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Chagas Disease Screening: Awareness, Practices And Perceived Barriers Among Health Care Providers In Connecticut

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Abstract

Background. An estimated 288,000 people in the United States are infected with Chagas disease. Despite published recommendations for health care providers, the neglected nature of this disease persists, in part due to gaps in knowledge and low levels of Chagas disease awareness among health care providers. A survey was emailed to health care providers to assess knowledge, screening practices and provider-perceived barriers to screening for Chagas disease.

Methods. The survey link was emailed to healthcare providers and department heads. Providers answered a series of questions categorized either as knowledge (K), practice (P), or perceived barriers (B), which were then scored by category. Analysis included Spearman's rho test to measure the strength of correlation coefficient between K and P scores, and between K and B scores, Kruskal-Wallis tests to see if average K, P and B scores were equal across specialty groups, and Pairwise Wilcoxon Rank Sum Tests to assess for a significant difference between average scores of cardiology, infectious disease and the "other specialties" category.

Results. 92 providers consented to complete the survey, 88 of whom fit the inclusion criteria of either affiliation with Yale University or YNHH. Infectious disease scored highest on average in knowledge and practices, and reported lower provider-perceived barriers (0.66±0.183, 0.35±0.247, 0.42±0.365). No specialty received higher than 0.66±0.183 on average for knowledge or screening practices. Average perceived barriers to screening were highest in the "other" specialty category (0.76±0.303). There was a significant positive association between knowledge scores and screening practice scores, and a significant negative association between knowledge scores and perceived barriers to screening.

Conclusions. This study revealed a knowledge deficit among health care providers in various specialties, which was associated with less frequent adherence to recommended screening practices for Chagas disease, as well as higher provider-perceived barriers to screening. This information can be used to inform provider education initiatives so that patients at risk for Chagas disease may be better served.

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Introduction

Though Chagas disease is likely underdiagnosed within the United States, efforts to estimate prevalence, diagnose at-risk populations, and treat have been gradually increasing (Forsyth et al., 2021; Ikedionwu et al., 2020). Despite publications providing screening and diagnosis recommendations, the neglected nature of this disease firmly persists (Forsyth et al., 2022; PAHO, 2019). An estimated 288,000 people in the U.S. are infected, with chronic infections making up the vast majority and acute infections seen only sporadically (Carter et al., 2012; Irish et al., 2022). To obtain prevalence estimates among Latin America-born U.S. residents, Irish et al., 2022 relied upon U.S. *T. cruzi* seroprevalence data to the extent that it was available. Beyond this, the authors used 2014–2018 microdata from IPUMS-USA—a database built from federal censuses and American Community Surveys—in addition to World Health Organization reports on seroprevalence in disease-endemic countries (Irish et al., 2022). These updated estimates are similar to those calculated in the past, but are likely more accurate due to relative improvements in U.S. seroprevalence data (Bern & Montgomery, 2009; Irish et al., 2022; Manne-Goehler et al., 2016).”

Chronic infection can be either indeterminate or determinate, with indeterminate signifying antibody seropositivity, but normal electrocardiogram findings, normal chest x-ray, and the absence of digestive megasyndromes (Rassi et al., 2010). Of those with chronic Chagas disease approximately 30-40% develop determinate (symptomatic) Chagas disease, which can manifest in various ways, including cardiac conduction abnormalities, cardiomyopathy, megaesophagus and megacolon (Pérez-Molina & Molina, 2018; Rassi et al., 2010). Cardiac involvement can eventually result in heart failure and sudden death (Pérez-Molina & Molina, 2018).

An estimated 43,000 women of reproductive-age in the U.S. are infected with Chagas disease, and, as a result, approximately 22-108 congenitally-infected infants are born in the U.S. each

year (Irish et al., 2022). Experts on this life-threatening disease urgently call for updated guidelines, for both cardiologists and obstetrics/gynecology specialists (Ayres et al., 2022). The public health importance of screening in the U.S. is highlighted by the reduced risk of vertical transmission in those treated prior to pregnancy and the >90% cure rate in infants treated within the first year of life (Carlier et al., 2019; Forsyth et al., 2022). In the larger at-risk population, more attention to screening, diagnosis and treatment may lead to better patient outcomes, more appropriate interventions and better U.S. prevalence estimates (Ayres et al., 2022; Crespillo-Andújar et al., 2022; Edwards et al., 2017; Forsyth et al., 2022; Meymandi et al., 2018; PAHO, 2019).

The causative agent of Chagas disease is the hemoflagellate, *Trypanosoma cruzi*, a protozoan parasite which is spread to humans primarily by the triatomine insect. Triatomines, colloquially referred to as “kissing bugs,” are in the order Hemiptera, family Reduviidae, and subfamily Triatominae. This nocturnal insect colonizes around and inside homes, both in Latin America and in the Southwest U.S. (Alvarado et al., 2022; Dye-Braumuller et al., 2020; Forsyth et al., 2022; Klotz et al., 2021; Klotz & Schmidt, 2020; Rassi et al., 2010). Historically, transmission from insect vector to human host was attributed predominantly to the vector taking a blood meal and defecating near the bite punctum, after which host behaviors, like scratching or rubbing, are thought to facilitate the spread of parasite-infested feces into the host bloodstream (Klotz & Schmidt, 2020; Rassi et al., 2010). Infections also spread through oral ingestion, through the aforementioned vertical transmission, and through blood/organ donation (Rassi et al., 2010). Additionally, transplant-related immunosuppression has been associated with Chagas disease reactivation in chronically infected recipients (Hamilton et al., 2022; Radisic & Repetto, 2020).

The oral route of transmission has received increased attention, due in part to notable foodborne outbreaks observed in South America and reports of triatomines in kitchens and food containers within the U.S. (Alarcón de Noya et al., 2015; FAO/WHO, 2014; Klotz & Schmidt,

2020; Nóbrega et al., 2009; Souza-Lima et al., 2013; Velásquez-Ortiz & Ramírez, 2020). The Food and Agriculture Organization of the United Nations (FAO) has ranked *T. cruzi* 10th out of the 24 most important foodborne parasites globally, though foodborne transmission is thought to be primarily relevant to endemic countries (FAO/WHO, 2014). *T. cruzi* does not replicate in food, so oral transmission depends instead on contamination, such as vector fecal matter in fruit juices, or ingestion of parasite-infected reservoir animals (FAO/WHO, 2014). The dominant mode of autochthonous transmission within the U.S. remains undetermined, though oral transmission has been proposed (Klotz & Schmidt, 2020). This suggestion is supported by triatomine defecation indices, and a lack of association between U.S. bite reports and positive serological findings (Klotz & Schmidt, 2020).

Chronic Chagas disease infections in the U.S. are most prevalent in populations who have emigrated from endemic areas of Latin America (Forsyth et al., 2022; Pérez-Molina & Molina, 2018). The ongoing need to spread awareness and improve screening must be considered within the context of xenophobia and stigma surrounding diseases associated with poverty (Forsyth et al., 2021; Montgomery et al., 2014). Some call for further analysis of “the political and economic structures that cause a widespread, life-threatening disease to persist in the shadows” (Forsyth et al., 2021). Others call specifically for increased advocacy to raise awareness of Chagas disease (Ayres et al., 2022). Many specifically focus on the deficits in knowledge among health care providers and the outcomes related to these knowledge gaps (Amstutz-Szalay, 2017; Edwards et al., 2018; Mahoney-West et al., 2021, 2022; Stimpert & Montgomery, 2010; Verani et al., 2010).

Little is known of provider awareness and screening practices in Connecticut. The counties of Fairfield, New Haven, and Hartford have the state’s highest hispanic populations (21.4%, 19.7%, 18.5%) (U.S. Census Bureau, 2021). As of 2021 the majority of Latin America-born immigrants living in Connecticut were from Mexico, Brazil, Colombia, and El Salvador (4.2%,

3.9%, 3.7%, 1.4%) (Migration Policy Institute, n.d.). Though these are all endemic countries, country prevalence may be an unreliable predictor of prevalence among U.S. immigrants due to within-country heterogeneity (Irish et al., 2022).

New Haven County is of particular interest due to its connection to a large healthcare system and academic institution. A survey was emailed to physicians and advanced practice providers (NPs, CNMs, PAs) who are affiliated with Yale-New Haven Hospital (YNHH) and/or Yale University. Data were collected on health care provider knowledge and practices surrounding Chagas disease, as well as provider-perceived barriers to screening. It was predicted that there would be an overall lack of awareness surrounding Chagas disease and its risks, and that this lack of knowledge would be associated with less frequent screening practices, as well as higher provider-perceived barriers to screening. This was based on results seen in similar provider survey studies (Amstutz-Szalay, 2017; Mahoney-West et al., 2021; Stimpert & Montgomery, 2010). Additionally, among providers, cardiology and infectious disease specialists were expected to be significantly more knowledgeable about Chagas disease, score significantly higher on the practice category questions, and report significantly lower perceived barriers to Chagas disease screening. This survey was an important step toward measuring levels of adherence to professional recommendations and toward fostering equitable patient care.

Methods

This study was granted exemption by the Yale Institutional Review Board (IRB# 2000033998). Research Electronic Data Capture (REDCap) software was used to create the survey instrument and survey link, and to capture respondent data. The survey link was shared via email with healthcare providers who are affiliated with Yale University or YNHH. The email containing the survey explanation and link can be found under Appendix A. The survey instrument can be found under Appendix B. Participants were recruited through public YNHH

directories, networks at the author's affiliated academic institutions (YSN and YSPH), and through emails by department leaders and administrators.

Survey and Scoring

Providers answered a series of questions categorized either as knowledge (K), practice (P), or perceived barrier (B). There were nine knowledge questions, three practice questions, and three perceived barrier questions. Targeted provider specialties included the following nine specialty categories relevant to Chagas disease screening: Primary Care/Family/Internal Medicine, Pediatric Primary Care, Women's Health/Midwifery/OBGYN, Cardiology (Adult), Cardiology (Pediatric), Gastroenterology (Adult), Gastroenterology (Pediatric), Infectious Disease (Adult), Infectious Disease (Pediatric). All other respondents were sorted into the category "other." Due to low response rate within certain specialties, the "other" category was later expanded to all aside from the main categories of interest, cardiology and infectious disease (**Table 2**).

Respondents received a score for each category (K, P, and B). All knowledge questions were scored out of 1 point, with correct answers to yes or no questions, and self-reported confidence in knowledge/familiarity resulting in a full point for that K question. One K question was originally 2 points total, but was weighted accordingly so as to not disproportionately affect the participants K score. A "check all that apply" question (#10) was categorized as correct (1 point) only if all four correct options were selected. Near-correct answers (2 out of 4, or 3 out of 4) did not contribute to the participant's total knowledge score. For each question regarding provider practices (P), participants were presented with a choice between "Never," "Rarely," "Sometimes," "Frequently," and "Always". These questions were scored ordinally as follows: Never (0), Rarely (1), Sometimes (2), Frequently (3), Always (4). Each P question was out of 4 points, and no weighted calculation was required. Higher scores P indicated more frequent Chagas disease screening. Perceived barrier questions were scored ordinally as follows: Not a barrier at all (0), Minor barrier (1), Moderate barrier (2), Major barrier (3). Each B question was

	Overall (N=88)
Provider Affiliation	
Hosptial Affiliated	40 (45.5%)
University Affiliated	14 (15.9%)
Both	34 (38.6%)
Neither	0 (0%)
Provider Type	
MD/DO	68 (77.3%)
NP	18 (20.5%)
Midwife	2 (2.3%)
PA	0 (0%)
Other	0 (0%)
Provider Specialty	
Primary Care/Family/Internal Medicine	10 (11.4%)
Pediatric Primary Care	9 (10.2%)
Womens Health/Midwifery/OBGYN	12 (13.6%)
Cardiology - Adult	23 (26.1%)
Cardiology - Pediatric	10 (11.4%)
Gastroenterology - Adult	1 (1.1%)
Gastroenterology - Pediatric	1 (1.1%)
Infectious Disease - Adult	11 (12.5%)
Infectious Disease - Pediatric	3 (3.4%)
Other	8 (9.1%)

Table 1. Participanting providers categorized by affiliation, type, and specialty.

out of 3 points, and no weighted calculation was required. Higher B scores indicated higher barriers to screening perceived by the individual clinician.

Statistical Analysis

R statistical software (version 4.2.3) was used for data analysis. K, P and B scores were based on the proportion of correct answers in each category. Scores were grouped by provider specialty and mean scores by specialties were calculated (**Figure 1a-c**). Spearman's rho test was used to measure the strength of correlation between mean K and P scores, and between mean K and B scores (**Figure 2a-b**). Kruskal-Wallis tests were used to check for equivalence in K, P and B scores across specialty groups. This non-parametric test was selected after Shapiro–Wilk Tests for K, P, and B scores yielded p-values below 0.05 (see histograms in supplemental figures for visualization of skew). This was followed by Pairwise Wilcoxon Rank Sum Tests with the Bonferroni p-value adjustment method to assess for a significant difference between cardiology and infectious disease.

	Overall (N=88)
Provider Specialty	
Other Specialty	41 (46.6%)
Infectious Disease	14 (15.9%)
Cardiology	33 (37.5%)

Table 2. Participanting providers categorized by Other, Infectious Disease and Cardiology. Due to low response rate within certain specialties, the "Other" category was expanded to all categories aside from the main categories of interest, cardiology and infectious disease.

Results

92 providers consented to complete the survey, 88 of whom fit the inclusion criteria of affiliation with Yale University and/or YNHH. Counts and percentages of providers affiliation, provider type, and provider specialty can be found in **Table 1**.

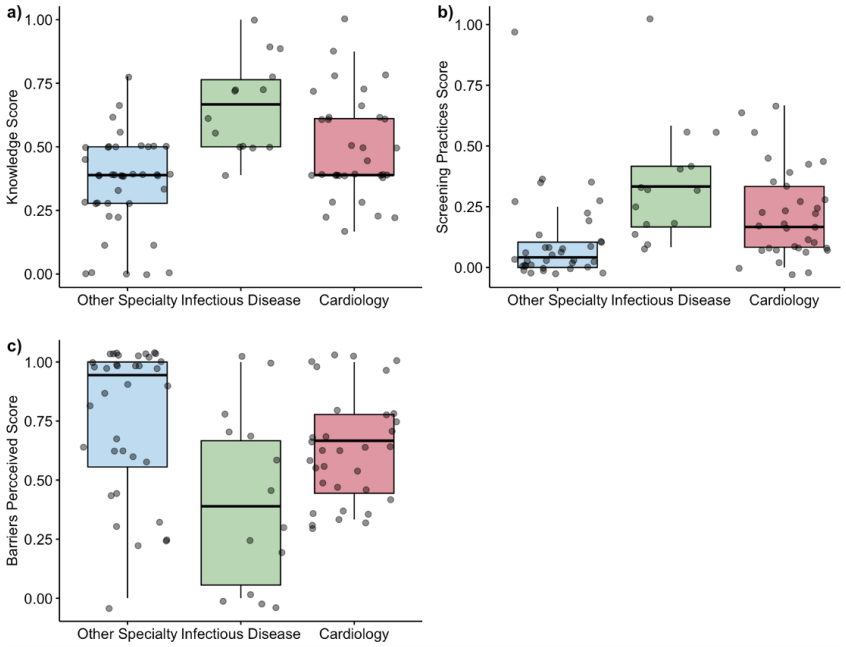

Figure 1. Boxplots by specialty showing **a)** knowledge **b)** screening practices, and **c)** perceived barriers.

Out of the 88 respondents, 5 had never heard of Chagas disease, resulting in automatic termination of the survey. These individuals received a 0 for their total knowledge scores and NA for all practice and barrier questions. Boxplots of provider scores by specialty can be found in **Figure 1a-c**. Infectious disease scored highest on average in K and P, and reported lower provider-perceived barriers to screening patients (0.66±0.183, 0.35±0.247, 0.42±0.365). No specialty received higher than 0.66±0.183 on average for knowledge or screening practices. Average perceived barriers to screening were highest in the “other” specialty category (0.76±0.303). Spearman’s rho test revealed a significant positive association between K and P ($p < .0001$, rho = 0.70) and a significant negative association between K and B (p-value <.0001, rho = -0.45) (**Figure 2a-b**). Due to not holding the normality assumption (See supplemental section), K, P and B scores were compared across the three specialty groups using Kruskal-Wallis rank sum test at a 5% significance level. Knowledge scores, screening practices scores, and the perceived barrier scores were statistically different by specialty category. To further investigate these differences across specialty categories, this was followed by three Pairwise Wilcoxon Rank Sum Tests with Bonferroni p-value adjustments. Regarding knowledge scores, infectious disease specialist scores were significantly greater than both cardiology

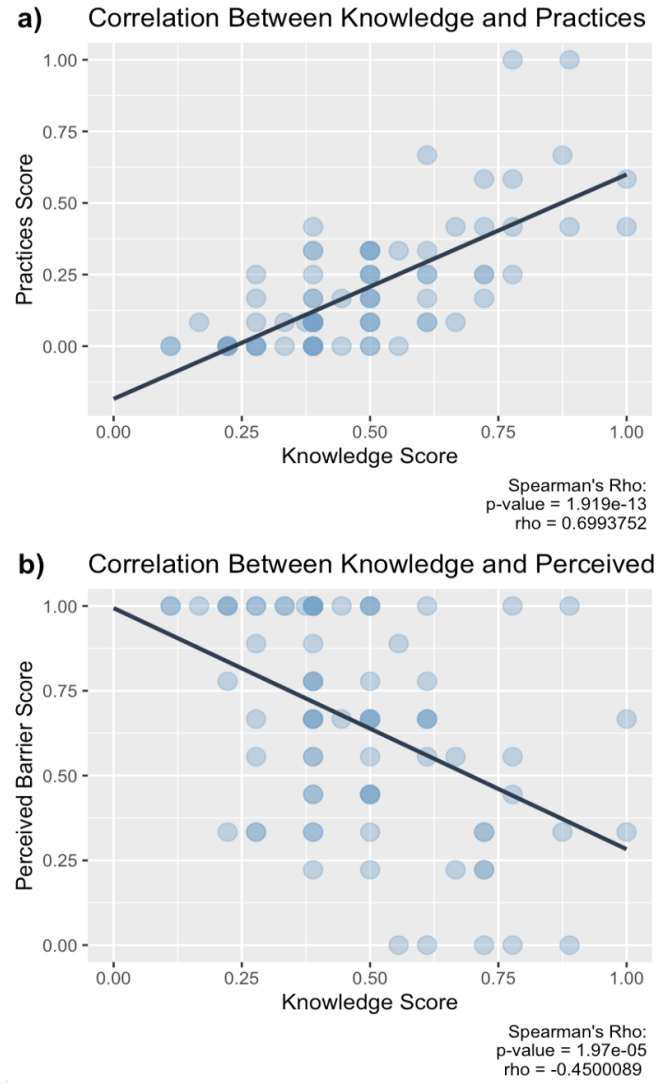

Figure 2. a) Correlations between K and P scores, and **b)** K and B scores, with results of Spearman's rank correlation coefficient shown.

(p=.02) and "other" specialties (p<.0001). Cardiology knowledge scores were not significantly different from "other" specialties (p=0.052). Screening practices scores for both infectious disease and cardiology were significantly different from "other" specialties (p<0.001, p<0.005), but infectious disease and cardiology were not significantly different from each other (p=0.17). Perceived barrier scores of infectious disease were significantly different from "other" (p=0.01), cardiology scores were not significantly different from "other" (p=0.08), and infectious disease scores were not significantly different from cardiology (p=0.16).

Discussion

Despite recent publications providing clear recommendations for screening and diagnosis, it is not surprising that the neglected nature of this disease persists (CDC, 2023; Forsyth et al., 2022; PAHO, 2019). Not only is it a disease historically associated with rural poverty, but, at least within the U.S., it affects primarily marginalized populations of Latin American immigrants (Ayres et al., 2022; Mahoney-West et al., 2021). Additionally, it is a silent, sometimes decades-long disease process (Forsyth et al., 2021; Hotez et al., 2013; Pérez-Molina & Molina, 2018). With disease characteristics such as this, the efforts toward increasing Chagas disease

education for healthcare providers are critical to further understanding and lessening the burden of this disease within the U.S.

In this study, knowledge of Chagas disease was strongly linked to better screening practices, as well as lower provider-perceived barriers to screening at-risk patients. The general lack of knowledge, infrequent screening practices, and perception of high barriers to screening is not unique to this study population (Amstutz-Szalay, 2017; Edwards et al., 2018; Mahoney-West et al., 2021; Malhotra et al., 2021; Soares Cajaiba-Soares et al., 2021; Stimpert & Montgomery, 2010; Verani et al., 2010). It is likely that education sessions would improve provider adherence to recommendations and provide them with the tools to better serve at-risk Latin American patients (Mahoney-West et al., 2022). Though the infectious disease specialists and cardiologists had higher screening practice scores, these specialists likely see patients after acute or chronic symptomatic disease has developed. In the survey instrument, practice questions focused on screening, but questions did not clearly specify this as asymptomatic screening. Asymptomatic screening practices compared to diagnostic testing practices may be a beneficial area to explore in future research. Improvement in screening practices of primary care/family medicine providers as well as women's health, midwifery, and OB-GYN providers is warranted, especially when the importance of preventing cases of vertical transmission is considered (Alarcón et al., 2016; CDC, 2012; Forsyth et al., 2022). Furthermore, provider education is needed, not only to catch asymptomatic positive cases that may progress into severe chronic illness, but to increase the number of providers available to support patients (Clark et al., 2022; Forsyth et al., 2021; Lynn et al., 2022).

Though the impact of structural bias, xenophobia, and stigma on the continued neglect of this life-threatening disease cannot be precisely disentangled from other structural issues within our healthcare system, the tools and resources to counter these forces of inequity are within reach to the average clinician. Recommendations are available and, with more awareness, screening

and research on this insidious disease, the information we have to combat it will only improve (Carlier et al., 2019; CDC, 2023; Forsyth et al., 2022; Nunes et al., 2018; Tan, 2023).

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Appendices

Appendix A.

Email to Lead Department Contact.
Email Subject:
Health Care Provider Survey To Complete
Email Body:

Dear Lead Department Contact

Thank you for your willingness to distribute this survey within your clinic/medical department. This study was granted IRB exception (IRB Protocol ID is 2000033998). Please email the below message to all providers on your clinic/medical department contact list:

Awareness, Practices and Perceived Barriers of a Neglected Disease – Provider Survey

Please complete this 5 minute survey. Every response is valuable, no matter the knowledge level.
The survey is entirely anonymous and investigates provider awareness, practices and perceived barriers to Chagas disease screening. It will be used to assess the need for education and communication regarding this neglected disease.

This study was granted IRB exemption (IRB Protocol ID: 2000033998). Please email erica.rayack@yale.edu with any questions.
If the above survey link does not work please copy and paste the following into your address bar: https://redcapynh.ynhh.org/surveys/?s=Y3X4HTH43E8TRJDP

Thank you for your time,

Erica J. Rayack (she/they)
Joint Degree MSN & MPH Student
Yale School of Nursing
Yale School of Public Health

Appendix B.

Data Dictionary Codebook

03-25-2023 21:20

#	Variable / Field Name	Field Label *Field Note*	Field Attributes (Field Type, Validation, Choices, Calculations, etc.)
Instrument: **Chagas Survey: Screening Awareness, Practices and Perceived Barriers Among Health Care Providers** (chagas_survey_screening_awareness_practices_and_pe) Enabled as survey			
1	[participant_id]	Participant ID	text
2	[participate]	I consent to participate in this short survey.	radio 1, Yes 2, No Stop actions on 2
3	[hosp_or_uni]	Please select which of the following applies to you:	radio 1, I am a health care provider who works within the Yale New Haven Health System 2, I am a health care provider who is otherwise affiliated with Yale University (professor, researcher, etc.) 3, Both of the above apply to me 4, Neither Stop actions on 4
4	[prov_type]	Provider Title	radio, Required 1, MD/DO 2, NP 3, Midwife 4, PA 5, Other
5	[other_text] Show the field ONLY if: [prov_type] = '5'	If "other" chosen, please specify	text
6	[spec]	Provider Specialty	radio, Required 1, Adult Primary Care/Family Medicine/Internal Medicine 2, Pediatric Primary Care 3, Women's Health/Midwifery/OBGYN 4, Cardiology - Adult 5, Cardiology - Pediatric 6, Gastroenterology - Adult 7, Gastroenterology - Pediatric 8, Infectious Disease - Adult 9, Infectious Disease - Pediatric 10, Other
7	[other_text_2] Show the field ONLY if: [spec] = '10'	If "other" chosen, please specify	text

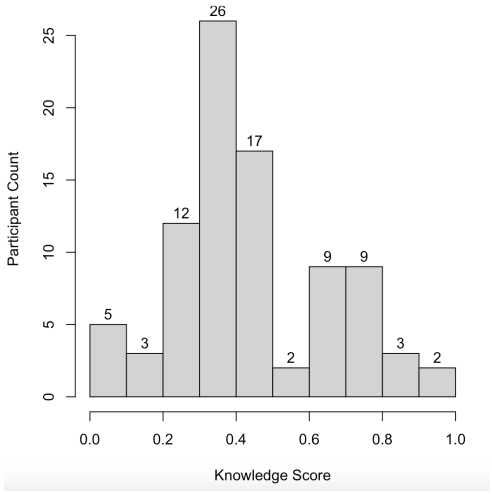
Blue text denotes how answers were set to be scored in R. With higher scores on K questions denoting higher knowledge, higher scores on P questions denoting more frequent screening practices, and lower B scores indicating lower prercieved barriers to screening.

8	[k1_heard]	1. Have you heard of Chagas disease?	radio, Required 1 Yes → 1 2 No → 0 Stop actions on 2
9	[k2_pathogen]	2. Chagas disease is caused by a _____ ?	radio 1 I do not know → 0 2 Bacterium → 0 3 Virus → 0 4 Parasite → 1 5 Fungus → 0
10	[k3_at_risk]	3. Are you familiar with who is at risk for Chagas disease?	radio 1 Not at all familiar → 0 (Weighted score 0) 2 Somewhat familiar → 1 (Weighted score 0.5) 3 Very familiar → 2 (Weighted score 1)
11	[p1_consider_risk]	4. How often do you consider the risk for Chagas disease in your patient population?	radio (Matrix) 1 Never → 0 2 Rarely → 1 3 Sometimes → 2 4 Frequently → 3 5 Always → 4
12	[p2_screen_freq]	5. How often do you screen for Chagas disease in your patients who are at risk?	radio (Matrix) 1 Never → 0 2 Rarely → 1 3 Sometimes → 2 4 Frequently → 3 5 Always → 4

13	[p3_educate]	6. How often do you educate at-risk patients on Chagas disease and Chagas disease screening?	radio (Matrix) 1 Never → 0 2 Rarely → 1 3 Sometimes → 2 4 Frequently → 3 5 Always → 4
14	[k4_confidence]	7. Are you confident that your knowledge of Chagas disease is up to date?	radio 1 Yes → 1 2 No → 0
15	[k5_congenital]	8. In the United States, how many cases of congenitally transmitted Chagas disease are estimated to occur annually?	radio 1 I do not know → 0 2 3 to 17 congenital infections → 0 3 22 to 108 congenital infections → 1 4 515 to 670 congenital infections → 0
16	[k6_clinicaldisease]	9. Approximately what percentage of patients with chronic Chagas infection develop clinical (symptomatic) disease?	radio 1 I do not know → 0 2 10-20% → 0 3 30%-40% → 1 4 50-60% → 0

17	[k7_chronic_determinate]	10. Patients with chronic Chagas disease may develop (check all that apply):	checkbox 1 k7_chronic_determinate___1 I do not know 2 k7_chronic_determinate___2 Cardiac conduction abnormalities 3 k7_chronic_determinate___3 Cardiomyopathy 4 k7_chronic_determinate___4 Megacolon 5 k7_chronic_determinate___5 Megaesophagus Field Annotation: @NONEOFTHEABOVE='1'
18	[k8_how_order]	11. Are you familiar with how to order a Chagas screening test?	radio 1 Yes 1 2 No 0
19	[k9_next_step]	12. What is the most important next step if a patient's Chagas test results are positive?	radio 1 Isolate the patient immediately 0 2 Treat the patient immediately 0 3 Order a confirmatory test 1 4 Take a "watch and wait" approach 0
20	[b1_risk]	Section Header: *Please rate how much of a barrier to testing each of the following items presents* 13. Lack of familiarity with who is at risk for Chagas disease	radio (Matrix) 1 Not a barrier at all 0 2 Minor barrier 1 3 Moderate barrier 2 4 Major barrier 3
21	[b2_how_order]	14. Lack of familiarity with how to order a Chagas screening test	radio (Matrix) 1 Not a barrier at all 0 2 Minor barrier 1 3 Moderate barrier 2 4 Major barrier 3
22	[b3_next_steps]	15. Lack of knowledge of what to do when a patient tests positive Chagas disease	radio (Matrix) 1 Not a barrier at all 0 2 Minor barrier 1 3 Moderate barrier 2 4 Major barrier 3
23	[thoughts]	Optional: Please share any comments or questions.	text
24	[interested]	Optional: Please provide your email if you are interested in learning more about Chagas disease.	text
25	[improve]	Optional: How can screening and referral for treatment for Chagas disease be improved at your clinic/department?	text
26	[chagas_survey_screening_awareness_practices_and_pe_complete]	Section Header: *Form Status* Complete?	dropdown 0 Incomplete 1 Unverified 2 Complete

Supplemental Materials



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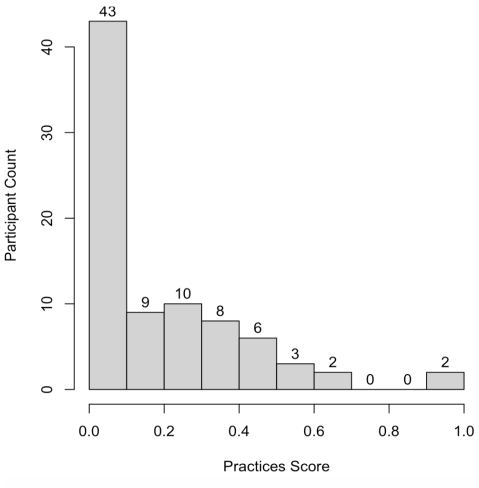

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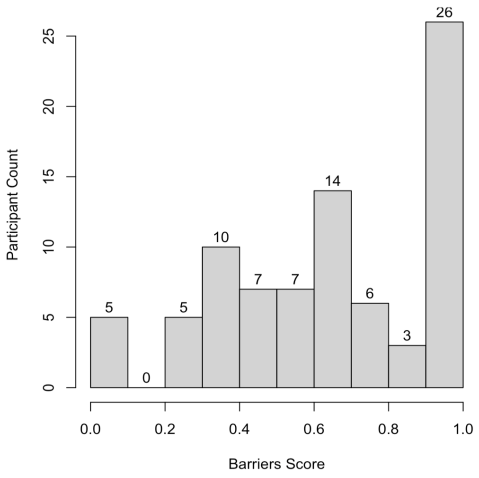

n=83

Histograms showing distribution of all participants' knowledge scores, practice scores, and perceived barriers scores.