Chagas Disease: Sharing the Burden and the Solutions in the United States and Mexico

Kirstin R.W. Matthews, Ph.D., Fellow in Science and Technology Policy
Jennifer R. Herricks, Ph.D., Postdoctoral Fellow in Disease and Poverty

ABSTRACT

Chagas disease—the third most common parasitic infection in the world—affects approximately 7.5 million people, mostly in Latin America. Population mobility between Latin America and the rest of the world has led to increasing detection of Chagas disease in the United States, Europe, Japan, and other parts of the world in the last decade. Those living in poverty, including in the United States and Mexico, are at risk of Chagas disease infection due to poor quality housing that leads to infestation by the disease-carrying insect, the kissing bug. The actual extent of the disease burden in Mexico, where the disease is endemic, and the United States is unclear due to limited diagnosis and surveillance. To help reduce outbreaks, the US and Mexican governments should implement surveillance programs, initiate vector control programs (as needed), increase awareness among health care providers, and fund research for the development of Chagas vaccines and treatments.

BACKGROUND

Approximately 7.5 million people around the globe are infected with the parasite that causes Chagas disease, costing more than $7 billion annually due to health care costs, reduced workforce productivity, and early mortality (Lee et al. 2013). The World Health Organization (WHO) has estimated 28,000 new cases and 12,000 deaths annually from Chagas disease worldwide. However, many experts believe that these numbers may be low, as additional cases go unreported or undiagnosed due to a lack of physician awareness.

The parasite causing Chagas disease is a single-celled protozoan, Trypanosoma cruzi (T. cruzi), most commonly found in the American continent. T. cruzi is not normally transmitted from person to person, but utilizes insects called triatomines, also known as “kissing bugs.” Kissing bugs spread Chagas disease directly to humans through its feces. The term “kissing bug” is used because the triatomine usually takes a blood meal from around the face when a person is asleep outside or in a poor housing structure that allows the bugs to get inside. As the bug feeds, it also defecates. When the person rubs the irritated spot, they unintentionally rub the bug’s feces, containing the parasite, into the open wound or into the eye. From there the parasite can enter the bloodstream.

T. cruzi can also infect other mammals, including dogs, woodrats, and armadillos via the kissing bugs. Infected animals can serve as a reservoir, allowing the parasite to spread to other kissing bugs when they take a blood meal from the infected
After approximately 2 months, the majority of infected individuals will enter into the chronic stage of infection in which the parasites leave the bloodstream and evade the immune system. Approximately 30% of patients will develop debilitating medical problems as a result of the infection (Bern 2015). These symptoms include dilation of the esophagus and colon, which interferes with the patient’s ability to eat and digest food, as well as abnormal heart rhythms, which can lead to heart failure and death (CDC 2013). Diagnosis of chronic Chagas disease relies on serological tests that detect antibodies to the parasite. No single test has the needed sensitivity and specificity to provide accurate diagnostic information; therefore at least two different serological tests are required to confirm diagnosis of chronic Chagas disease (Bern 2015).

If diagnosed, there are only two anti-parasitic drugs can be used to treat Chagas disease: nifurtimox or benznidazole. However, some T. cruzi parasites have been identified that are resistant to these drugs (Carabarin-Lima et al.). In addition, these drugs are known to be extremely toxic and therefore are not approved by the US Food and Drug Administration (FDA) and are only available through the US Centers for Disease Control and Prevention (CDC) or the WHO (Bern 2015). Despite the toxic side effects, these drugs can be lifesaving, with 80–90% efficacy when given to treat acute Chagas disease. The effectiveness of anti-parasitic drugs to treat chronic Chagas disease has been debated, but a recent study suggests that this type of treatment offers no benefit to patients who already show signs of cardiac disease (Morillo et al. 2015). Due to the asymptomatic nature of acute Chagas and a lack of physician awareness about the disease, many patients are not diagnosed in time to receive effective treatment. Once heart disease is detected, doctors can only alleviate the symptoms using a complex regimen of drugs and a pacemaker to treat the abnormal heart rhythms and, in more severe cases, a heart transplant (Bern 2015).
RISK AND EXPOSURE

Historically, Chagas disease was predominantly found in poor, rural areas of Latin America. However, researchers are now finding more cases in North America and other parts of the globe (Hotez et al. 2013). The majority of Chagas disease infected individuals in the United States are thought to be immigrants from endemic areas, but there is increasing evidence of disease transmission occurring in the United States (Barry et al. 2012).

The biggest risk factor associated with contracting Chagas disease is poverty, especially extreme poverty (Hotez et al. 2013). An estimated 1.6 million households in the United States and 5 million people in Mexico live in extreme poverty, less than $2 per person per day (Shafer and Edin 2013; World Bank 2015). Many of these impoverished individuals are living in poor quality homes that may sometimes lack basic utilities, air conditioning, and indoor plumbing, increasing their risk of exposure to the insect vectors that can spread diseases, including Chagas (Barry et al. 2012).

In Mexico, Chagas disease is estimated to impact 1.1 million to 5.5 million people, and yet research suggests that less than 0.5% of infected individuals are able to access treatment for the disease (Carabarin-Lima et al. 2013; Manne et al. 2013). The states of Jalisco and Oaxaca are most affected by Chagas (see Figure 2), where the prevalence exceeds 10% of the state’s population (Carabarin-Lima et al. 2013). In certain areas of Mexico, 50 to 70% of kissing bugs and up to 30% of dogs have tested positive for the Chagas parasite (Carabarin-Lima et al. 2013).

In the United States, the impact of Chagas disease is greatest in California and Texas (see Figure 3) in terms of estimated numbers of cases (Manne-Goehler et al. 2015). Despite the fact that many states are affected by Chagas, the disease is formally reportable in only three US states: Texas, Arizona, and Tennessee. In Texas, approximately 50% of kissing bugs and 20% of dogs are estimated to be infected with the *T. cruzi* parasite (Barry et al. 2012). Conservative assessments suggest that there are 300,000 people living with Chagas in the United States, but other estimates suggest nearly 1 million people in the country and 300,000 in Texas may have Chagas disease (Barry et al. 2012).

30%

Approximately 30% of patients will develop debilitating medical problems as a result of the infection.

FIGURE 2 — TOP FIVE STATES IN MEXICO WITH ESTIMATED CASES OF CHAGAS DISEASE

<table>
<thead>
<tr>
<th>States</th>
<th>Cases</th>
<th>Population (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Jalisco</td>
<td>890,168</td>
<td>7.35</td>
</tr>
<tr>
<td>2 Oaxaca</td>
<td>672,947</td>
<td>3.80</td>
</tr>
<tr>
<td>3 Chiapas</td>
<td>611,564</td>
<td>4.79</td>
</tr>
<tr>
<td>4 Veracruz</td>
<td>438,719</td>
<td>7.64</td>
</tr>
<tr>
<td>5 Guerrero</td>
<td>383,947</td>
<td>3.38</td>
</tr>
</tbody>
</table>

The primary barrier to preventative measures in the United States and Mexico is the lack of awareness about Chagas disease. The public does not realize the risks associated with kissing bugs or animals that can possibly carry the \( T. \) \textit{cruzi} parasite. Furthermore, many health care providers are unfamiliar with Chagas disease, its symptoms, progression, and causes. A 2010 survey of U.S. physicians found that 14% of primary care doctors, 47% of obstetrician/gynecologists, 23% of cardiologists, 19% of infectious disease specialists, and 25% of physicians involved in organ transplantation had never heard of Chagas disease or \( T. \) \textit{cruzi} (Stimpert and Montgomery 2010). A similar lack of awareness among physicians and the public has also been documented in Mexico (Manne et al. 2013). This lack of awareness leads to delays or misdiagnosis, which can result in patients progressing to the untreatable chronic stage of disease. Misdiagnosis also results in an underrepresentation of the burden of Chagas disease in the United States and Mexico. Many of the estimates of Chagas disease are derived utilizing data obtained from blood screening or wildlife infection rates. Geographical risk maps are based on

**FIGURE 3 — TOP FIVE STATES IN THE U.S. WITH REPORTED ESTIMATED CASES OF CHAGAS DISEASE**

<table>
<thead>
<tr>
<th>States</th>
<th>Cases</th>
<th>Population (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 California</td>
<td>71,000</td>
<td>38.4</td>
</tr>
<tr>
<td>2 Texas</td>
<td>37,200</td>
<td>26.5</td>
</tr>
<tr>
<td>3 Florida</td>
<td>18,200</td>
<td>19.6</td>
</tr>
<tr>
<td>4 New York</td>
<td>17,500</td>
<td>19.7</td>
</tr>
<tr>
<td>5 Illinois</td>
<td>9,200</td>
<td>12.9</td>
</tr>
</tbody>
</table>


Furthermore, increasing temperatures due to climate change could lead to migration of kissing bugs to the northern United States (Garza et al. 2014). Interestingly, climate can also affect the behavior of kissing bugs, increasing incidents of Chagas disease. For example, when high temperatures exceed 30°C (86°F) and the humidity is low, insects may increase their feeding rate to avoid dehydration (Garza et al. 2014).

**RECOMMENDATIONS**

The \( T. \) \textit{cruzi} parasite that causes Chagas disease does not acknowledge national boundaries, crossing from Southern and Central Latin America to Mexico and the United States via human, animal, and insect migration. To combat Chagas disease and the spread of kissing bugs and \( T. \) \textit{cruzi}, the United States and Mexico need to develop a coordinated effort to increase physician and public awareness, disease surveillance, and vector control. Furthermore, additional funding should be directed toward research on treatments for acute and chronic infections.
the concentrations of kissing bug vectors and general demographics, and rely less on reported incidents (Sarkar et al 2010). This results in significantly different prevalence estimates from study to study.

Better physician awareness will improve surveillance data, helping public health offices determine which populations are most at risk. The state of Texas is leading the way by taking the first step toward tracking the prevalence and impact of Chagas. In 2015, Texas legislators passed a bill, with bipartisan support, that establishes a sentinel surveillance program and physician education for emerging and neglected tropical diseases, such as Chagas disease. But Texas is only one state. Surveillance and education need to be expanded throughout the United States and in coordination with Mexico and other countries in Latin America. Health care provider awareness initiatives should be implemented during their training, as well as through continued education curriculum.

Due to the large population of kissing bugs migrating to southern US states and Mexico, both countries need to coordinate on a vector control program. Mexico’s Secretariat of Health has a series of existing public health programs aimed to control and eliminate Chagas. In addition, Mexico is part of IPCA (Initiative of Central America for the Interruption of Vectorial and Transfusional Chagas Disease Transmission), which promotes blood screening and increased nifurtimox donations.

While blood bank screening for the T. cruzi parasite is mandatory in Mexico, it is not mandatory in the United States (AABB 2015). However, since the U.S began a voluntary screening program of blood donations in 2007, over 2,000 Chagas disease–positive cases have been detected throughout the country, with the largest numbers of cases found in California, Florida, Texas, and New York (AABB 2015). New policies mandating screening of blood and transplant organs for the T. cruzi parasite would reduce Chagas disease rates in the United States.

Other international cooperative programs in the past have successfully reduced the prevalence of Chagas. In 1991, Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay coordinated on the Southern Cone Initiative (Iniciativa de Salud del Cono Sur, INCONSUR), which helped reduce the estimated incidence of Chagas disease by 65% between 1990 and 2000 (Yamagata and Nakagawa 2006). INCONSUR focused on eliminating the kissing bug as well as the transmission of T. cruzi through blood transfusions. INCONSUR’s success suggests that development of a coordinated effort through collaborative public health initiatives is the most effective solution to limiting Chagas incidents in US and Mexico.

The United States and Mexico already work collaboratively on cross-border surveillance through the Binational Border Infectious Disease Surveillance Program (BIDS), a partnership between the CDC and Mexico’s Secretariat of Health. This program could be expanded to include vector control as well as help provide access to existing medications to individuals who test positive for Chagas.

Finally, to help those infected with T. cruzi, the United States and Mexico should fund initiatives directed toward new and novel treatments for Chagas disease—at both the acute and chronic stages. Unfortunately, since the poor are the most likely to be affected by Chagas disease, there is not a great financial incentive for pharmaceutical companies to develop new drugs. However, philanthropic organizations and government funding agencies can help push for increased research, and new public–private partnerships with pharmaceutical companies can fund development to ensure treatments are accessible to vulnerable populations.

The exact way in which the parasite causes symptoms to manifest is not yet completely understood, and this lack of knowledge represents a large gap in the ability to diagnose, treat, and prevent the most devastating outcomes.
CONCLUSION

Traditionally, Chagas disease is commonly believed to only afflict the poor in rural parts of Latin America. However, the migration of infected humans, animals, and insects has brought the parasite T. cruzi to other parts of the world, including the United States and Mexico. Through cross-border collaborations, the United States and Mexico governments can take steps to reduce the risk of Chagas disease by increasing awareness among health care providers and the community in order to protect their most vulnerable citizens, implementing vector control and surveillance programs, and developing novel treatments for acute and chronic Chagas disease.

ENDNOTES

1. The term vector is used to describe the insect or organism that carries a disease-causing pathogen and transmits it to another organism. In the case of Chagas disease the vector is the kissing bug.
2. From remarks by Dr. Mercedes Juan Lopez, Mexico’s Secretary of Health, September 30, 2015, at the Baker Institute conference “The United States and Mexico: Addressing a Shared Legacy of Neglected Tropical Diseases and Poverty.”
3. Ibid.

REFERENCES


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ACKNOWLEDGEMENTS

The authors would like to acknowledge Dr. Peter Hotez, who reviewed and advised on this article. We would also like to acknowledge support for the Disease and Poverty Program from the AbbVie Foundation and Clare Glassell.

AUTHORS

Kirstin R.W. Matthews, Ph.D., is a fellow in science and technology policy at the Baker Institute. She is also a lecturer in the Wiess School of Natural Sciences and an adjunct lecturer in the Department of Sociology at Rice University. Her research focuses on the intersection between traditional biomedical research and public policy.

Jennifer R. Herricks, Ph.D., is a postdoctoral fellow in disease and poverty at the Baker Institute and the National School of Tropical Medicine at Baylor College of Medicine. Her current research is focused on the relationship between poverty and disease, especially neglected tropical diseases.

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Cite as: