

Neglected Tropical Diseases in the United States *Pathologies of Poverty*

Introduction

Neglected Tropical Diseases (NTDs) are a common cohort of 17 pathologies prevalent in tropical or subtropical regions that are often significant within poverty stricken or developing areas. NTDs are typically viral, parasitic, or bacterial in nature.¹

Box 1: Characteristics of Neglected Tropical Diseases²

- High prevalence
- Chronic, disabling, and/or disfiguring symptoms
- Generally high disease burden, but relatively low mortality rates
 - Disease burden is the impact of a health problem on an area measured by financial cost, mortality, morbidity, or other indicators.
- Poverty Promoting
 - Often affect productivity, child development, pregnancy outcomes, education, etc.
- Amenable to therapeutic intervention or public health control programs

The World Bank estimates that 1.4 billion people live on less than \$1.25 per day. It is possible that nearly all of the “bottom billion” is affected by at least one NTD. Globally, between 600-800 million people, mostly children, have at least one form of a soil-transmitted helminth (parasitic worm) infection. Hookworm, for example, causes childhood and maternal anemia, and with an estimated prevalence of 600 million cases, results in the greatest disability and disease burden of any NTD. It is speculated that the 13 most prevalent NTDs result in roughly 57 million Disability-Adjusted Life Years (DALYs) lost, producing an impact that is greater (in terms of DALYs lost) than Malaria or Tuberculosis.³ Despite their normally chronic epidemiology, NTDs worldwide still cause an estimated 534,000 deaths on an annual basis.⁴

¹ World Health Organization, "Neglected Tropical Diseases," 2013.
NSTM, National School of Tropical Medicine at Baylor College of Medicine, 2013,
<www.bcm.edu/tropicalmedicine/>.

² Peter Hotez, "Neglected Infections of Poverty in the United States of America," *PLoS Neglected Tropical Diseases* 2.6 (2008).

Peter Hotez, "Introduction to the Neglected Tropical Diseases," *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 1-11.

³ Peter Hotez, et al., "Rescuing the bottom billion through control of neglected tropical diseases," *The Lancet* (2009).

⁴ Peter Hotez, et al., "Rescuing the bottom billion through control of neglected tropical diseases," *The Lancet* (2009).

Poverty in the United States

In 2011, the official poverty rate in the United States was 15.0 percent (an estimated 46.2 million individuals).⁵ Research released in 2012 by the National Poverty Center combining the joint efforts of the University of Michigan and Harvard University revealed that approximately 1.46 million families (representing about 2.8 million children) in the United States live on less than \$2 per person, per day. These numbers are astounding, especially considering that the “\$2 per day” metric was adapted for this study from a similar scale utilized by the World Bank to assess poverty in developing countries.⁶ Whether acknowledged or not, these results demonstrate that similar conditions (to those of the developing world) not only exist here in the United States, but disproportionately affect specific regional and racial demographics.

Neglected Tropical Diseases in the United States

Although NTDs are commonly associated with rural villages in regions such as Sub-Saharan Africa, the aforementioned research is evidence for congruent circumstances in the United States that serve to support and perpetuate the presence of such pathologies within our own country. Studies suggest that prevalence rates for selected tropical diseases in certain areas of the United States may even rival those of low or middle-income countries.⁷

Dr. Peter Hotez, MD, PhD a pediatrician and the Dean of the National School of Tropical Medicine at the Baylor College of Medicine in Houston, Texas is the foremost authority on NTDs in the United States. He notes, “poverty in the US is not evenly distributed, but instead it is focally concentrated into several defined geographic regions, each with unique socioeconomic characteristics”⁸. In his extensive writings, Hotez identifies six major socio-economically

⁵ United States Census Bureau, Income, Poverty and Health Insurance in the United States: 2011 - Highlights, 2012.

⁶ National Poverty Center, "Extreme Poverty in the United States, 1996 to 2011," Policy Brief University of Michigan Gerald R. Ford School of Public Policy, 2012.

⁷ Peter Hotez, “Fighting neglected tropical diseases in the southern United States,” BMJ (2012).

⁸ Peter Hotez, “Neglected Infections of Poverty in the United States of America,” PLoS Neglected Tropical Diseases 2.6 (2008).

distressed regions of the United States with an especially high burden of NTD⁹ [*please reference*

Figure 1, p. 17]:

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|--------------------------|---|
| 1. Appalachia | 4. Disadvantaged urban enclaves of the East Coast |
| 2. The Mississippi Delta | 5. Borderlands between the US and Mexico |
| 3. The Deep South | 6. Tribal lands in the Prairie States |

For NTDs to persist in these areas, several factors are important to consider. The first is environment or climate. The Southern United States and Mississippi Delta are typically warm, wet, and humid, producing conditions conducive to the survivability and spread of NTDs. However, Hotez is also quick to identify the existence of these diseases in regions outside of their ideal climate, and prefers to term NTDs in the United States as “Neglected Infections of Poverty” or NIoPs to reflect their primary characteristic of affecting the poor and marginalized, regardless of climate.¹⁰

Thus a second, and considerably more important factor to consider is that of infrastructure. One has only to examine infrastructural state of post-Katrina New Orleans to discover exacerbated incidence rates of Chagas disease and dengue fever. Substandard housing with limited ventilation and air conditioning or living spaces and communities that lack proper street drainage, plumbing, sanitation, and garbage collection create the perfect situation for these diseases to thrive.¹¹

Some tropical infections utilize insect vectors that can gain easy access into households through open windows or broken screens. Other parasitic lifecycles rely on egg and larval development through human and animal fecal material, which becomes more likely in poor communities without the means to properly dispose of waste. Similarly, these areas often bear the additional burden of infrequent or difficult access to primary, preventative, and maternal

⁹ Peter Hotez, “Neglected Infections of Poverty in the United States of America,” *PLoS Neglected Tropical Diseases* 2.6 (2008).

¹⁰ Peter Hotez, “Neglected Infections of Poverty in the United States of America,” *PLoS Neglected Tropical Diseases* 2.6 (2008).

Peter Hotez, "Future Trends in Control of Neglected Tropical Diseases and the Antipoverty Vaccines," *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 143-155.

¹¹ Peter Hotez, “Tropical Diseases: The New Plague of Poverty,” *The New York Times* 2012 August.

healthcare, and may further lack the appropriate resources to properly diagnose and treat NTDs.

According to Hotez, neglect of these diseases occurs on multiple levels, namely¹²:

1. Community – NTDs arouse fear and create stigma
2. National – NTDs are often prevalent within remote or marginalized areas and are thus a low priority for intervention
3. International – collectively NTDs are perceived as less of a “threat” than the big three pathologies of developing countries (Malaria, Tuberculosis, HIV/AIDs)

Unsurprisingly, NTDs in the United States disproportionately affect poor and minority populations, namely Blacks, Hispanics, and immigrant groups. As many as five million Americans may be infected with at least one NTD. Common pathologies of significance in the United States include¹³:

Helminthic (parasitic worm infections):

1. *Toxocariasis* (caused by a dog/cat roundworm)
2. *Strongyloidiasis* (caused by pinworm / threadworm)
3. *Cysticercosis* (caused by pork tapeworm)
4. *Toxoplasmosis* (caused by *Toxoplasma Gondii*)

Protozoan Infections:

1. *Giardiasis*
2. *Chagas* – vector: blood sucking “kissing” bug

Studies suggest that there may be as many as 2.8 million African-Americans in the United States infected with toxocariasis and greater than 300,000 (primarily Hispanic) individuals with Chagas disease. Seroprevalence (evidence of infection through blood testing) of certain

¹² Peter Hotez, “Introduction to the Neglected Tropical Diseases,” *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 1-11.

¹³ Peter Hotez, “Neglected Infections of Poverty in the United States of America,” *PLoS Neglected Tropical Diseases* 2.6 (2008).

Peter Hotez, “Neglected Diseases and Poverty in “The Other America”: The Greatest Health Disparity in the United States?,” *PLoS Neglected Tropical Diseases* 1.3 (2007).

Peter Hotez, “The Neglected Tropical Diseases of North America,” *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 113-126.

diseases can be as high as 50% in some refugee populations entering the United States from countries in sub-Saharan Africa.¹⁴

Box 2: A Historical Note – The Lazy Southerner¹⁵

Hookworm, which causes severe anemia and protein deficiency and subsequent delays in growth and development, was especially prevalent in the American South during the 1800s and early 1900s. Some researchers attribute the early 20th century concept of the “Lazy Southerner” or “Sick Man of the South” to the symptoms of this parasitic intestinal worm. In a retrospective study, University of Chicago economist Hoyt Bleakly cited chronic hookworm infection as responsible for a 43 percent reduction in future wage earnings during the early 1900s as a result of impacted school attendance, performance, and childhood maturation. Duke University historian and physician Margaret Humphreys credits New Deal Programs (1930s) with alleviating the burden of disease in the South as the dominant agrarian economy was supplanted by more urban and industrial centers and agricultural workers were relocated to more developed areas. Hookworm is no longer believed to be an especially significant NTD in the United States.

Examples of Specific Epidemiology

Toxocariasis¹⁶ is a soil transmitted helminth infection caused primarily by roundworms from dogs and cats. It is considered to be the most common human parasitic worm infection in the United States affecting as many as 2.8 million individuals. When inside of canines the worms generally cause minimal damage and few symptoms, in fact most puppies acquire the worm (*Toxocara canis*) through the placenta of the mother prior to birth or when nursing. It is standard procedure to begin a drug-aided de-worming regimen to rid puppies of these worms and protect older dogs against infection. However, as one can imagine, this requires an investment in veterinary care and access to expensive canine pharmaceuticals, resources that poorer communities are more likely to lack. Worm larvae are passed in canine or cat feces and can easily contaminate playgrounds or backyards. Research conducted in the United States in 1996 showed that 30% of dogs less than 6 months old were positive for *Toxocara* eggs in their feces.

¹⁴ Peter Hotez, "Neglected Infections of Poverty in the United States of America," PLoS Neglected Tropical Diseases 2.6 (2008).

¹⁵ Peter Hotez, "Neglected Diseases and Poverty in "The Other America": The Greatest Health Disparity in the United States?," PLoS Neglected Tropical Diseases 1.3 (2007).

Center for Disease Control, "Parasites – Hookworm", 2013

¹⁶ Center for Disease Control, "Parasites – Toxocariasis", 2013

Peter Hotez and Patricia Wilkins, "Toxocariasis: America's Most Common Neglected Infection of Poverty and a Helminthiasis of Global Importance?," PLoS Neglected Tropical Diseases 3.3 (2009).

A study of a town in Connecticut revealed the presence of *T. canis* in 27% of public play areas. Once inside of the human body, the larvae will penetrate the intestine and migrate through various organs (visceral larval migrans; VLM), affecting everything from the respiratory system to the central nervous system. Though comparatively rare, migrating worms can cause seizures (neural larval migrans; NLM), blindness (ocular larval migrans; OLM), developmental delays and more commonly, pneumonia. Some researchers question whether this parasitic infection might be partly to blame for increasing rates of asthma among the urban poor. In 2007 the seroprevalence of this disease was estimated to be around 23% among individuals living in poverty.¹⁷ Dr. Hotez contends, the initial step in addressing this problem is acknowledging the significant impact it has on our domestic population¹⁸:

As a potential explanation for the high rates of asthma and developmental delays among disadvantaged children in poor urban and rural areas, there is an urgent need to fully explore the contribution of toxocariasis to these conditions, which in turn will require increased advocacy and resource mobilization. Recognition of toxocariasis as a common parasitic disease in the US and possibly an even greater health problem in developing countries is a first important step to national and international efforts to combat this neglected infection of poverty.

Cysticercosis¹⁹ is a potentially serious disease caused most commonly by the pork tapeworm, *Taenia Solium*. Cooking and food preparation practices, especially within certain cultures, may yield an increased risk of undercooked pork consumption. As such, evidence suggests that this condition is especially common among immigrant populations. Parasitic larval cysts are ingested and can cause taeniasis (pork tapeworm infection), which is generally asymptomatic and fairly harmless. Cysticercosis results when eggs produced by these worms auto-infect the human host or are passed in feces to the environment where they are subsequently ingested by people or livestock. Once the eggs hatch, larvae may spread and encyst in muscle

¹⁷ Peter Hotez, "Neglected Diseases and Poverty in "The Other America": The Greatest Health Disparity in the United States?," *PLoS Neglected Tropical Diseases* 1.3 (2007).

¹⁸ Peter Hotez and Patricia Wilkins, "Toxocariasis: America's Most Common Neglected Infection of Poverty and a Helminthiasis of Global Importance?," *PLoS Neglected Tropical Diseases* 3.3 (2009).

¹⁹ Center for Disease Control, "Parasites – Cysticercosis", 2013

throughout the body. This is a particularly dangerous occurrence in brain tissue as it could cause seizures, neurological injury, and comas.

Studies estimate that seroprevalence among the Latino population is approximately 2.8%. Some hospitals in Los Angeles report that nearly 10% of all seizures presenting to the emergency department are caused by neurocysticercosis, further evidence of the pervasive nature of this NTD.²⁰ As Dr. Hotez explains, “The large number of possible cases of cysticercosis suggests that there is an urgent need for better surveillance studies on the presence of this condition in the Southwestern United States and for treatment of patients who harbor the pork tapeworm as a means of reducing the prevalence of this serious disease of poverty”.²¹

Toxoplasmosis²² is a parasitic infection caused by *Toxoplasma gondii* and a leading cause of death attributed to food born illness in the United States. [More](#) than 60 million individuals (22.5% of the population 12 years and older) in the United States are believed to carry the *Toxoplasma* parasite, but are frequently asymptomatic (or display mild flu-like symptoms) because of immune response mediation. Toxoplasmosis is ordinarily caused by ingestion of underprepared meat or through accidental infection via cat feces and contaminated litter boxes. In immuno-compromised or pregnant individuals, this common parasite can become congenital (and passed on to unborn children) causing severe health effects including miscarriage, ocular disease, mental disabilities, and seizures. Disease progression that reaches this stage is more prevalent among the poor (potentially related to rates of HIV/AIDs) and disproportionately affects both Mexican and African Americans.

²⁰ Peter Hotez, “Neglected Diseases and Poverty in “The Other America”: The Greatest Health Disparity in the United States?,” *PLoS Neglected Tropical Diseases* 1.3 (2007).

²¹ Peter Hotez, “The Neglected Tropical Diseases of North America,” *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 113-126.

Peter Hotez, “Neglected Diseases and Poverty in “The Other America”: The Greatest Health Disparity in the United States?,” *PLoS Neglected Tropical Diseases* 1.3 (2007).

²² Center for Disease Control, “Parasites – Toxoplasmosis”, 2013

Chagas Disease²³ is caused by the parasite *Trypanosoma cruzi* but transmitted by a triatomine (“kissing bug”) vector. Chagas disease is widespread throughout much of Mexico, Central America, and South America and is thus especially prevalent within Hispanic populations in the United States; more than 300,000 persons may be infected with *T. cruzi* throughout the country. Humans typically acquire the disease in childhood from the vector or through congenital passage from the mother to the infant, accentuating the importance of screening and consistent maternal care. Infections tend to progress from acute to chronic, but are primarily asymptomatic or mild in nature, especially if managed properly.

Chagas can display a complex disease cycle that sometimes make it difficult to diagnosis and appropriately intervene. The chronic phase, while potentially unproblematic, can last for the lifetime of the human host if left untreated. An estimated 20-30% of individuals will develop debilitating medical complications implicating the circulatory system (heart arrhythmias, swelling, and related pathologies) or gastro-intestinal tract (upon migration of the parasite). In these instances, treatment of Chagas is highly resource intensive, potentially precluding patients of reduced socio-economic means to access the required health care. As Bern et al note, “despite the public health importance of Chagas disease, few rigorous clinical trials have been conducted...the complex natural history of the infection and inadequate tools to assess cure have made it difficult to definitively appropriate end points and follow-up intervals”.²⁴

A common quality of these diseases is their compounding negative effects on overall health. Symptoms can manifest throughout the body, causing an array of problems that can be chronic, debilitating, or disruptive in nature. As health conditions become increasingly severe, individuals can become further compromised by immune-deficiencies or a variety of complications caused by the same parasite as it migrates through different locations and organ systems. The end results – developmental delays, fatigue, and malnutrition, to name a few –

²³ Center for Disease Control, “Parasites – Chagas Disease”, 2013

Caryn Bern, et al., "Evaluation and Treatment of Chagas Disease in the United States," *JAMA* 298.18 (2007).

²⁴ Caryn Bern, et al., "Evaluation and Treatment of Chagas Disease in the United States," *JAMA* 298.18 (2007).

ensue in a loss of productivity and economic potential that ultimately further inhibits the situations and positive outcomes for the disease-susceptible poor.

Addressing the Problem

Many once significant 19th and 20th century NTDs in the United States are no longer believed to be pressing issues of public health, although we lack definitive certainty as large scale epidemiological surveys for once common pathologies have not been conducted within the past three decades.²⁵ There is a high probability that infections such as ascariasis (human roundworm; estimated at nearly four million cases in the 1960s/1970s) and strongyloidiasis (pinworm / threadworm) are still important infections, but their true extent of impact is unknown because of “a lack of political will to study the problem,” ensuing in a complacency of perpetual neglect.²⁶

Dr. Hotez comments:

The frequent unavailability of reliable numbers on the prevalence of the NTDs is reflective of their neglected status and of their disproportionate impact on the poorest of the poor. Many of these NTDs could be easily controlled or eliminated at relatively modest cost. The most immediate need is to support studies in order to better assess the true prevalence of these infections and then to identify simple and cost-effective public health solutions. There are really no excuses for allowing such glaring health disparities to continue in the backyards of some of the world’s wealthiest countries.

Thus the need to obtain actual numbers and data underscores the importance of developing comprehensive and thorough surveillance programs that will enable increased understanding of disease causation and its interaction with poverty. Such initiatives would aid in the assessment of the disease burden for specific NTDs, identify minority populations at the greatest risk for infection, and inform the creation of simple, holistic, and cost-effective public health and “structural” interventions.²⁷ In both concept and design, “an effective and integrated program to control neglected tropical diseases strengthens local health systems, fosters

²⁵ Peter Hotez, “The Neglected Tropical Diseases of North America,” *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 113-126.

²⁶ Peter Hotez, “Neglected Diseases and Poverty in “The Other America”: The Greatest Health Disparity in the United States?,” *PLoS Neglected Tropical Diseases* 1.3 (2007).

²⁷ Peter Hotez, “Neglected Diseases and Poverty in “The Other America”: The Greatest Health Disparity in the United States?,” *PLoS Neglected Tropical Diseases* 1.3 (2007).

community involvement in health, helps to ensure monitoring and accountability, and serves to de-stigmatize these conditions by dispelling myths and misconceptions about them through evidence based information and education”²⁸.

Fortunately most NTDs are fairly straightforward and inexpensive to treat provided proper resources and diagnosis. Nearly all NTDs can accurately be characterized as “tool ready” or potentially amenable to drug therapy, public health programs, educational outreach, screening initiatives, and/or infrastructural improvement. However, they are also largely “tool deficient” in that current control or treatment strategies are suboptimal or inadequate in fully addressing the prevalence of disease within a given region.²⁹

NTDs are common among the poor because they thrive in under-developed areas that promote infection; they persist among the poor because the means or interest to improve environmental conditions and health care accessibility is often lacking. The structural causes of NTDs necessitate improved collaboration between federal, state, and local agencies as well as academic and educational institutions. As infrastructure, housing conditions, and health resources are improved, the prevalence of these diseases will continue to decrease.

As previously mentioned, NTDs can be managed effectively in the clinic, provided that individuals have the means to access those services and facilities. Expansive surveillance programs will aid in identifying the highest risk populations, who can then be targeted for educational outreach (food preparation techniques, sanitary disposal awareness, symptom recognition, pregnancy issues, etc.) and possible screening efforts. With the congenital possibilities of NTDs like Chagas and Toxoplasmosis, newborn screening may prove especially effective in regions of prevalence so that early intervention may begin to mitigate symptoms and reduce or eliminate the severity of the disease later in life.³⁰ Similarly, because of varied clinical

²⁸ Peter Hotez, et al., "Control of Neglected Tropical Diseases," *N Engl J Med* 357.10 (2007).

²⁹ Peter Hotez and Bernard Pecoul, "'Manifesto' for Advancing the Control and Elimination of Neglected Tropical Diseases," *PLoS Neglected Tropical Diseases* 4.5 (2010).

³⁰ Kami Kim, "Time to Screen for Congenital Toxoplasmosis?," *Clinical Infectious Diseases* 42.10 (2006): 1395-1997.

manifestations (that frequently include symptoms such as anemia or diarrhea, which may obscure causation) it is imperative that clinicians and health professionals who work within these high-risk areas are properly trained to recognize, assess, and manage common NTDs.

Research and Development

A major area of “tool deficiency” for NTDs is funding for vaccine and therapeutic development and (more generally) control and prevention mechanisms. Treatment of Chagas disease, for example, utilizes drugs of questionable efficacy and we remain limited in our ability to effectively target children, absent a specific pediatric formula. In other instances, viable drugs are available, but proper means of distribution and implementation (for example, public health programs) need to be devised to ensure delivery to infected individuals.

Globally a phenomenon known as the 10/90 gap illustrates the generally insufficient resources devoted to addressing NTDs [Box 3]. The Disability-Adjust Life Year (DALY), is a popular metric, originally devised in the

early 1990s by the Global Burden of Disease Program, frequently used to appropriate funding and identify diseases of particular

Box 3: The 10/90 Gap³¹
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Only 10 percent of all global research and development funding is committed to diseases that disproportionately affect 90% of the world’s population living in low-income and middle-income countries.
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importance and impact. However, despite practical and well-informed intentions King et al, argue that the measurement fundamentally undervalues the significance of NTDs (and related comorbidities), which can negatively impact the financial resources that are specifically devoted to alleviating the burden of NTDs through research, policy, and education [*reference* Box 4].

³¹ Peter Hotez and Bernard Pecoul, ““Manifesto” for Advancing the Control and Elimination of Neglected Tropical Diseases,” PLoS Neglected Tropical Diseases 4.5 (2010).
Peter Hotez, “Future Trends in Control of Neglected Tropical Diseases and the Antipoverty Vaccines,” Forgotten People, Forgotten Diseases (ASM Press, 2008) 143-155.
Peter Hotez, “Neglected Infections of Poverty in the United States of America,” PLoS Neglected Tropical Diseases 2.6 (2008).

Box 4: A Closer Examination of the Disability-Adjusted Life Year (DALY)³²

- Initially an attractive health metric for the Global Burden of Disease (GBD) program (early 1990s)
 - o Comprehensive; takes into account premature mortality, morbidity, impairment, and disability
- Designed to provide a quantitative, objective scale to aid policy makers and decisions regarding the provision of health services
- Composite scale derived from the following simplified formula:

$$\text{DALY} = \text{Years of Life Lost (YLLs)} + \text{Years Lived with Disability (YLDs)}$$

- o $\text{YLL} = (\text{standard life expectation} - \text{age at death}) \times (\text{age weight}) \times (\text{future discount})$
 - o $\text{YLD} = (\text{duration of disease}) \times (\text{prevalence}) \times (\text{disability weight}) \times (\text{age weight}) \times (\text{future discount})$
 - o Weight: relative scale that reflects the severity of the disease or the influence of the factor (age, etc.)
 - o Future Discount: actual years lived factor more than years projected; future discount takes into the account the uncertainty of aging and quality of life by making those years progressively less valuable in the calculation
- DALYs *fail* to acknowledge the implications of context on the burden of disease (especially for the poor)
 - Their greatest strength (generality and objectivity for comparative use) is also a significant drawback, overlooking *patient perspective and situation*
 - Non-representative of the impact of poverty on disability; results in an underestimation of disability weights for chronic diseases that produce a variety of co-morbid conditions, complications, and symptoms like NTDs
 - Results in a fundamental misevaluation, particularly for NTDs, that may undermine the true importance and public health impact of these diseases when designing, implementing, and allocating policies, programs, and/or research funding
 - “Because the DALY calculations are the underpinnings of the GBD program’s disease rankings, we conjecture that these flaws systematically undervalue priorities for controlling the diseases of the poor”³³

A closer examination of pharmaceutical innovation and research expenditures reveals extensive disparities that illustrate the neglected nature of these diseases [Box 5]. However, it also important to consider that many of the factors that cause or exacerbate the incidences and consequences of NTDs are rooted in systemic poverty and poor infrastructure, which ultimately

³² Charles King and Anne-Marie Bertino, “Asymmetries of Poverty: Why Global Burden of Disease Valuations Underestimate the Burden of Neglected Tropical Diseases,” PLoS Neglected Tropical Diseases 2.3 (2008).

³³ Charles King and Anne-Marie Bertino, “Asymmetries of Poverty: Why Global Burden of Disease Valuations Underestimate the Burden of Neglected Tropical Diseases,” PLoS Neglected Tropical Diseases 2.3 (2008).

limits the efficacy of purely bio-medical research investments. It becomes quickly evident that NTDs are seldom considered a priority for funding or policy implementation, despite their large-scale impact and potential to affect millions of people worldwide.

Box 5: Mind the Gap, *Disparities in NTD Research and Development*³⁴

- From 1976-2004 over **1,550** chemical entities were marketed, of these **only 21 drugs** targeted tropical diseases (11 of which focused on malaria or tuberculosis). **Only 10 products (0.6% of total products developed) over the past 30 years** were specifically designed to target NTDs
- Ivermectin (a common pharmaceutical for parasitic infections) was first developed as a veterinary product to protect lucrative livestock herds and only later supported for further development in humans.
- Approximately 75% of all neglected disease aid and research initiatives are targeted at HIV/AIDs, Malaria, and Tuberculosis; only \$600 million worldwide is available for all NTDs per year (compare this number to an estimate 1-1.2 billion incidences of NTD infection)
- The annual budget of the National Institute of Allergy and Infectious Disease in 2006 was \$4.4 billion. \$1.6 billion was spent on bio-defense, none of the other disease-focused programs specifically included NTDs

Interdisciplinary Collaboration and Institutional Partnerships

In an effort to expand research initiatives and increase collaboration, the National School of Tropical Medicine – the first educational institution of its kind in the United States – was founded in 2011 at the Baylor College of Medicine in Houston, Texas. Under the leadership of Dr. Hotez, the school has, in a short time, built impressive and exciting partnerships that collectively seek to address NTDs in the United States and beyond. “The enormous impact of NTDs and NIOs on global health and economics,” explains the schools website, “is dramatically disproportionate to the existence of NTD/NIO-specific research and educational opportunities”.³⁵

The National School of Tropical Medicine is joined in collaboration by Texas Children’s Hospital, the Baylor College of Medicine Department of Pediatrics and Global Health, the Sabin Vaccine Institute, the James Baker Institute for Public Policy at Rice University, and the Rice

³⁴ Peter Hotez, “Future Trends in Control of Neglected Tropical Diseases and the Antipoverty Vaccines,” *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 143-155.

Peter Hotez, “Neglected Infections of Poverty in the United States of America,” *PLoS Neglected Tropical Diseases* 2.6 (2008).

³⁵ NSTM, *National School of Tropical Medicine at Baylor College of Medicine*, 2013, <www.bcm.edu/tropicalmedicine/>.

University 360° for Global Health Technologies, along with additional partnerships with other universities in economics and the social and pharmaceutical sciences.

Figure 2: Institutional partnerships for advancing awareness and interventions for NTDs



These institutions form the foundation of an interdisciplinary and comprehensive national resource that aims to provide for the advancement of antipoverty interventions – within the areas of education, research, clinical care, and policy – that specifically target the poverty promoting features of NTDs and seek to prevent the socio-economic consequences of systemic pathologies.³⁶

The Sabin Vaccine Institute is dedicated to reducing human suffering from vaccine preventable NTDs and maintains product development partnerships (PDPs) with a variety of

³⁶ Peter Hotez, "Future Trends in Control of Neglected Tropical Diseases and the Antipoverty Vaccines," *Forgotten People, Forgotten Diseases* (ASM Press, 2008) 143-155.

global organizations to ensure a focus on safe, effective, low-cost vaccines for tropical infections in developing countries. It is possible that innovations in these areas abroad, could be reasonably translated for domestic implementation in communities severely lacking infrastructural development.³⁷

<p>Box 6: Collaborators in Education, Research, Policy and Clinical Care³⁸</p> <ul style="list-style-type: none">• Department of Pediatrics at Baylor College of Medicine and Texas Children’s Hospital functions as one of the nation’s largest, most diverse, and respected pediatric programs. Maternal and pre-natal care are critical areas in the early diagnosis and management of NTDs. Specific involvement includes the Texas Children’s Center for Global Health, Baylor College of Medicine Vaccine Research Center, and Baylor College of Medicine Center for Globalization.• Rice 360° Institute for Global Health Technologies works to apply bioengineering innovation to advance understanding and development of health diagnostics and medical devices. NTDs are considered “tool deficient” and need appropriate technologies to ensure more efficient and effective control and treatment strategies.• The James Baker Institute for Public Policy at Rice University will work with the National School of Tropical Medicine to inform new public policies for NTDs in United States. These diseases are often overlooked in terms of infrastructural improvement and funding initiatives and poorer communities with high incidences of NTDs would benefit from increased advocacy and awareness at the political level.• University of Houston (social sciences, economics, School of Pharmacy) aids in the design of sociological studies that may advance a more community based perspective and awareness of NTDs. The School of Pharmacy offers a venue in which to initiate pharmaceutical and drug development studies prior to population implementation.

Houston, Texas is an ideal location for this initial collaboration to begin, as its climate and relative proximity to the equator is similar to many locations of high NTD prevalence around the world. Furthermore, the partnership exists primarily between institutions that comprise the nucleus of Texas Medical Center, the largest in the world, which not only ensures access to expansive clinical, research, and educational resources, but an annual patient population in excess of 7.1 million people.³⁹ The National School of Tropical Medicine and its affiliates are thus uniquely situated to make a lasting impact on the poorer communities living in the midst of

³⁷ Sabin Vaccine Institute, 2013, <www.sabin.org>.

³⁸ NSTM, National School of Tropical Medicine at Baylor College of Medicine, 2013, <www.bcm.edu/tropicalmedicine/>.

³⁹ NSTM, National School of Tropical Medicine at Baylor College of Medicine, 2013, <www.bcm.edu/tropicalmedicine/>.

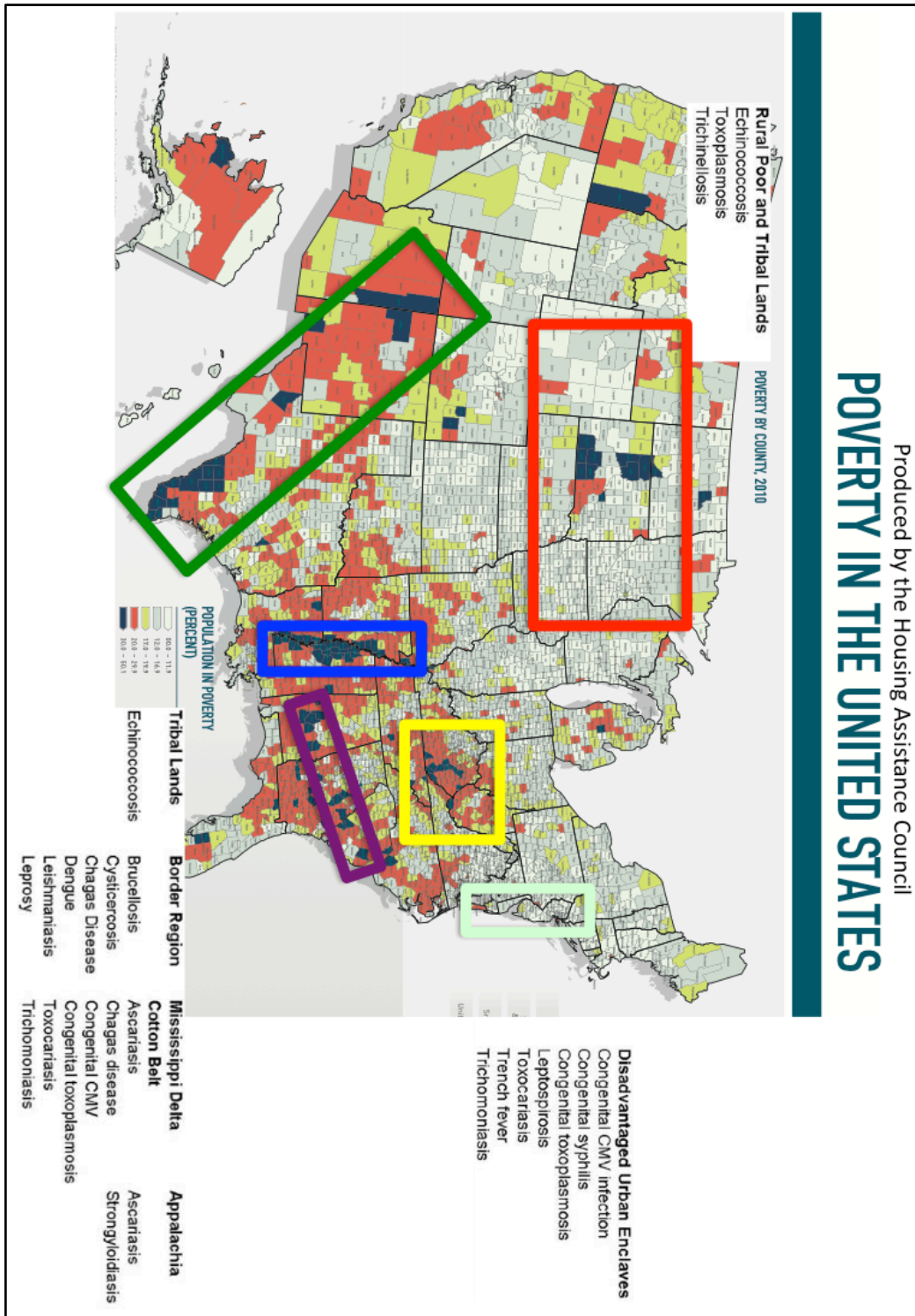
prevalent NTD infections along the Texas-Mexico borderlands and Southern (Mississippi, Louisiana) regions. The Baylor College of Medicine recently launched a Tropical Medicine Clinic at their teaching affiliate, Ben Taub Hospital (a public care center, frequently serving low-income individuals), which will enable area patients to seek specialized services for NTDs.

A Stepping Stone for the Future

The exciting partnerships forming at the Texas Medical Center in Houston is indicative of a renewed investment in addressing the NTDs of the United States. However, we still need a greater national commitment to fully understanding and quantifying the presence of these diseases within our country and the extent to which they contribute and interact with poverty and poorer populations. Neglected tropical diseases have both historically and presently represent one of the most glaring health disparities in the United States. The root problem of this inequity is not medical, but systemic within the vicious outcomes of perpetual poverty. Thus medicine, research, and clinical care have only partly to do with a solution. Most importantly, physicians, researchers, policy makers, and governmental officials alike must continue to promote the development of both health and general infrastructure through powerful and comprehensive collaboration. Addressing the issues of poverty is never a one-dimensional intervention, and the diversity of institutions associated with the National School of Tropical Medicine is a profound testament to this idea.

The reality that these neglected diseases, commonly tied to developing countries, exist so abundantly in the world's wealthiest country is reflective of an unfulfilled responsibility to the poor and marginalized. We've managed to finally begin to address this obligation and will hopefully continue to expand as we further develop interventions and integrative solutions to not only these debilitating diseases and infections, but also to the larger problems of poverty and wellbeing that continue to plague the poor and marginalized in this country.

Figure 1: Poverty and Disease Regions of the United States⁴⁰



⁴⁰ National Housing Assistance Council 2011

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