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SHORT REPORT
Trypanosoma cruzi screening in Texas blood donors, 2008–2012

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SUMMARY

Chagas disease is an important emerging disease in Texas that results in cardiomyopathy in about 30% of those infected with the parasite *Trypanosoma cruzi*. Between the years 2008 and 2012, about 1/6500 blood donors were *T. cruzi* antibody-confirmed positive. We found older persons and minority populations, particularly Hispanic, at highest risk for screening positive for *T. cruzi* antibodies during routine blood donation. Zip code analysis determined that *T. cruzi* is associated with poverty. Chagas disease has a significant disease burden and is a cause of substantial economic losses in Texas.

Key words: Blood donors, Chagas disease, repeat reactive, RIPA, risk factors, seroprevalence, *Trypanosoma cruzi*.

Chagas disease (American trypanosomiasis) has emerged as an important neglected tropical disease in the United States [1]. The disease is caused by the parasite *Trypanosoma cruzi*, which is most commonly transmitted to humans following a blood meal by an infected triatomine insect. About one-third of those who become chronically infected can develop cardiomyopathy, other cardiac sequelae, and death. While the epidemiology of this disease has been extensively studied in Latin America, little is known about the burden of disease in the southern part of the United States where there is increasing evidence of autochthonous transmission [1, 2]. Previous reports from individual blood centres in Texas have suggested a higher than expected burden of disease; however, these reports only covered isolated regions of the state [2]. This study aimed to evaluate associated demographic risk factors and estimate the prevalence of Chagas blood donors who tested positive for *T. cruzi* antibodies across multiple, large blood donation centres throughout Texas.

Data were consolidated from all blood donors tested for *T. cruzi* antibodies between 2008 and 2012 from the five collaborating blood centres and the AABB Chagas Biovigilance Network [3]. Data from each individual donor were only included once in the analysis. Any blood donor who screened

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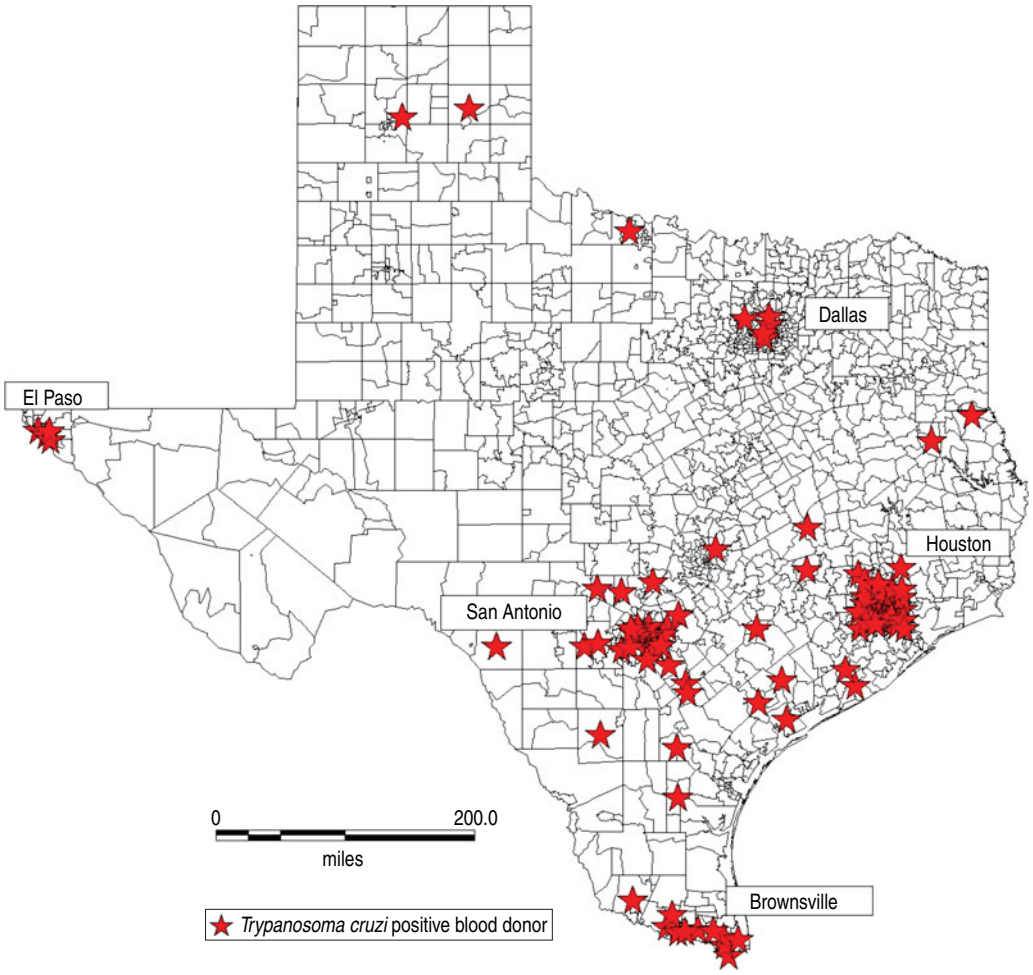

Fig. 1. Distribution of *Trypanosoma cruzi*-infected blood donors in Texas.

repeatedly reactive for antibodies to *T. cruzi* by either FDA licensed screening test, the Ortho *T. cruzi* ELISA system (Ortho-Clinical Diagnostics, USA) or Abbott PRISM Chagas chemiluminescent immunoassay (Abbott Laboratories, USA), had a sample submitted for additional confirmation testing by radio-immunoprecipitation assay (RIPA; Quest Diagnostics, USA). Only those cases found positive by RIPA were considered antibody-confirmed positive. The study objective was to describe the demographic and geographical variables of confirmed blood donors in Texas. All statistics were analysed using Stata v. 12 software (StataCorp., USA). This study was reviewed by the Institutional Review Board at Baylor College of Medicine and was determined to be exempt since all data were de-identified.

Over the 5-year study period, 907 398 individual blood donors were tested for *T. cruzi* antibodies. The blood donor population was equally distributed by gender (50% female, 50% male). The mean age of donors was 37 years (range 15–99 years). Blood donors were primarily Caucasian (52%) or Hispanic (38%). African American (6%), Asian (2%), and other minorities were minimally represented in this population.

Of those tested, 1/6500 ($n = 140$) persons were confirmed positive for *T. cruzi* antibody by RIPA testing. Figure 1 shows the geographical distribution of positive donors in the state, with *T. cruzi*-infected donors predominately located around the main urban donation centres. Prevalence of cases increased with age in a linear trend: ages 16–20 years (18/100 000), ages 21–30 years (24/100 000), ages 31–40 years (26/100 000), ages 41–50 years (33/100 000), and ages >51 years (39/100 000). Prevalence of cases was highest in Hispanics (34/100 000) and mixed races (33/100 000), and lowest in Caucasians (5/100 000) and Asians (6/100 000). No African Americans were confirmed *T. cruzi* antibody positive during the study period.

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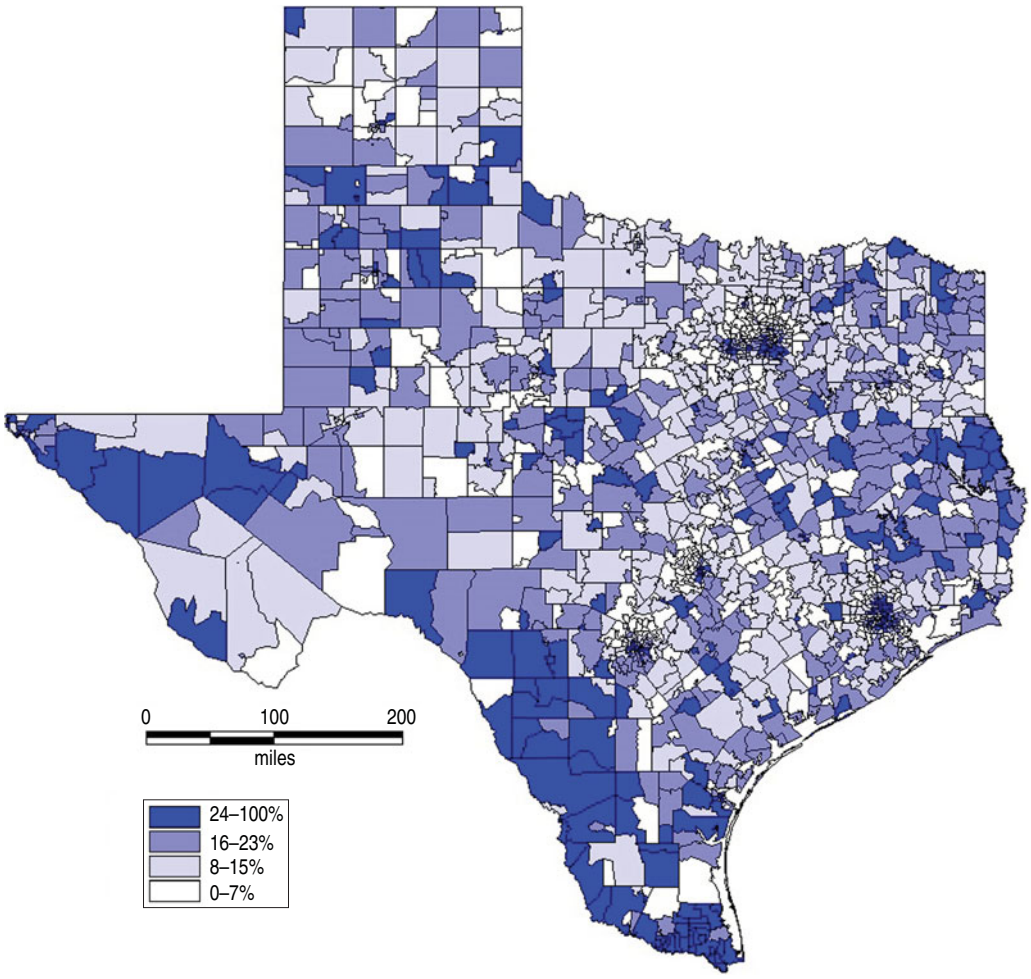

Fig. 2. Potential high-risk areas for disease transmission: percentage of homes living below the poverty line by zip code.

Blood donors originated from 75% (1938/2599) of zip codes in Texas, and positive cases came from 109 different zip codes. Zip code-level data were collected from the US Census Bureau's American Fact Finder database [4]. Wilcoxon rank sum analysis was used to measure associations between zip codes of confirmed donors *vs.* zip codes of negative donors. We found that confirmed *T. cruzi* antibody-positive blood donors were statistically more likely ($P < 0{\cdot}002$) to reside in a zip code with a higher percentage of residents living in poverty (median 16·5%) compared to zip codes of negative donors (median 14·4%). Figure 2 geographically displays the percentage of persons living below the poverty line for each zip code. The US Census Bureau defines the poverty line as the minimum level of resources that are adequate to meet basic needs [4]. For example, the poverty line is US$23 283 for a family of four [4]. We also found that confirmed *T. cruzi* antibody-positive donors were statistically more likely ($P < 0{\cdot}001$) to reside in zip codes that had a higher percentage of foreign-born residents (median 17·2%) compared to zip codes of negative donors (median 6·5%).

Finally, we estimated societal costs for chronic Chagas disease in blood donors in Texas using the RIPA-confirmed donors ($n = 140$). Cost estimates were based on the assumption that 30% would develop chronic Chagas disease (42 of RIPA confirmed). The societal cost for healthcare and lost wages of chronic infection for these cases would equal about US$3.8 million (US$91 531/case) [5]. These chronic Chagas cases would accrue 150 disability-adjusted life years lost (3·57 DALYs/case). The cost per case had been adjusted to US standards by the originating author [5].

One limitation of this study is that our study population might not be representative of the entire state. There were few blood donors screened in the more

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south central part of the state (South Texas Plains and Western Hill Country) where *T. cruzi* transmission risk is predicted to be highest based on vector abundance, a well-documented domestic transmission cycle, and other environmental factors [6–8]. However, this high-risk area has a smaller population compared to the rest of state, which is most likely the contributing factor of low blood donor numbers. We found poverty was associated with testing positive in our donor population, and as seen in Figure 2, those in the south central part of the state had the highest percent of impoverished residents. By not including this area, and only considering blood donors for this study, we are likely underestimating the true burden of Chagas disease.

Blood centre screening is an important component in understanding the epidemiology of *T. cruzi* in Texas. By combining data from multiple blood centres, we were able to more accurately describe the prevalence of *T. cruzi* infection in the state. About 1/6500 blood donors were confirmed positive for *T. cruzi* antibodies in Texas. This rate is consistent with other studies in the southern United States, indicating a substantial disease burden [9]. People of advanced age, Hispanics, and mixed races were found to be at highest risk for infection. While the number of Caucasians and Asians infected were low, there is a possibility that these populations represent locally acquired infections. Infection also disproportionately occurred in people living in impoverished zip codes. Future studies should aim to understand the histories and specific risk factors for acquiring Chagas infection to better understand the transmission risk within the United States. Additionally, blood donors testing positive for *T. cruzi* infection should be evaluated for cardiac manifestations of disease to determine health outcomes in this population.

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DECLARATION OF INTEREST

None.

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