>

### Why Invest in Reducing the Burden of NTDs Globally?

The aggregative burden of disease associated with NTDs is responsible for approximately 500,000 deaths annually. In DALYs, the NTDs are equivalent to the combined effects of HIV/AIDS, tuberculosis, and malaria. Of the listed major NTDs (Table I), ten are notable for their high intensity of transmission and high prevalence: urinary and intestinal schistosomiasis,<sup>5</sup> lymphatic filariasis, onchocerciasis (Figure 3), soil-transmitted helminth infections (ascaris, richuriasis, and hookworm), African trypanosomiasis, visceral leishmaniasis, Buruli ulcer (Figure 4), American trypanosomiasis (Chagas disease), and blinding trachoma.<sup>6-8</sup>



**Figure 3.** “The blind leading the blind” due to river blindness (onchocerciasis) in southern Sudan. A commemorative statue simulating this scene whereby a blind man is being led by a young boy is erected outside the World Health Organization in Geneva, Switzerland and outside the Carter Center in Atlanta, GA. (Photo by Carlos Franco-Paredes).



**Figure 4.** Buruli ulcer in the lower extremity of an 8-year-old male in southern Sudan demonstrating the classic findings of undermined borders, subcutaneous and fatty tissue involvement by the mycolactone toxin of *Mycobacterium ulcerans*. (Photo by Carlos Franco-Paredes).

Controlling or eliminating NTDs lifts millions of persons out of poverty by increasing access to education because NTDs infect more than 400 million school-aged children throughout the developing world. Treating their infections is the single most cost-effective way to boost school attendance, opening the door to growth and learning for the next generation of workers. Additionally, controlling and eliminating NTDs strengthens worker productivity, contributing hundreds of billions of dollars to developing economies through increased worker productivity.<sup>2-4</sup>

To date, there have been successes in addressing NTDs. Elephantiasis has been successfully controlled in China, Thailand, Sri Lanka, Suriname, Solomon Islands, Trinidad and Tobago, Egypt, Costa Rica and Korea. River blindness has been eliminated as a public health

problem in ten West African countries to the benefit of some 60 million people. Trachoma's global prevalence has been reduced from 149 million cases in 1997 to 60 million cases in 2008. NTD control promotes and improves the efficacy of immunizations, vitamin and malaria bed net distribution and maternal and child health programs. A comprehensive 3-year, multicountry study found that integrated interventions delivered through a community-based approach doubled the coverage rate for malaria treatment and bed net usage when combined with treatment for river blindness.<sup>6-8</sup> For less than a 10% add-on cost, combining NTD treatment with current malaria control efforts significantly reduces anemia-caused morbidity and mortality.

When investments are made in NTD control, results are extraordinary because treatments are inexpensive and effective. Unfortunately, NTDs have traditionally not received a great deal of donor nation support, but the tide has been turning during the last decade. These diseases have effective, proven, and low-cost interventions.<sup>3</sup> Although we are facing challenging economic times, eliminating NTDs is one of the most cost-effective ways to attack global poverty and health issues; for less than 50 cents per person per year, we can treat seven of the most common NTDs—making the elimination of NTDs the best buy in public health.<sup>5,8</sup>

The health of people around the world is a global responsibility, particularly for those diseases such as the NTDs that represent remediable injustices of socially disadvantaged populations in the contemporary world.<sup>6</sup> Preventing, treating, and rehabilitating those at risk for or suffering from NTDs will promote individuals' freedoms and capabilities. This will reduce injustice and return a sense of dignity into their lives, in addition to being a grand public health intervention.

*Correspondence:* Carlos Franco Paredes, MD, PhD  
Rollins School of Public Health, Emory University  
Atlanta, Georgia

E-mail: carlos.franco.paredes@gmail.com

## REFERENCES

1. Molyneux DH. "Neglected" diseases but unrecognised successes challenges and opportunities for infectious disease control. *Lancet* 2004;364:380-383.

2. Franco-Paredes C, Jones D, Rodríguez-Morales AJ, Santos-Preciado JI. Commentary: Improving the health of neglected populations in Latin America. *BMC Public Health* 2007;7:11.
3. Molyneux DH, Hotez PJ, Fenwick A. "Rapid-impact interventions:" how a policy of integrated control for Africa's neglected tropical diseases could benefit the poor. *PLoS Med* 2005;2:e336.
4. Franco-Paredes C, Von A, Hidron A, Rodríguez-Morales AJ, Téllez I, Barragán M, et al. Chagas disease: an impediment in achieving the Millennium Development Goals in Latin America. *BMC Int Health Hum Rights* 2007;7:7.
5. Quandelacy TM, Riefkohl A, Franco-Paredes C. Prevalence of untreated schistosomiasis among Sudanese refugees: "The Lost Boys of Sudan" in the United States. *Bol Med Hosp Infant Mex* 2010;67:503-506.
6. Hotez PJ, Bottazzi ME, Franco-Paredes C, Ault SK, Roses-Periago M. The neglected tropical diseases of Latin America and the Caribbean: a review of disease burden and distribution and a roadmap for control and elimination. *PLoS Negl Trop Dis* 2008;2:e300.
7. Hotez PJ, Molyneux DH, Fenwick A, Kumaresan J, Sachs SE, Sachs JD, et al. Control of neglected tropical diseases. *N Engl J Med* 2007;357:1018-1027.
8. Von A, Zaragoza E, Jones D, Rodríguez-Morales A, Franco-Paredes C. New insights into Chagas disease: a neglected disease in Latin America. *J Infect Dev Ctries* 2007;1:99-111.