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Review

Chagas Disease in Context: How Social, Economic, and Cultural Realities Shape Risk

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Abstract: Chagas disease remains one of the most pressing and under-addressed neglected tropical diseases in Latin America and beyond. While conventionally understood through a biomedical lens centered on vectors and reservoirs, the persistence and global spread of Chagas disease cannot be fully explained without considering the social, economic, and political structures that sustain vulnerability and hinder equitable access to care. This narrative review reframes Chagas disease risk by integrating the concepts of hazard, exposure, and vulnerability into a broader socioecological framework. We explore how poverty, migration, housing precarity, weak health systems, and fragmented public policies interact to shape transmission dynamics and clinical outcomes across endemic and non-endemic settings. We further examine how climate change, urban expansion, and global economic systems—particularly those driven by extractivism and neoliberal reforms—compound risk and limit institutional response. Drawing on multidisciplinary research and case studies from Latin America and migrant populations in the United States and Europe, we argue that addressing Chagas disease requires going beyond vector control and pharmaceutical interventions. It demands a structural approach that accounts for environmental degradation, institutional invisibility, and sociocultural disconnects between policy and community needs. We conclude with policy and research recommendations grounded in equity, transdisciplinarity, and human ecology. Our review contributes to a growing body of literature calling for the reconceptualization of neglected diseases as the product of biosocial processes, rather than isolated pathogenic events.

Keywords: *Trypanosoma cruzi*; social determinants of health; vulnerability; human ecology; neglected tropical diseases; health inequities

1. Introduction

Neglected tropical diseases (NTDs) comprise a diverse group of communicable diseases that predominantly affect populations in tropical and subtropical regions. These diseases disproportionately impact individuals living in poverty, with inadequate sanitation, and limited access to healthcare. As Brindley et al. [1] emphasize, NTDs are defined not only by their health burden but also by the social neglect that sustains their persistence—manifestations of deep-rooted inequities in political prioritization, funding, and healthcare systems. Notably, the term "neglected" does not imply that only marginalized groups are biologically susceptible. Rather, it highlights that while anyone residing within the geographic range of these pathogens may be at risk, it is socially and

economically marginalized who are least likely to receive timely testing, diagnosis, or treatment due to entrenched systemic barriers [2]. Furthermore, because NTDs primarily affect impoverished communities, they generate limited commercial incentives for pharmaceutical research and development. This has historically hindered the advancement of vaccines, diagnostic tools, and effective treatments [3]. Chagas disease, in particular, stands as a striking example of how enduring health disparities are not only medical challenges but also urgent matters of social justice and human rights; its control and elimination are essential not only for public health but for the fulfillment of basic human dignity and equity [4].

Among NTDs, Chagas disease (CD), caused by the protozoan parasite *Trypanosoma cruzi*, stands out as one of the most severe, complex, and geographically expanding infections. Traditionally concentrated in rural areas of Latin America, Chagas disease has long been associated with impoverished living conditions—such as mud walls, thatched roofs, and lack of basic services—that facilitate the proliferation of triatomine vectors. Current estimates indicate that 6 to 7 million people are infected globally, with approximately 10,000 deaths annually attributed to the disease and its complications [5,6]. While historical confined to Latin America, the burden of Chagas disease now extends to non-endemic regions—with significant numbers of cases detected in Spain, Germany, Australia, and other parts of Europe—largely due to migration and evolving socio-environmental dynamics [7,8].

Despite progress in vector control and blood transfusion safety, Chagas disease remains significantly overlooked in policy agendas, research funding, and healthcare delivery. It serves as a paradigmatic example of how infectious diseases become embedded within broader patterns of social vulnerability, disproportionately affecting marginalized and often invisible populations. The complexity of Chagas disease extends well beyond the parasite-vector-host dynamic, encompassing the socioecological determinants of exposure, systemic delays in diagnosis and treatment, and environmental disruptions that alter future transmission risks.

Understanding the socioeconomic burden of Chagas disease thus requires distinguishing three interrelated components of risk: hazard, exposure, and vulnerability [9,10]. Hazard refers to the biological presence of *T. cruzi* and competent triatomine vectors; exposure denotes the probability of human contact with these sources; and vulnerability encompasses the social, economic, and systemic factors that influence individuals' ability to avoid infection or access care once infected. These risk components are not evenly distributed, they are profoundly shaped by structural inequalities and environmental change.

This narrative review examines how socioeconomic determinants influence each dimension of Chagas disease risk across both endemic and non-endemic settings. It highlights emerging threats such as climate change, identifies critical gaps in public policy, and proposes integrated strategies to mitigate the burden of Chagas disease within the broader pursuit of global health equity.

2. Socioeconomic Determinants and Risk Components

The neoliberal economic model, with its emphasis on mass production and large-scale development, has driven extensive deforestation and environmental degradation. These processes have intensified interactions between humans, vectors, and wildlife reservoirs, contributing to the emergence and re-emergence of infectious diseases. Moreover, neoliberalism policies exacerbate economic inequality, increasing disease risk among vulnerable populations while simultaneously restricting their access to healthcare services [11]. As Rohr et al. [12] argue, the expansion of global food production—often achieved through forest conversion, habitat fragmentation, and intensified agriculture—has altered ecological systems in ways that increase the likelihood of zoonotic spillover. These landscape transformations, frequently linked to export-driven agro-industrial policies, not only reduce biodiversity but also create favorable conditions for the persistence and transmission of vector-borne diseases such as Chagas disease.

Risk analysis across general, particular, and individual levels provides a conceptual framework to understand the processes that drive disease emergence and identify integrated, sustainable interventions. At the general level, the economic system influence large-scale decisions that shape diseases risk. That particular level reflects ways of life tied to social class; while individual level encompasses personal choices and lifestyles (Table 1).

Hazard: The hazard associated with Chagas disease refers to the biological presence of *T. cruzi* and its triatomine vectors, and is strongly influenced by human-driven changes in biodiversity and land use [13]. Urbanization, for example, increases opportunities for contact between humans, parasites, and vectors. Triatomines are highly adaptable and can colonize fragmented and degraded environments. In urban and peri-urban settings, deteriorating housing structures can provide ideal refuges for triatomine bugs to shelter, feed, and reproduce. However, urban environments encompass a wide range of socioeconomic conditions, making it essential to examine how the interaction between urbanization patterns and living conditions influences house infestation rates and *Trypanosoma cruzi* infection in vectors—and, by extension, the risk of Chagas disease

transmission. For example, in the city of Cochabamba, Bolivia, it was found that wealthier northern neighborhoods with better infrastructure exhibited significantly lower infestation rates and *T. cruzi* prevalence in vectors compared to poorer southern zones with inadequate housing and services. These findings emphasize that urban areas should not be treated as homogeneous entities in risk assessments [14]. Meanwhile, rural and sylvatic environments present their own challenges, as populations living in or near forested areas may be exposed to sylvatic transmission cycles sustained by wild animal reservoirs and sylvatic triatomines. As demonstrated by Ibarra-Cerdeña et al. [9] in the Yucatán Peninsula, traditional agriculture, forest edge settlement, and resource extraction activities facilitate sustained interactions between humans and infected vectors in rural and forested settings. When human-inhabited regions intersect with the ecological range of *T. cruzi*, triatomines, and mammalian reservoirs—and contain a mosaic of sylvatic, rural, and urban landscapes—the hazard is significantly amplified due to the overlapping ecologies and mobility of both vectors, and hosts.

Table 1. Specific socioeconomic factors and their association with risk components.

Scale of Analysis	Hazard	Exposure	Vulnerability
Country–Regional (economic, political, social, environmental systems)	Production models Environmental degradation Loss of species diversity Increase in reservoir host populations Climate change Gentrification	Deforestation Agricultural and livestock expansion Urbanization Wildlife trade	Social inequality Centralized health policies Health budget allocation Chagas disease classified as an NTD
Local (cultural and community livelihoods)	Real estate development in ecologically sensitive areas Rural-to-urban migration	Subsistence activities (e.g., hunting) Night-time outdoor work in rural areas Poor housing maintenance Ineffective housing policy Shortages of diagnostic supplies	Informal employment Multiple job holding (pluriactivity) Place of residence Lack of access to reliable health information Absence of public health campaigns Misinformation Stigmatization
Individual (lifestyles and behavior)	—	Lack of preventive measures to avoid vector contact Lack of regular and deep home cleaning	Low perceived risk and susceptibility Lack of knowledge about transmission

Exposure: Exposure refers to the probability of human contact with infected vectors or contaminated sources. Socioeconomic factors influence exposure through occupational, domestic, and behavioral pathways. Agricultural workers are especially vulnerable due to overnight stays in infested shelters and proximity to sylvatic transmission cycles. In Bolivia, Azogue et al. [15] found that pregnant women engaged in agricultural labor had significantly higher seroprevalence of *T. cruzi*, increasing the risk of congenital transmission. In rural Mexico, Espinoza-Gómez et al. [16] observed that household practices—such as keeping domestic animals indoors—heightened exposure to triatomines. Deficiencies in public services, such as poor lighting, inadequate wall plastering, and lack of waste management, further exacerbated household exposure.

In urban settings, city expansion into remnants of native vegetation increases human-vector contact. This occurs in both high-income residential developments and informal settlements on the urban periphery. In Mérida, Yucatán, Guzmán-Tapia et al. [17] reported frequent sightings of *T. dimidiata* near vacant lots and vegetation patches regardless of resident' socioeconomic status. Additionally, Montes de Oca-Aguilar et al. [18] demonstrated that triatomines exhibit morpho-functional adaptations that allow them to persist across the rural–urban gradient, underscoring the entomological risk to unregulated urbanization. Thus, while vulnerability may differ across income groups, urban expansion itself is a structural driver of increased exposure.

Vulnerability: Vulnerability refers to the social and systemic capacity to prevent infection, access diagnosis, and manage disease progression. It is shaped by both structural conditions and individual health factors that shape health outcomes and perpetuate inequalities. A critical driver of vulnerability is the lack of awareness and health education—especially among healthcare providers. Despite the medical importance of *T. cruzi*, studies show widespread knowledge gaps even among trained personnel, leading to underdiagnosis, clinical mismanagement, and treatment delayed, particularly in non-endemic and underserved regions [19] Although continuing education efforts—such as webinars—can improve clinical awareness [20], such interventions remain sporadic and lack institutional permanence.

Vulnerability is further aggravated by comorbidities. Patients with Chagas disease often suffer from metabolic syndrome (e.g., hypertension, obesity, and dyslipidemia), which exacerbate the risk of cardiovascular complications and accelerate disease progression [21]. In patients with HIV, immunosuppression can trigger

reactivation of *T. cruzi* parasitemia, increasing mortality [22]. There is growing evidence suggesting that chronic *Trypanosoma cruzi* infection may be associated with increased cancer risk, particularly in the gynecological, gastrointestinal, and hematological systems, although a definitive causal link has not yet been established. Long-term infection can induce persistent inflammation, which may accelerate cycles of cell death and regeneration, promote DNA damage, and increase the likelihood of oncogene activation—all of which are biological mechanisms implicated in tumor development. The coexistence of Chagas disease and cancer may also complicate clinical management, potentially worsening prognosis and reducing the effectiveness of treatment in co-infected individuals [23]. These intersecting health conditions intensify clinical complexity and disproportionately affect already vulnerable populations.

Institutional barriers further heighten vulnerability. Jimeno et al. [24] reported that inconsistencies in diagnostic protocols, stigmatization by healthcare personnel, and lack of decentralized services dissuade individuals from seeking care in Bolivia. Similarly, Aké-Chan et al. [25] found that in southeast Mexico, public health interventions often fail to reach rural and Indigenous communities due to poor implementation and lack of political will. Beyond limiting access, stigma and misinformation have concrete effects on patient behavior: fear of being discriminated against by providers, or labeled as "unproductive" or "contagious," leads many to postpone or avoid diagnosis and treatment [5,26]. These experiences are reinforced by xenophobic attitudes in migrant settings, where Chagas disease is associated with poverty and foreignness, creating additional barriers to continuity of care [26,27]. In this context, vulnerability is not simply a function of biological susceptibility—it is the product of systemic neglect and social exclusion, perpetuated by fragile health systems and the invisibility of affected populations in policy agendas. Addressing these challenges requires anti-stigma campaigns explicitly designed to counter misinformation and xenophobia, while promoting inclusive narratives that recognize the rights and dignity of those living with Chagas [27].

3. Structural Drivers and Policy Implications

Crucially, the risk of *T. cruzi* infection cannot be explained solely by individual behaviors or environmental exposure. It is embedded in broader macroeconomic and sociopolitical structures. Despite growing evidence of its urban spread and ecological complexity, Chagas disease is still largely framed as a rural problem of poor housing. This reductionist narrative reinforces stigma, obscures structural determinants and undermines culturally appropriate interventions [27–29]. Such framing also leads to misguided policies. Programs that replace housing based on construction materials risk ignoring the cultural significance of traditional architecture. As Mandrini et al. [30] argue, these initiatives often fail to achieve long-term vector control and may alienate communities by disregarding local knowledge. For individuals capable of gestation, the possibility of congenital transmission further compounds emotional, psychological and social burdens [29,31].

Moreover, many surveillance systems diagnostic to areas with confirmed vector presence, neglecting the effects of urbanization, migration, and deforestation on disease dynamics. These blind spots deepen uncertainty and perpetuate neglect. As Buekens et al. [32] emphasize, insufficient integration of Chagas disease into national health agendas—especially for women and migrants—reinforces clinical and health inequities.

These patterns of neglect are further compounded by systemic under-recognition in urban and non-endemic settings. In the United States alone, over 300,000 individuals are estimated to live with *T. cruzi* infection—yet awareness among healthcare professionals remains strikingly low, and Chagas disease is rarely included in differential diagnoses, even among cardiac patients at risk [33]. National screening programs are lacking, and most detection relies on blood donor screening, which misses vast portions of the vulnerable population. Similarly, the RAISE study underscores how the disease's chronic nature and diagnostic dissociation from early-life infection render it practically invisible in routine health surveillance and mortality statistics—even among patients dying from Chagas cardiomyopathy [34]. This institutional invisibility persists even in highly urbanized and industrialized healthcare systems, highlighting the need to reframe Chagas disease not only as a tropical rural issue, but as a chronic,transnational, and urban health concern.

Migration status is another key determinant of vulnerability. In non-endemic countries like the United States, Latin American immigrants face multiple barriers to healthcare, including lack of insurance, fear of deportation, legal documentation, and culturally inappropriate services. Hyson et al. [35] found that despite clear clinical guidelines, Chagas disease is vastly underdiagnosed among migrant populations, leading to silent progression of cardiac disease. Undocumented Latin American immigrants, may avoid seeking care—even when symptomatic—due to fear of legal repercussions, thereby reinforcing cycles of invisibility and untreated diseases [36].

4. Comparative Contexts: Endemic and Non-Endemic Regions

The epidemiology of Chagas disease varies markedly between endemic and non-endemic regions due to differences in environmental, socioeconomic, and health system factors that influence hazard, exposure, and vulnerability. In endemic countries such as Bolivia, Mexico, and Brazil, the hazard remains closely associated with the presence of triatomine vectors in domestic and peri domestic settings. Rural low-income housing—particularly homes constructed with unplastered adobe walls, thatched roofs, and dirt floors—often provide ideal habitats for vector colonization [16,37]. For example, a study conducted in rural Argentine Chaco found that households with cracked walls and proximity to animal enclosures had triatomine infestation rates up to three times higher than those with reinforced or modernized housing [37]. Similarly, in the Yucatán Peninsula of Mexico, Waleckx et al. [38] documented how rural indigenous communities, particularly among Mayan populations, exhibited sustained high exposure risks due the proximity of houses to vegetation, artificial lighting, and the presence of domestic animals that act as reservoirs of the parasite.

Environmental degradation also plays a crucial role. Agricultural expansion, deforestation, and the disruption of sylvatic ecosystems increase human-vector contact by displacing triatomine populations into human-modified environments [39]. These land-use changes exacerbate exposure, particularly among agricultural workers and indigenous populations dependent on subsistence farming.

In non-endemic regions, such as the United States and Spain, the principal hazard stems not from autochthonous vector transmission but from the introduction of chronic *T. cruzi* infections through human migration. In the United States, it is estimated that over 300,000 people, primarily from Latin America, are living with chronic Chagas disease [7,35]. Although competent triatomine vectors are present in the southern states, sustained autochthonous transmission is considered rare and likely under detected due to limited surveillance and low clinician awareness [40].

Exposure in non-endemic countries is largely related to congenital transmission, blood transfusions, and organ transplantation. Screening vary across countries: while Spain has implemented national-level blood donor and prenatal screening initiatives [41], the United States lacks a universal approach, relying on targeted screening in some states and blood banks [7,42].

Vulnerability among migrants in non-endemic settings is strongly shaped by systemic barriers. Hyson et al. [35] and Montgomery et al. [7] noted that Latin American migrants often face legal insecurity, language barriers, economic exclusion, and healthcare system discrimination, all of which hinder timely diagnosis and treatment. Furthermore, fear of deportation discourages undocumented individuals from accessing healthcare services, even when symptomatic [36].

Alarmingly, up to 99% of *T. cruzi*-infected individuals living in the U.S. are estimated to remain undiagnosed [35]. Similar patterns are observed in Spain, where despite proactive screening measures, undocumented migrants often fall outside formal health systems, contributing to the silent transmission of congenital Chagas disease [41].

In both endemic and non-endemic regions, social determinants—including poverty, housing precarity, health system inequities, and migration status—are central to understanding who is most risk and least protected from Chagas disease.

5. Climate Change and Emerging Risks

Climate change introduces a complex and multidimensional risk facto to Chagas disease by reshaping ecological dynamics of transmission and intensifying underlying social vulnerabilities. Rising temperatures, altered precipitation patterns, and increased climatic variability are predicted to expand the geographic range of triatomine vectors into areas historically considered unsuitable for vector survival and parasite transmission [43]. In North America, projections suggest that several triatomine species, including *Triatoma sanguisuga* and *T. gerstaeckeri*, could shift their distribution northward into new ecological niches in response to warming trends [43]. Similar trends are expected in South America, where vector ranges could extend into cooler, previously protected highland areas.

However, climate change impacts on Chagas disease are not limited to biological vector range shifts. It also interacts closely with social determinants of health, amplifying exposure and vulnerability in historically marginalized populations. Populations already burdened by poverty, precarious housing, and limited healthcare access are disproportionately exposed to climate-related stressors such as extreme heat, droughts, floods, and hurricanes [43]. These environmental shocks often drive rural communities to migrate to urban peripheries, where they settle in informal, poorly serviced neighborhoods that replicate ecological and social conditions conducive to vector-human contact while restricting access to health services.

Lessons from other neglected tropical diseases reveal how climate-driven rural-to-urban migration can intensify disease transmission; for example, in Dhaka, climate-driven expansions of *Aedes* mosquito habitats has intensified dengue transmission in densely populated informal settlements [44], Likewise, environmental disruptions have triggered cutaneous leishmaniasis outbreaks among displaced populations [45], while modeling studies on lymphatic filariasis demonstrate how hurricanes and climate crises further erode resilience by overwhelming basic urban services [46].

Thus, climate change not only modifies biological hazard but increases exposure through environmental displacement and deepens vulnerability by weakening health systems and exacerbating social inequities. Integrating climate-related risks into surveillance, prevention, and control efforts must be a central component of future Chagas disease control strategies.

6. Policy Gaps: Fragmentation between Policy and Reality

Despite decades of targeted efforts to control Chagas disease, major policy gaps persist in both endemic and non-endemic countries, reinforcing social vulnerabilities and perpetuating transmission cycles. In endemic regions of Latin America, many national programs have prioritized vector control and blood transfusion safety, largely focusing on interrupting acute-phase transmission [47]. However, these interventions have often been inconsistent, short-term, and poorly integrated with broader health system strengthening. For example, in Yucatán, Mexico, Aké-Chan et al. [25] demonstrated that while insecticide spraying campaigns exist, systematic surveillance for chronic cases, congenital transmission detection, and patient follow-up lack continuity and institutional coordination, particularly in rural and indigenous areas. Thousands of infected individuals remain undiagnosed and untreated despite formal Chagas control policies. In Bolivia, where Chagas prevalence is among the highest worldwide, vector control has reduced house infestation in some areas. Yet diagnosis and treatment access remain severely limited, especially in rural communities [24]. The availability of treatment relies on external drug donation programs, underscoring the absence of sustainable national procurement mechanisms [48].

In non-endemic regions, such as the United States, policy gaps manifest differently. There is no comprehensive national screening strategy for risk populations, including blood donors, pregnant women, or organ recipients [7,42]. Although some states have partial initiatives, migrants often face enormous barriers—fear of deportation, lack of insurance, and low awareness among clinicians [49]. Even among diagnosed cases, access to treatment remains limited and inconsistent [36]. In Spain, despite proactive screening policies [36], undocumented migrants remain at higher risk of being excluded from preventive care [45].

Crucially, many public health policies conceptualize Chagas disease primarily through a biomedical lens, overlooking the structural drivers—such as poverty, exclusion, and migration—that sustain vulnerability [25]. Program fragility is compounded by funding volatility, as many Chagas initiatives depend on temporary external support instead of long-term inclusion in national health budgets [8].

The COVID-19 pandemic starkly revealed the fragility of health systems and the vulnerability of neglected tropical disease (NTD) programs to multidimensional shocks. Modeling studies have shown that control efforts across seven NTDs were significantly disrupted as resources were diverted during the pandemic, creating "windows of opportunity" for increased disease transmission [50]. Echoing this, NTDs have been proposed as critical indicators of pandemic preparedness, underscoring that health system resilience cannot be achieved without their explicit integration into preparedness frameworks [51]. For Chagas disease in particular, the COVID-19 pandemic led to a marked reduction in screening and treatment access—especially for congenital transmission—due to overwhelmed health systems, workforce reassignments, and the prioritization of acute pandemic response efforts [52]. As further emphasized by Zaidel et al. [52], the absence of Chagas care within routine primary healthcare frameworks left patients especially vulnerable, exacerbating long-standing disparities in diagnosis and treatment throughout the crisis.

Simultaneously, climate change compounds these challenges: environmental shifts in temperature and humidity are projected to expand Chagas transmission zones, especially in marginalized regions, while climate-induced migration and extreme weather events disrupt surveillance and continuity of care [43]. Together, these crises—pandemic, economic disruption, climate instability, and displacement—expose deep systemic weaknesses while heightening infectious disease risk. It follows that preparedness strategies for future crises must include neglected diseases like Chagas as integral components, rather than peripheral concerns.

7. Conclusions and Recommendations

Chagas disease continues to impose a significant and persistent socioeconomic burden across endemic and non-endemic regions, shaped by the dynamic interaction of hazard, exposure, and vulnerability. While biological

factors such as the presence of *T. cruzi* and its triatomine vectors define the biological potential for transmission, it is poverty, systemic exclusion, fragmented healthcare policies, and environmental disruption that ultimately determine real-world transmission patterns and disease outcomes.

Climate change acts as a powerful risk amplifier, by expanding triatomine vector distribution and intensifying social vulnerabilities that elevate exposure and hinder access to care. Evidence from Chagas and other neglected tropical diseases highlights the urgent need to incorporate social vulnerability and climate resilience into public health strategies.

Persistent policy gaps—including the failure to implement systematic congenital screening, fragmented surveillance, weak integration of Chagas management into primary healthcare, and underfunded control programs—continue to perpetuate cycles of neglect.

Understanding the risk of *T. cruzi* transmission requires an integrative perspective that goes beyond isolated biological or behavioral explanations. Drawing from a human ecology framework, we interpret hazard, exposure, and vulnerability as co-constructed through the dynamic interactions between ecological systems, human practices, and structural conditions. This perspective acknowledges that zoonotic disease risk emerges from coupled socio-ecological processes and that the determinants of infection cannot be fully understood without considering how landscapes, livelihoods, and institutional contexts shape contact between vectors, hosts, and humans [10].

To overcome these challenges, future efforts must adopt a holistic, integrated, and equity-oriented approach, including:

- Strengthening and Integrating Surveillance Systems: This includes implanting active case-finding strategies across rural, peri-urban, and migrant communities; establishing mandatory congenital screening for pregnant individuals form endemic regions; creating robust registries of diagnosed cases; and ensuring consistent long-term clinical follow-up through universal healthcare systems. Surveillance should also be decentralized and community-engaged to ensure timely detection and responsiveness.
- Community-Based Housing and Vector Control Programs: Vector control efforts must be grounded in participatory, culturally appropriate housing improvement initiatives that involve affected communities in decision-making and implementation. These programs should address structural risk factors—such as wall plastering, roofing material, and animal enclosures—while linking to broader poverty-reduction strategies including access to sanitation, land rights, and sustainable livelihoods.
- Health Systems Strengthening: Chagas diagnosis, treatment, and patient support services must be fully integrated into national primary healthcare systems. This includes training frontline providers, decentralizing diagnostics and treatment, ensuing drug availability, and promoting culturally competent care. In parallel, anti-stigma campaigns must address xenophobia and misinformation that hinder migrant populations from seeking care, especially in non-endemic regions.
- Climate-Resilient Public Health Strategies: Public health strategies must proactively incorporate Chagas disease risk into national and regional climate adaptation plans. This involves anticipating vector range shifts, strengthening urban planning to reduce informal settlements near vegetated areas, integrating vector risk into disaster preparedness frameworks, and ensuring continuity of care during climate-related emergencies such as floods or droughts.
- Political Commitment and Sustainable Financing: Addressing Chagas disease requires sustained domestic investment in prevention, care, and research—moving beyond dependence on temporary or donor-driven programs. National policies should ensure that Chagas disease is prioritized in health budgets, with long-term strategies supported by intersectoral collaboration across ministries of health, housing, environment, and migration. Clear accountability mechanisms and community participation are essential.

Addressing Chagas disease demands confronting the structural inequities, governance failures, and environmental injustices that sustain it. Only by recognizing Chagas as both a biological and social disease can we chart a path toward lasting control, equity, and health justice.

Author Contributions

M.A.-C.: conceptualization, investigation, formal analysis, methodology, writing—original draft, writing—review & editing; A.C.: conceptualization, investigation, writing—review & editing; A.A.: conceptualization, investigation, writing—review & editing; C.N.I.-C.: conceptualization, investigation, formal analysis, methodology, project administration, resources, supervision, validation, writing—original draft, writing—review & editing. All authors have read and agreed to the published version of the manuscript.

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References

1. Brindley, P.J.; Bethony, J.; Hotez, P.J. What are neglected tropical diseases? *PLoS Negl. Trop. Dis.* **2022**, *16*, e0010210.
2. Hotez, P.J.; Molyneux, D.; Fenwick, A.; et al. Control of neglected tropical diseases. *N. Engl. J. Med.* **2007**, *357*, 1018–1027.
3. Trouiller, P.; Olliaro, P.; Torreele, E.; et al. Drug development for neglected diseases: A deficient market and a public-health policy failure. *Lancet* **2002**, *359*, 2188–2194.
4. Franco-Paredes, C.; Von, A.; Hidron, A.; et al. Chagas disease: An impediment in achieving the Millennium Development Goals in Latin America. *BMC Int. Health Hum. Rights* **2007**, *7*, 7.
5. Gómez-Ochoa, S.; Rojas, L.; Echeverría, L.; et al. Global, regional, and national trends of Chagas disease from 1990 to 2019: Comprehensive analysis of the global burden of disease study. *Glob. Heart* **2022**, *17*, 59.
6. Bern, C. Chagas' disease. *N. Engl. J. Med.* **2015**, *373*, 456–466.
7. Montgomery, S.; Starr, M.; Cantey, P.; et al. Neglected parasitic infections in the United States: Chagas disease. *Am. J. Trop. Med. Hyg.* **2014**, *90*, 814.
8. Gascon, J.; Bern, C.; Pinazo, M. Chagas disease in Spain, the United States and other non-endemic countries. *Acta Trop.* **2010**, *115*, 22–27.
9. Valdez-Tah, A.; Huicochea-Gómez, L.; Ortega-Canto, J.; et al. Social Representations and Practices Towards Triatomines and Chagas Disease in Calakmul, México. *PLoS ONE* **2015**, *10*, e0132830.
10. Ibarra-Cerdeña, C.N.; González-Martínez, A.; Valdez-Tah, A.; et al. Tackling Exposure to Chagas Disease in the Yucatán from A Human Ecology Perspective. In *Culture, Environment and Health in the Yucatán Peninsula*, 1st ed.; Springer: Cham, Switzerland, 2019; pp. 293–325.
11. Breilh, J. *Critical Epidemiology and the People's Health*; Oxford University Press: Oxford, UK, 2021.
12. Rohr, J.; Barrett, C.; Civitello, D.; et al. Emerging human infectious diseases and the links to global food production. *Nat. Sustain.* **2019***, 2*, 445–456.
13. Glidden, C.; Nova, N.; Kain, M.; et al. Human mediated impacts on biodiversity and the consequences for zoonotic disease spillover. *Curr. Biol.* **2021**, *31*, R1342–R1361.
14. Medrano-Mercado, N.; Ugarte-Fernandez, R.; Butrón, V.; et al. Urban transmission of Chagas disease in Cochabamba, Bolivia. *Mem. Inst. Oswaldo Cruz* **2008**, *103*, 423–430.
15. Azogue, E. Women and congenital Chagas' disease in Santa Cruz, Bolivia: Epidemiological and sociocultural aspects. *Soc. Sci. Med.* **1993**, *37*, 503–511.
16. Espinoza-Gómez, F.; Rojas-Larios, F.; Zavala-Cerna, N.; et al. Socioeconomic determinants of Chagas disease in western Mexico. *Adv. Prev. Med. Health Care* **2022**, *5*,1032.
17. Guzmán-Tapia, Y.; Ramírez-Sierra, M.; Dumonteil, E. Urban infestation by Triatoma dimidiate in the city of Mérida, Yucatán, México. *Vector-Borne Zoonotic Dis.* **2007**, *7*, 597–606.
18. Montes de Oca-Aguilar, A.; González-Martínez, A.; Chan-González, R.; et al. Signs of Urban Evolution? Morpho-Functional Traits Co-variation Along a Nature-Urban Gradient in a Chagas Disease Vector. *Front. Ecol. Evol.* **2022**, *10*, 805040.

19. Cajaiba-Soares, A.; Martinez-Silveira, M.; Paim Miranda, D.; et al. Healthcare Workers' Knowledge about Chagas Disease: A Systematic Review. *Am. J. Trop. Med. Hyg.* **2021,** *104*, 1631–1638.
20. Stigler, P.; Pacheco, G.; Núñez, E.; et al. Assessing the effectiveness of Chagas disease education for healthcare providers in the United States. *BMC Infect. Dis*. **2020**, *20*, 743.
21. Rocha, M.; Teixeira, M.; Ribeiro, A. An update on the management of Chagas cardiomyopathy. *Expert Rev. Anti-Infect. Ther.* **2007**, *4*, 727–743.
22. Shikanai-Yasuda, M.; Mediano, M.; Novaes, C.; et al. Clinical profile and mortality in patients with *T. cruzi*/HIV co-infection from the multicenter data base of the "Network for healthcare and study of *Trypanosoma cruzi*/HIV co-infection and other immunosuppression conditions". *PLoS Negl. Trop. Dis.* **2021**, *15*, e0009809.
23. Franco, P.I.; do Carmo Neto, J.R.; Miguel, M.P.; et al. Cancer and *Trypanosoma cruzi*: Tumor induction or protection? *Biochimie* **2023**, *207*, 113–121.
24. Jimeno, I.; Mendoza, N.; Zapana, F.; et al. Social determinants in the access to health care for Chagas disease: A qualitative research on family life in the "Valle Alto" of Cochabamba, Bolivia. *PLoS ONE* **2021**, *16*, e0255226.
25. Aké-Chan, M.; Sanmartino, M.; Castillo-Burguete, M.; et al. (In)coherence between Chagas disease policy and the experiences of those affected in Mexico: The need for a transdisciplinary approach. *PLoS Negl. Trop. Dis*. **2025**, *19*, e0013052.
26. Forsyth, C.J.; Stigler, P.; Pacheco, G.; et al. Current Gaps and Needs for Increasing Access to Healthcare for People with Chagas Disease in the USA. *Curr. Trop. Med. Rep.* **2019**, *6*, 13–22.
27. Sanmartino, M.; Avaria, A.; Gómez i Prat, J.; et al. Do not be afraid of us: Chagas disease as explained by people affected by it. *Interface* **2015**, *19*, 1063–1075.
28. Ventura-Garcia, L.; Roura, M.; Pell, C.; et al. Sociocultural aspects of Chagas disease: A systematic review of qualitative research. *PLoS Negl. Trop. Dis.* **2013**, *7*, e2410.
29. Ventura-Garcia, L.; Muela-Ribera, J.; Martínez-Hernández, A. Chagas, Risk and Health Seeking among Bolivian Women in Catalonia. *Med. Anthropol.* **2021**, *40*, 541–556.
30. Mandrini, M.; Cejas, N.; Bazán, A. Erradicación de ranchos, ¿Erradicación de saberes? Reflexiones sobre la región noroeste de la Provincia de Córdoba, Argentina. *An. Del. IAA* **2018**, *48*, 83–94.
31. Avaria, A.; Plaza, C. Health experiences of pregnant and women with chagas disease in the Atacama, Tarapaca, and Metropolitan regions of Chile. Mistreatment as an indicator of healthcare barriers. *PLoS ONE* **2024**, *19*, e0313498.
32. Buekens, P.; Cafferata, M.L.; Alger, J.; et al. For The Congenital Chagas Working Group. Congenital Transmission of *Trypanosoma cruzi* in Argentina, Honduras, and Mexico: An Observational Prospective Study. *Am. J. Trop. Med. Hyg*. **2018**, *98*, 478–485.
33. Ayres, J.; Marcus, R.; Standley, C.J. The Importance of Screening for Chagas Disease Against the Backdrop of Changing Epidemiology in the USA. *Curr. Trop. Med. Rep.* **2022**, *9*, 185–193.
34. Ribeiro, A.L.; Machado, Í.; Cousin, E.; et al. The burden of Chagas disease in the contemporary world: The RAISE study. *Glob. Heart* **2024**, *19*, 2.
35. Hyson, P.; Barahona, L.V.; Pedraza-Arévalo, L.C.; et al. Experiences with Diagnosis and Treatment of Chagas Disease at a United States Teaching Hospital-Clinical Features of Patients with Positive Screening Serologic Testing. *Trop. Med. Infect. Dis*. **2021**, *6*, 93.
36. Bern, C.; Montgomery, S.P.; Herwaldt, B.L.; et al. Evaluation and Treatment of Chagas Disease in the United States: A Systematic Review. *JAMA* **2007**, *298*, 2171–2181.
37. Fernández, M.D.; Gaspe, M.S.; Gürtler, R.E. Inequalities in the social determinants of health and Chagas disease transmission risk in indigenous and creole households in the Argentine Chaco. *Parasites Vectors* **2019**, *12*, 184.
38. Waleckx, E.; Camara-Mejia, J.; Ramírez-Sierra, M.; et al. An innovative ecohealth intervention for Chagas disease vector control in Yucatan, Mexico. *RSTMH* **2015**, *109*, 143–149.
39. Santos, W.S.; Gurgel-Gonçalves, R.; Garcez, L.M.; et al. Deforestation effects on Attalea palms and their resident Rhodnius, vectors of Chagas disease, in eastern Amazonia. *PLoS ONE* **2021**, *16*, e0252071.
40. Valdez-Tah, A.; Ibarra-Cerdeña, C.N. Call to action: Chagas disease risk in California (1916–2018). *PLoS Negl. Trop. Dis.* **2021**,*15*, e0009035.
41. Imaz-Iglesia, I.; García-San Miguel, L.; Ayala-Morillas, L.; et al. Economic evaluation of Chagas disease screening in Spain. *Acta Trop.* **2015**, *148*, 77–88.
42. Montgomery, S.P.; Parise, M.E.; Dotson, E.M.; et al. What do we know about Chagas disease in the United States? *Am. J. Trop. Med. Hyg*. **2016**, *95*, 1225–1227.
43. Forsyth, C.; Higuita, N.; Hamer, S.; et al. Climate change and *Trypanosoma cruzi* transmission in North and central America. *Lancet Microbe* **2024**, *5*, 100946.
44. McMichael, C. Climate change-related migration and infectious disease. *Virulence* **2015**, *6*, 548–553.

45. Bamorovat, M.; Sharifi, I.; Aflatoonian, M.; et al. A prospective longitudinal study on the elimination trend of rural cutaneous leishmaniasis in southeastern Iran: Climate change, population displacement, and agricultural transition from 1991 to 2021. *Sci. Total Environ.* **2024**, *913*, 169684.
46. Oscar, R.; Lemoine, J.; Direny, A.N.; et al. Haiti National Program for the Elimination of Lymphatic Filariasis A Model of Success in the Face of Adversity. *PLoS Negl. Trop. Dis*. **2014,** *8*, e2915.
47. Dias, J.; Silveira, A.; Schofield, C. The impact of Chagas disease control in Latin America: A review. *Mem. Inst. Oswaldo Cruz*. **2002**, *97*, 603–612.
48. Jannin, J.; Villa, L. An overview of Chagas disease treatment. *Mem. Inst. Oswaldo Cruz*. **2007**, *102*, 95–98.
49. Requena-Méndez, A.; Albajar-Viñas, P.; Angheben, A.; et al. Health Policies to Control Chagas Disease Transmission in European Countries. *PLoS Negl. Trop. Dis*. **2014**, *8*, e3245.
50. Borlase, A.; Le Rutte, E.A.; Castaño, S.; et al. Evaluating and mitigating the potential indirect effect of COVID-19 on control programmes for seven neglected tropical diseases: A modelling study. *Lancet Glob. Health* **2022**, *10*, e1600–e1611.
51. Ehrenberg, N.; Ehrenberg, J.; Fontes, G.; et al. Neglected tropical diseases as a barometer for progress in health systems in times of COVID-19. *BMJ Glob. Health* **2021**, 6, e004709.
52. Zaidel, E.; Forsyth, C.; Novick, G.; et al. COVID-19: Implications for people with Chagas disease. *Glob. Heart* **2020**, *15*, 69.