

Review Article

Healthcare Workers' Knowledge about Chagas Disease: A Systematic Review

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Abstract. Transmission of Chagas disease (CD) has decreased in recent decades, but the disease remains an important problem in endemic areas. There was an increase in the proportion of nonvector transmission, mainly in non-endemic countries. The aim of this study was to gather evidence concerning healthcare professional's knowledge about CD. Searches were performed through Medline/PubMed, Lilacs, Web of Science databases, and Scielo archives, from which 13/97 articles were selected for a qualitative analysis after full-text reading. Most of the studies were from the United States, the oldest published in 2007 and the most recent in 2020, and most of them used surveys as the evaluation method. Each article used different methods, according to the epidemiological status of vector transmission. Two studies targeted specialty-related questions, and two used focus groups as methods for data gathering. Despite differences between the studies, all of them presented knowledge deficits among healthcare workers, regarding at least one of the evaluated aspects. In comparison with population surveys, healthcare professionals demonstrated higher results related to clinical aspects and awareness of the disease's importance. Most of the articles showed a low perception of CD's knowledge by the participants and a low probability of considering CD in the diagnosis of their patients. A previous contact with the subject was pointed by some studies as capable of improving knowledge of the participants. This study emphasizes the importance of continuing education to address deficits of healthcare professionals' knowledge.

INTRODUCTION

Human Chagas disease (CD) was discovered by Carlos Chagas in 1909, at Lassance, Minas Gerais, Brazil. He initially described its clinical aspects, transmission vectors, and its etiological agent, *Trypanosoma cruzi* (*T. cruzi*).^{1,2} Insects of the Reduviidae family are mainly responsible for vector transmission, from which about 140 species have been described as potential transmitters.³

In the 1980s, the HIV epidemic highlighted the known possibility of transfusion transmission of infectious diseases, including CD.⁴ Furthermore, better control of vector circulation allowed for other forms of transmission to gather more visibility. As globalization spread around the world, vertical transmission became a key epidemiologic issue among non-endemic countries.^{5,6} Besides, in the past years, oral transmission has also been responsible for causing outbreaks of acute CD.^{7–9}

Eight million people are estimated to be infected with CD around the world, with approximately 236,000 disability-adjusted life years (DALYs) mostly in Latin America, with more than 10,000 deaths/year.^{10,11} In South America, there are about 100 million people at risk of contracting CD, and 21 countries are endemic for the disease in the American continent.¹² In Brazil, for example, most recent data, from 2014, showed that about 4.6 million people are infected with *T. cruzi*.¹³

A health surveillance system must target on the development of epidemiologic control integrated actions as a tool on infectious disease prevention.¹⁴ A multi-professional healthcare team (physician, nurses, and nurse assistants) is essential for the health surveillance system to work and for proper guidance and health care of a community.¹⁵ Community health workers are also identified to have an important role in primary care,

connecting the community and the healthcare system.¹⁶ Falavigna-Guilherme et al.¹⁷ showed that initiatives targeting community and health workers' awareness can reduce the number of houses infested by the vector of CD. Thus, it is extremely important to verify the knowledge level of the health professionals about CD, as well as their capability on providing awareness for the community and development of interventions aiming the correction of local deficits. Training activities on the healthcare team are also necessary to improve their role as active agents on epidemiologic surveillance and prevention. This study aims to gather evidence about knowledge and perceptions about CD, as well as its transmission, diagnosis, prevention, and treatment by healthcare workers.

MATERIALS AND METHODS

A systematic review concerning healthcare workers' knowledge about CD and its transmission was conducted. Searches were performed through Medline/PubMed, Lilacs, and Web of Science databases, along with complementary gathering on SciELO electronic library until July 2020. In addition, references cited on selected articles were reviewed for further pertinent studies that matched the inclusion criteria. The report of this systematic review was based in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement guidelines criteria.¹⁸

Inclusion and exclusion criteria. Observational studies that evaluated healthcare workers' knowledge about CD, as well as its diagnosis, treatment, form of transmission, and prevention, were selected. Research involving healthcare workers such as physicians of any specialty, nurses, nurse assistants, or community health workers individually or as a multidisciplinary group were considered for selection. Not original articles, reviews, systematic reviews, editorials, letters, and commentaries were excluded. Languages were English, Spanish, and Portuguese, and date of publication was not considered for exclusion.

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Search strategy and selection of studies. To conduct the research, search strategies were constructed with subject headings based on MeSH for Medline/PubMed and DeCS for Lilacs databases and then combined with keywords to amplify search sensibility. The search strategy for PubMed was (“CD”[MeSH Terms] OR “*T. cruzi*”[MeSH Terms] OR “triatominae”[MeSH Terms] OR “CD”) AND (“Health personnel”[MeSH Terms] OR “Health personnel” OR “Allied health personnel” OR “Health Workers” OR “Nursing Assistants” OR nurses[Title/Abstract] OR Physicians[Title/Abstract] OR doctors [Title/Abstract] OR “Health professionals” OR “health care providers” OR “health agents” OR “health care”) AND (“Knowledge”[MeSH Terms] OR “health knowledge, attitudes, practice”[MeSH Terms] OR ([knowledge OR awareness OR attitudes] AND Chagas[Title/Abstract]) OR “awareness”[MeSH Terms] OR “Attitude to health”[MeSH Terms] OR “Education, public health professional”[MeSH Terms] OR “Attitude of health personnel”[MeSH Terms]). Then, the strategy was adapted for other databases according to their respective formats or languages.

Duplicates were excluded, and two reviewers performed a selection by title and abstract independently. Then, the selection was carried out after the full articles were pursued and read according to the inclusion criteria.

Quality evaluation and risk of bias. For evaluation of the methodological quality of included studies, a point system

tool adapted from Critical Appraisal Skills Program qualitative checklist was used¹⁹. According to Madigan et al.,²⁰ quality was considered based on the number of affirmative answers, being low quality (0–2), moderate quality (3–5), and high quality (more than 6).

Results’ evaluation and presentation. The results were divided according to vector transmission status of CD by the WHO Map Production, concerning distribution of cases.¹⁰ Thus, the studies were classified based on the country of data collection among the following: vector transmission in progress, accidental vector transmission, and absence of vector transmission.

Based on the CNS resolution no. 466/12, the ethics committee evaluation was waived.

RESULTS

A total of 97 articles were found, of which 80 were from PubMed/Medline, six from Lilacs, 10 from Web of Science, one from SciELO, and five were excluded for being duplicates. Of the 80 remaining studies, 19 articles were found eligible for the study. After reading full text, six articles had to be excluded. One was excluded because it was a replica of another selected article published in a different year and journal,²¹ another was excluded for being a preliminary study that was later published as a full article,²² and four articles were excluded for not meeting the inclusion criteria (not being an observational study,²³ do not evaluate CD knowledge^{17,24,25}).

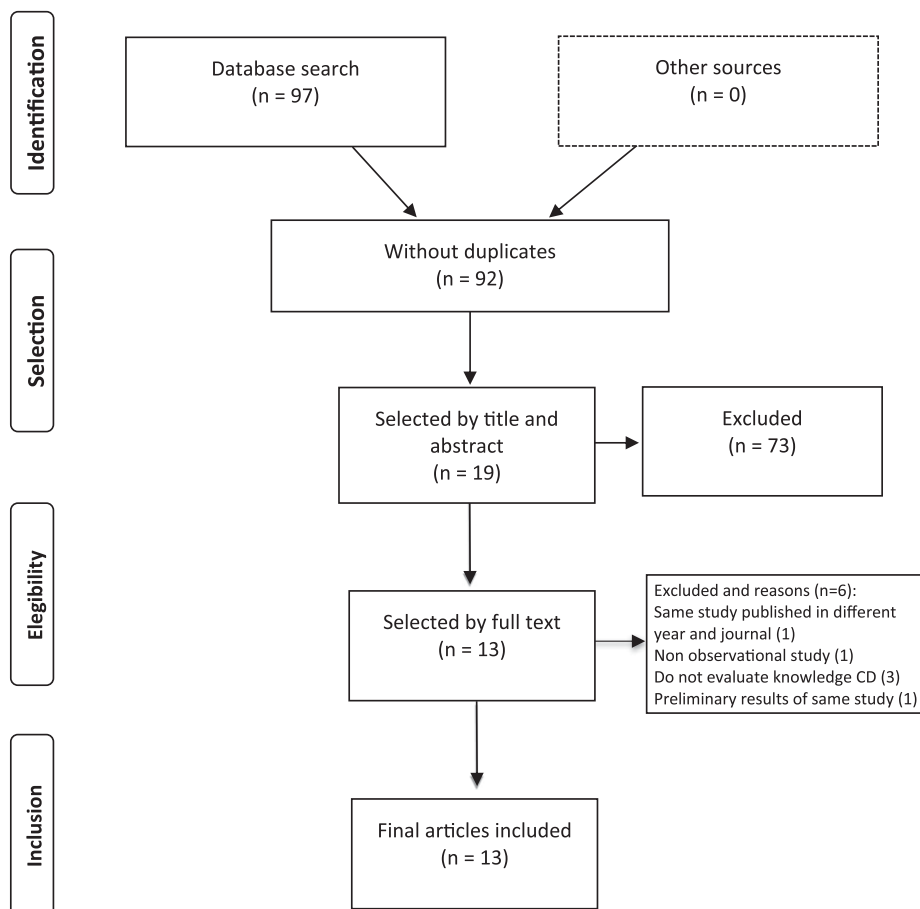


FIGURE 1. Flowchart of identification and selection of the articles used for systematic review of the literature about evaluation of health professionals’ knowledge about Chagas disease.

Finally, 13 articles were included in the descriptive analysis^{26–38} (Figure 1). Hand searches for additional references cited on selected articles did not result in further inclusion.

Among selected articles, the oldest was published in 2007 and the most recent in 2020. The most common language was English,^{26–31,34,36–38} followed by Spanish^{32,33} and Portuguese.³⁵

Studies in countries with accidental vector transmission.

There were five studies, all from the United States,^{26,29,31,36,38} with two of them being classified as high quality^{26,38} and the rest of them as moderate quality,^{29,31,36} as discriminated in Table 1. All studies were conducted through structured online surveys, except for Lambert et al.,³¹ who applied a semi-structured survey. The selected studies' samples were only composed by physicians—two of them with only specialists,^{29,38} two with specialists and general physicians,^{26,36} and one with only general physicians.³¹ The study by Verani et al.³⁸ was the only study to describe demographic characteristics of the sample.

Amstutz-Szalay,²⁶ Stimpert and Montgomery,³⁶ Verani et al.,³⁸ and Edwards et al.²⁹ evaluated how often do healthcare workers considerate CD as diagnosis (Table 2). All studies suggested that most physicians had never considered CD as a diagnosis among patients on their clinical practice (88.5%²⁶, 29–70%³⁶, 78%³⁸, 75.6%²⁹). In these studies, self-perception of knowledge about CD was considered, resulting in frequencies of limited and very limited knowledge, around 27–68%,³⁶ 82.8%,²⁶ and 88.3%,³⁸ 68.1%.²⁹ On the other hand, Edwards et al.²⁹ evaluated healthcare workers' knowledge about congenital transmission of CD. Lambert et al.³¹ showed that physicians from areas at higher risk of local accidental infection for CD were more likely to consider CD as diagnosis if the patients had Hispanic ethnicity. All authors evaluated healthcare workers' capability of identifying symptoms of the disease, except for Lambert et al.,³¹ and the worst result was in Verani et al.,³⁸ with only 32% correct answers among participants. Etiology was described by the same studies, and Verani et al.³⁸ also showed the worst frequency of correct answers about the etiological agent (58%).

Studies in countries with ongoing transmission. Five articles about studies in countries with ongoing vector transmission were found, of which three were from Mexico^{27,32,37} and two from Brazil.^{28,35} Qualitative analysis defined four studies as high quality^{27,32,35,37} and one²⁸ as moderate quality. All studies were conducted through structured surveys, administered by the researchers, except for Rodrigues et al.³⁵ who also used focus groups and recording methods to elucidate

conflicting results. Lugo-Caballero et al.³² and Berger et al.²⁷ were the only studies to validate the research instrument and perform a pilot study. For recruited sample, Lugo-Caballero et al.³² and Berger et al.²⁷ defined only physicians; Trivedi and Shangavi³⁷ defined only nurses; Colosio et al.²⁸ defined physicians, nurses, nurse assistants, and health workers; and Rodrigues et al.³⁵ defined only community health agents (Table 3). The study by Berger et al.²⁷ was the only study to describe social–epidemiologic characteristics of the sample.

All studies in countries with ongoing vector transmission analyzed clinical features, with an analysis in three of them at both acute and chronic phases of CD,^{27,28,35} in one of them only at the chronic phase,³⁷ and in another one only at the acute phase of the disease.³² All selected studies questioned forms of transmission, except for Rodrigues et al.³⁵ Trivedi and Shangavi³⁷ only mentioned the recognition of the insect vector, which was correctly identified among 27% of participants. Rodrigues et al.³⁵ investigated the ability to forward the suspected insects to a right destination, which were appointed as correct to 81.2% of the participants. The other studies of these countries evaluated the capability of identifying forms of transmission, which were incorrect in 52.6%²⁷ and 68%³² of participants. In the study by Colosio et al.,²⁸ only 21% of participants recognized vertical transmission. Treatment was evaluated in all studies from countries with ongoing vector transmission,^{27,28,32} except for Rodrigues et al.,³⁵ and its results were incorrectly pointed by 31%,²⁸ 41%,²⁷ and 52%³² of the responders, respectively. Diagnosis was correctly analyzed in 66%, 40%, and more than 50% of participants in the study by Colosio et al.,²⁸ Lugo-Caballero et al.,³² and Rodrigues et al.,³⁵ respectively. Most participants in the study by Rodrigues et al.³⁵ considered having satisfactory knowledge about CD, and 60.7% affirmed the healthcare team had knowledge over symptomatology.

Studies in countries without vector transmission. Three studies conducted in countries without vector transmission were selected, all from Spain.^{30,33,34} Qualitative analysis classified all articles as high quality. The evaluation method used by Muñoz-Vilches et al.³³ applied a structured interview-administered survey. The sample composed of physicians and nurses, and described demographic aspects involving age, gender, and years of professional experience. The variables were symptomatology, transmission, diagnosis, treatment, and epidemiology, with correct answers in 54.3%, 71.6%, 70.6%, 41.4%, and 56.9% of participants, respectively. Muñoz-Vilches et al.³³ were the only authors to investigate the knowledge of oral transmission in their survey. In

TABLE 1
Characteristics of all studies selected for systematic review by countries

Sample country	First author (year)	Type of study	No. of participants	Type of professional	Study quality (critical appraisal skills program)	Question model
USA	Amstutz-Szalay ²⁶	Cross-sectional	105	GP and SP	High (7/10)	Multiple choice
USA	Edwards et al. ²⁹	Cross-sectional	204	SP	Moderate (4/10)	Multiple choice
USA	Lambert et al. ³¹	Cross-sectional	22	GP	Moderate (5/10)	Open question
USA	Stimpert and Montgomery ³⁶	Cross-sectional	1,142	GP and SP	Moderate (5/10)	Multiple choice
USA	Verani et al. ³⁸	Cross-sectional	421	SP	High (7/10)	Multiple choice
Mexico	Lugo-Caballero et al. ³²	Cross-sectional	90	GP	High (8/10)	Multiple choice
Mexico	Berger et al. ²⁷	Cross-sectional	78	GP and SP	High (9/10)	Multiple choice
Mexico	Trivedi and Shangavi ³⁷	Cross-sectional	45	NUR	High (7/10)	Multiple choice
Brazil	Colosio et al. ²⁸	Cross-sectional	487	GP, SP, NUR, NA, and CHW	Moderate (5/10)	Multiple choice
Brazil	Rodrigues et al. ³⁵	Cross-sectional	65	CHW	High (8/10)	Multiple choice, field notes, and records
Spain	Muñoz-Vilches et al. ³³	Cross-sectional	116	SP and NUR	High (9/10)	Multiple choice
Spain	Iglesias-Rus et al. ³⁰	Cross-sectional	81	GP and NUR	High (8/10)	Field notes and records
Spain	Ramos Rincon et al. ³⁴	Cross-sectional	349	GP and MS	High (9/10)	Multiple choice

CHW = community health worker; GP = general physician; MS = medical students; NA = nursing assistant; NUR = nurse; SP = specialist physician.

TABLE 2
Aspects of the instruments used in the studies

Content aspects	Main types of questions by topic	Studies
Practical experience with the disease	Service experience How often and do you consider the diagnosis? How often do you investigate CD? How to orientate a patient when encountering an insect vector?	Amstutz-Szalay ²⁶ , Colosio et al. ²⁸ ; Edwards et al. ²⁹ ; Lambert et al. ³¹ ; Stimpert and Montgomery ³⁶ ; Verani et al., ³⁸ Rodrigues et al., ³⁵ Iglesias-Rus et al. ³⁰
Objective knowledge on clinical aspects	Do you know the disease? How is the diagnosis? What are the suggestive findings? What are the symptoms? What is the treatment and effects? What is the severity, evolution/prognosis?	Amstutz-Szalay ²⁶ , Colosio et al. ²⁸ ; Edwards et al. ²⁹ ; Lambert et al. ³¹ ; Stimpert and Montgomery ³⁶ ; Verani et al. ³⁸ ; Lugo-Caballero et al. ³² ; Muñoz-Vilches et al. ³³ ; Trivedi and Sanghavi, ³⁷ Ramos-Rincon et al., ³⁴ Rodrigues et al. ³⁵
Epidemiology	Prevalence/incidence? How common is it in the region? What is the geographical distribution? Is CD endemic in this region?	Amstutz-Szalay ²⁶ ; Edwards et al. ²⁹ ; Trivedi and Sanghavi, ³⁷ Ramos-Rincon et al. ³⁴
Transmission	What is the etiological agent? How is the transmission? Do you recognize the vector?	Colosio et al. ²⁸ ; Edwards et al. ²⁹ ; Stimpert and Montgomery ³⁶ ; Verani et al. ³⁸ ; Lugo-Caballero et al. ³² ; Muñoz-Vilches et al. ³³ ; Trivedi and Sanghavi, ³⁷ Ramos-Rincon et al. ³⁴
Self-assessment of knowledge	Opinions on aspects of the disease How do you evaluate yourself in capability to deal with CD?	Amstutz-Szalay ²⁶ ; Stimpert and Montgomery ³⁶ ; Verani et al. ³⁸ ; Muñoz-Vilches et al., ³³ Rodrigues et al. ³⁵

CD = Chagas disease.

comparison between workers' study groups, more correct answers were found among physicians than among nurses (93.6% and 68.1%, respectively).

Ramos-Rincon et al.³⁴ performed a survey with health students and residents. The instrument was designed and validated as Chagas Level of Knowledge Scale for medical and other health professionals. The study demonstrated differences between the mean number of correct answers of the group with health students and residents (7.0) from the potential aid workers' group (1.8). Only 23% of the health students and residents knew the treatment for CD; 59% knew that it could be transmitted congenitally. The results were better for the participants who had received information about CD previously (7.2 versus 4.3 correct answers).

Iglesias-Rus et al.³⁰ used a different approach by performing a qualitative research with focus groups and observation to evaluate the knowledge of family physicians and nurses. Physicians showed better knowledge than nurses, but they considered themselves as having insufficient knowledge. None of the participants mentioned the congenital transmission of CD. Previous contact with CD from research, experience with patients, and personal concern were appointed as factors that could justify for some participants to have broader knowledge about the disease.

Considering all analyzed studies, most were classified as high quality, and the articles from Mexico and Spain stand out, which were of high quality.^{27,30,32-34,37} All studies,²⁶⁻³⁸ independent of country of origin, presented both the need to improve perception of CD among healthcare workers and the lack of knowledge about aspects of CD (Table 4).

DISCUSSION

Healthcare workers' knowledge about CD is essential for adequate management and control of the infection through proper tracking and prevention. However, the topic is not being

well investigated according to the small number of studies found in our review, even though a broad literature search was performed. Furthermore, the studies adopted different types of questionnaires, mostly influenced by epidemiological characteristics and local needs of each study, hindering the expected synthesis of these results or comparisons.

The United States, which was defined as a country with accidental vector transmission, held most studies, as CD can be considered a concern especially because of the elevated immigration rates of Latin individuals from endemic areas of neglected tropical diseases (NTDs), and also because of an increase on infected newborns.³⁹ Thus, the higher rates of congenital infection for CD led to a greater need to amplify the awareness and knowledge for professionals who are not used to manage the disease.⁴⁰ Edwards et al.²⁹ and Verani et al.³⁸ prioritized medical specialists that were in major contact with congenitally infected patients.

The immigratory phenomena also influenced the spread of the disease in Europe, mostly in Spain, where there is a large number of Bolivian immigrants.⁴¹ Concern about the immigration impacts on healthcare systems also reflected in research founding, with an increase on European investments in NTDs in the last decade, including CD.⁴² Thus, a higher attention was provided to CD congenital infection, leading to confirmation of cost-effectiveness in screening of pregnant Hispanic women.⁴¹ However, unlike American studies, European studies did not prioritize vertical transmission, considering all general aspects of the disease, including vector transmission, even in a country without documented cases.^{30,33,34}

In South America, the reduction in vector transmission by *Triatoma infestans* among countries such as Brazil, Peru, and Uruguay leads to an evident epidemiological transition, especially increasing the importance of active surveillance for recognition of clinical signs and vectors by the general population.⁴³ Cross-sectional studies with population inquiries were performed to evaluate the community awareness and knowledge in historically affected regions.⁴⁴⁻⁵¹

TABLE 3
Characteristics of sample population of selected studies by setting

Study site	First author (year)	Type of profession	Setting	Targeting questions
Accidental vector transmission				
United States	Stimpert and Montgomery ³⁶	OB/GYN, infectologists, primary care givers, transplants doctors, and cardiologists	Online	General aspects
	Verani et al. ³⁸	OB/GYN	Online	Focused on specialty
	Edwards et al. ²⁹	Pediatric infectologists	Online	Focused on specialty
	Lambert et al. ³¹	Physicians in general	Online	General aspects
	Amstutz-Szalay ²⁶	Cardiologists, emergencists, and family physicians	Online	General aspects
Vector transmission in progress				
Mexico	Lugo-Caballero et al. ³²	Medical undergraduate on social service	Primary care	General aspects
	Trivedi and Sanghavi ³⁷	Blood bank screening nurses	Blood banks	General aspects
Brazil	Berger et al. ²⁷	Physicians	On-line	General aspects
	Colosio et al. ²⁸	Physicians, nurses, nursing assistants, and CHW	Primary care	General aspects
	Rodrigues et al. ³⁵	CHW	Primary care	General aspects
No vector transmission				
Spain	Muñoz-Vilches et al. ³³	Physicians and nurses	Public hospitals: Areas of Gynecology and pediatrics	General aspects
	Ramos-Rincon et al. ³⁴	Physicians, medical students, and health students	Health/student meetings	General aspects
	Iglesias-Rus et al. ³⁰	Familial physician and nurses	Primary care	General aspects
	Ramos-Rincón et al. ³⁴	Physician, medical and health students, and pharmacists	Health/student conferences and classes	General aspects

CHW = community health worker; OB/GYN = obstetricians and gynecologists.

Residents of endemic areas showed a good perception and capacity of identifying the vector, but generally they were not able to recognize the importance of the disease and its consequences to their health,^{44–49} except in Brazilian studies.⁵⁰ Thereby, proximity to routine local practice was determinant to increase awareness of the disease's existence, but it was not sufficient to engage people on prevention because individuals were not aware of the disease's implications, pointing to a knowledge deficit.^{44–49}

Brazilian studies showed a satisfactory knowledge about prevention, risk factors, and the vector related to the disease among the community. Despite that, even in areas with good results, Villela et al.⁵⁰ showed a decrease in knowledge among younger generations due to a longer time duration from the period when the disease was not yet controlled, reinforcing the need for continued education in risk areas.

Studies in ongoing vector transmission areas demonstrated better knowledge related to vectors, but not regarding other forms of transmission.^{27,28,32,35,37} Trivedi and Shangavi³⁷ estimated that the unfamiliarity with CD by nurses in blood banks' triages could be responsible for infecting around 600,000 blood bags before the nationwide mandate of screening for CD. Muñoz-Vilches et al.,³³ Iglesias-Rus et al.,³⁰ Ramos-Rincon et al.,³⁴ and Colosio et al.²⁸ demonstrated that medical workers tend to have more accurate answers regarding CD than nurses and other health workers. Because of the different types of questionnaires, the comparison between professionals was not possible in other studies.

Therefore, irrespective of forms of transmission and similarities with local routine, it is essential to include CD as a subject in develop continued education programs for health professionals, not only for improving their clinical practice and capability of recognizing CD but also for the ability of passing this knowledge to the community where they are allocated.¹⁷

Ramos-Rincon et al.,³⁴ Iglesias-Rus et al.,³⁰ and Berger et al.²⁷ showed that previous training can improve knowledge degree. The early identification can also reduce the financial burden to healthcare systems due to CD.⁵²

Regardless of the study area, there is a general lack of knowledge among health professionals about clinical and epidemiological aspects of CD.^{26–38} The worst results were related to self-perception of knowledge and consideration at diagnosis, with a need for interventions aiming the implementation of the staff confidence on diagnosis, especially among endemic regions. Otherwise, the review showed an increase tendency in research funding for CD higher than the disease burden of DALYS,⁵³ whereas American studies suggest the reappearance of CD.^{54–57} Thereby, training healthcare workers in promoting active surveillance of the community is presented as an effective strategy for prevention of the reappearance of the disease.

A limitation of this study was the small number of articles found in the literature, especially from endemic areas, even with most of them being classified as high-quality studies. Even though Latin American countries such as Peru, Argentina and Bolivia⁴³ present remarkable burden of CD, they did not perform studies regarding healthcare professionals' knowledge, impairing comparisons between endemic and non-endemic areas. One study suggested that web surveys or surveys sent by e-mail allow professionals to gather information about CD before they start answering the questions, what may result in an overestimation of their knowledge.³¹ The use of online questionnaires can also be associated with selection bias, as some responders could have been affected to subject preference or unawareness in the process of decision to participate. Furthermore, the questionnaires did not follow a standard model. They were different according to the epidemiologic area of the study, which impaired generalization and comparisons.

TABLE 4
Results and conclusions of studies

First authors (year)	Main results	Conclusions
Amstuz-Szalay ²⁶	82.8% with limited knowledge, 1% did not know the disease, 17.2% with excellent or good knowledge, and 88.5% did not consider CD as a possible diagnosis.	Need to increase translation services in the region and interventions aimed at increasing the likelihood of recognition of patients at risk for the disease.
Edward et al. ²⁹	99.5% knew that CD is caused by a parasite and 90.3% knew that cure rates for congenital CD exceed 90% when treatment is instituted in the first weeks of life. 50.2% considered themselves with "limited" knowledge and 17.9% "very limited." 80.9% reported that at least 1% of their patients were children of Latino immigrants, but 75.6% reported that they "never" or "rarely" considered a diagnosis of congenital CD in newborns of Latin American origin.	Increased awareness among members of the sampled society, as leaders in childcare, could lead to a diagnostic evaluation of at-risk babies and better long-term outcomes of congenital CD.
Lambert et al. ³¹	22 physicians responded to the study, eight classified CD as potential diagnosis, and 14 did not. Physicians who practice within the geographic range of higher risk for CD are more likely to consider it in the differential diagnosis of Hispanic patients than for Caucasian and African American patients ($P < 0.05$). Qualitative analysis revealed that travel history is a concern of some physicians.	It is necessary to outline the areas with the highest risk of transmission, followed by the implementation of an action plan that includes educating both the general population and public health officials.
Stimpert and Montgomery ³⁶	29–60% never considered the risk for CD in their patient population. The general lack of consciousness was common in all groups, more pronounced in obstetricians and gynecologists, and less pronounced in infectious disease physicians.	Substantial knowledge deficit on CD among health professionals, which could have a negative effect on patient health if CD is not recognized and adequately treated.
Verani et al. ³⁸	77% described their level of knowledge about CD as "very limited" or "never heard of." Although 66.9% reported that at least 1% of the population served is from Mexico, Central America, or South America, 78% reported "never" considering a diagnosis of CD among their patients in those regions. For five questions with defined correct answers, 61% provided at least one correct answer. Only 1% got the five questions right.	Increased awareness of CD can help detect treatable birth cases in the United States.
Lugo-Caballero et al. ³²	90% of participants had already diagnosed before a vector-borne disease; 68% consider it to be transmitted only by the vector. For 78.6% of physicians, a patient with asthenia, adynamia, and edematous eyelid injury may suggest a case of CD. 57% would consider using a chest X-ray to support the diagnosis of cardiomegaly.	Evidence justifies the establishment of a continuing education program on vector-borne diseases in areas of high endemicity, such as Mexico.
Berger et al. ²⁷	Knowledge of the basic clinical aspects of CD and screening practices differed if the interviewees had a history of previous training. Statistical difference in knowledge was observed based on the duration of medical practice or level of confidence in relation to knowledge of CD, with higher mean scores of knowledge and higher probability of screening.	Despite presenting better results than previous studies and from other countries, they concluded that further studies were still needed to be carried out and compared with educational measures.
Trivedi and Sanghavi ³⁷	80% of nurses responded to at least one question incorrectly or incompletely, and 13% of the nurses answered at least two questions incorrectly or incompletely.	Hypothesis that if 80% of nurses are unaware of the risk factors for CD, up to 600,000 units of blood in Mexico are not effectively screened each year.
Colosio et al. ²⁸	51% did not correctly relate the symptomatology of the acute phase, 65% correctly hit the chronic form, 96% said they requested the Machado-Guerreiro reaction to confirm the diagnosis of <i>Trypanosoma cruzi</i> infection, 98% of the physicians demonstrated clarification regarding the vector form, and 79% regarding transfusion. The congenital form was reported by 21% of these professionals.	There is a lack of knowledge of professionals from all classes working in primary care involved in the study, with regard to relevant aspects of the disease.
Rodrigues et al. ³⁵	75% consider professionals had satisfactory knowledge about CD, and 60.7% affirmed the health team knew the symptoms and above 50% knew the diagnostic examinations. 76% of the community health agents affirmed the health team knew how to forward suspected insect vector.	The study highlights the existence of gaps and unawareness of the health professionals about the primary care system associated with CD in the investigated cities.
Muñoz-Vilches et al. ³³	78.4% and 71.6% correctly adjusted the mechanisms of transmission and diagnosis, respectively. 54.3% of the professionals knew the clinical manifestations. 41.4% agreed to treat the disease, and 50% of the professionals knew that the treatment is more effective and better tolerated in children than adults.	"The lack of training in CD to care for pregnant women at risk of having the disease and their children makes it necessary to start training activities to expand this knowledge, as well as to raise awareness among health authorities."
Iglesias-Rus et al. ³⁰	Family physicians considered having insufficient knowledge of CD but had broader knowledge than nurses. Previous contact with the disease was associated with broader knowledge by the participants. Congenital transmission was not mentioned during the focus group discussions. Some of the participants mistake CD with Zika virus. Even in the absence of knowledge, some health workers demonstrated will to learn.	"The results show the lack of knowledge about CD, the epidemiology in a non-endemic country, and the heterogeneity of practices of primary care professionals in the management of this health problem"
Ramos-Rincon et al. ³⁴	The mean score of the healthcare students and residents was 7.0; 67.1% knew about transmission through blood transfusions, 59% knew about congenital transmission, and only 23% knew the drug used on the treatment of CD. Those with previous information about CD had better scores on the scale.	The application of the scale showed a higher rate of correct answers among those who had received previous information on CD. The study reaffirms the need to continue training on neglected tropical diseases in healthcare workers and students.

CONCLUSION

Chagas disease is an illness of global relevance, in which health surveillance plays an important role. This review shows that few studies were performed regarding healthcare workers' knowledge about CD. Most studies identified a lack of basic knowledge among the participants. There is a need for more studies about this subject, especially among areas in danger for the reappearance of the disease, so that resources and funding can be directed according to major deficits in each region.

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