Globalization of Chagas Disease: an update

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Amsterdam, Netherlands, April 12, 2016
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Commercial relations disclosure

- In the last ten years I had the following commercial/funding relationships with the below mentioned companies/organizations:
  - FUNDACREDESA
  - Astra Zeneca
  - Pfizer
  - UFAM
  - Abbvie
  - Sanofi
  - Bayer
  - ISID
  - JIDC
Chagas Disease Epidemiology

- **Natural Geographical Distribution**
  - ≥18 countries in 2 ecological zones:
    - Southern Cone, vector lives in–doors
    - Rest of Latin America, vector lives out–doors

- **Causative Agent**
  - *Trypanosoma cruzi*

- **Main Vectors**
  - Triatomine bugs: *Triatoma maculata, T. dimidiata, Rhodnius prolixus* and *Panstrongylus geniculatus*

Chagas Disease Epidemiology

- Reservoirs
  - Practically any wild mammal (also domestic)
Chagas Disease EcoEpidemiology

- Reservoirs
  - Practically any wild mammal (also domestic)

Rural Miranda, Venezuela, March 2008
Vectorial Transmission

Triatomine bug ingests blood from humans living in poor quality housing in endemic areas

Trujillo, Venezuela, July 2004

Metacyclic trypomastigote s in feces

Scratching or rubbing

Epimastigote stage

Skin or Mucosa

Trypomastigote

Amastigote

Bloodstream

Cell Disruption

(Myocytes, nerve cells or smooth muscle cells)

Bloodstream

Rhodnius prolixus

Triatoma maculata

Pastrongylus geniculatus


Trujillo, Venezuela, July 2004

Figure 2

Title: Cycle of transmission of Trypanosoma cruzi and its vectors to humans. Triatomine bugs live in the crevices of poorly constructed houses in impoverished areas in Latin America. Metacyclic trypomastigote is the infecting form to humans, while the amastigote is the intracellular form responsible for the immunopathogenesis in target human organs.

Chagas Disease Epidemiology

- **Discovery**
  - 100 years ago by Carlos Chagas (1909)

- **Vectorial Transmission Interruption**
  - This disease have had an intense vectorial intervention
  - Particularly in South America southern cone,
  - Control programs reduced significantly its transmission and seroprevalence
World Patterns of Migration

The urban and rural population of the world, 1950-2030

- World, total population
- World, urban population
- World, rural population

World Urbanization Prospects: 2005 Revision
World Patterns of Migration

Most movement occurs within regions
Origin and destination of international migrants, circa 2000

Human Development Index, 2007
- Very High
- High
- Medium
- Low

Regions
- North America
- Europe
- Oceania
- Latin America and the Caribbean
- Asia
- Africa

Number of migrants (in millions)

The size of countries is proportional to 2007 population.
Changes in Disease Geographical Records

Migration and Communicable Diseases

MALARIA

Chagas Disease and Migration

Figure 1. Migration flows of immigrants from endemic countries for Trypanosoma cruzi, estimates of infected individuals and cases of Chagas disease in destination countries.

Europe excluding Spain, 2003-2005
- Immigrants: 483,074
- Infected: 19,323
- With symptoms: 3,865

Spain, 2007
- Immigrants: 1,796,256
- Infected: 102,852
- With symptoms: 20,571

Canada, 2000
- Immigrants: 232,235
- Infected: 4,166
- With symptoms: 833

USA, 2000
- Immigrants: 12.4 millions
- Infected: 760,346
- With symptoms: 59,069

Japan, 2007
- Immigrants: 95,473

Australia, 2006
- Immigrants: 80,099
- Infected: 3,287
- With symptoms: 657

14,000,000
10,000,000 - 30,000,000
30,000,000 - 99,999,999
20,000,000 - 99,000

Fig. 2 | Migration routes from Latin America and estimation of the total number of infected individuals in non-endemic countries.

Chagas Disease and Migration

- **Main features**
  - This condition emerges as a global public health problem now seen in regions such as Europe and North America.
  - People, even asymptomatic, from different countries of Latin America are carriers of the infection.
  - **Risk of transmission:**
    - Blood transfusions
    - Transplantation
    - Mother–to–Child
    - Imported contaminated food and bugs

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Chagas Disease and Migration

- **Chagas Disease in Europe – WHO Statement**
  - Cases of Chagas disease in Europe are known to occur from
    - transfusion of contaminated blood
    - mother to child (congenital transmission)
    - during organ transplantation.
  - It is estimated that the number of infected cases in Europe exceeds **80,000**
  - With more than **3,900** laboratory-confirmed cases during the past 10 years
Distribution of cases of *Trypanosoma cruzi* infection in Europe by country, and reported transmission (autochthonous, transfusional or congenital transmission of infection acquired among European travellers to disease-endemic areas) among the European population (data reported to WHO as of December 2009)
Table 1 Estimated number of immigrants with Chagas’ disease and chronic chagasic cardiomyopathy (ChrChC) living in Europe

<table>
<thead>
<tr>
<th>Country of origin</th>
<th>Prevalence*</th>
<th>Norway</th>
<th>Portugal</th>
<th>Spain</th>
<th>Sweden</th>
<th>Switzerland</th>
<th>UK</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>49.00%</td>
<td>568</td>
<td>1039</td>
<td>1028</td>
<td>2657</td>
<td>2064</td>
<td>679</td>
<td>1188</td>
<td>1914</td>
</tr>
<tr>
<td>Bolivia</td>
<td>14.80%</td>
<td>313</td>
<td>53</td>
<td>58</td>
<td>2537</td>
<td>1374</td>
<td>1143</td>
<td>186</td>
<td>2328</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.80%</td>
<td>1632</td>
<td>4991</td>
<td>3820</td>
<td>4024</td>
<td>14984</td>
<td>2515</td>
<td>2571</td>
<td>219090</td>
</tr>
<tr>
<td>Chile</td>
<td>12.00%</td>
<td>5341</td>
<td>5341</td>
<td>5341</td>
<td>5341</td>
<td>5341</td>
<td>5341</td>
<td>5341</td>
<td>5341</td>
</tr>
<tr>
<td>Colombia</td>
<td>12.00%</td>
<td>3826</td>
<td>3826</td>
<td>3826</td>
<td>3826</td>
<td>3826</td>
<td>3826</td>
<td>3826</td>
<td>3826</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>11.70%</td>
<td>399</td>
<td>159</td>
<td>159</td>
<td>159</td>
<td>159</td>
<td>159</td>
<td>159</td>
<td>159</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.20%</td>
<td>425</td>
<td>425</td>
<td>425</td>
<td>425</td>
<td>425</td>
<td>425</td>
<td>425</td>
<td>425</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.5–6.8%</td>
<td>471</td>
<td>538</td>
<td>538</td>
<td>538</td>
<td>538</td>
<td>538</td>
<td>538</td>
<td>538</td>
</tr>
<tr>
<td>Peru</td>
<td>0.20%</td>
<td>677</td>
<td>204</td>
<td>204</td>
<td>204</td>
<td>204</td>
<td>204</td>
<td>204</td>
<td>204</td>
</tr>
<tr>
<td>Paraguay</td>
<td>45.00%</td>
<td>81</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>El Salvador</td>
<td>1.50%</td>
<td>157</td>
<td>135</td>
<td>135</td>
<td>135</td>
<td>135</td>
<td>135</td>
<td>135</td>
<td>135</td>
</tr>
<tr>
<td>Uruguay</td>
<td>0.60%</td>
<td>250</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
</tr>
<tr>
<td>Venezuela</td>
<td>1.30%</td>
<td>250</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
<td>2235</td>
</tr>
<tr>
<td>Total no. of immigrants</td>
<td>–</td>
<td>4478</td>
<td>7431</td>
<td>7431</td>
<td>7431</td>
<td>7431</td>
<td>7431</td>
<td>7431</td>
<td>7431</td>
</tr>
</tbody>
</table>

Figure 2: Estimated number of Chagas’ disease infected patients in Europe. Colour-code denotes expected frequency.

Guerri-Guttenberg et al.
Chagas Disease and Migration

- Affected Countries
  - North America:
    - USA
    - Canada
  - Europe:
    - Spain
    - UK
    - Italy
    - France
    - Switzerland
    - Belgium
  - Sporadic cases:
    - Greece
    - Luxembourg
    - Netherlands
    - Norway
    - Portugal
    - Romania
    - Sweden
    - Ireland
    - Poland
    - Iceland
    - Finland
    - Czech Rep.
    - Slovakia
    - Hungary
Table 2. Heterogeneity of pooled prevalence estimates of Chagas disease by type of study recruitment setting.

<table>
<thead>
<tr>
<th>Type</th>
<th>Positive</th>
<th>Screened</th>
<th>Prevalence (%)</th>
<th>95% Cl.</th>
<th>% weight (random)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHC</td>
<td>216</td>
<td>2471</td>
<td>8.7</td>
<td>7.7–9.9</td>
<td>33.27</td>
</tr>
<tr>
<td>blood donors</td>
<td>14</td>
<td>2629</td>
<td>0.5</td>
<td>0.3–0.9</td>
<td>33.29</td>
</tr>
<tr>
<td>pregnancy</td>
<td>374</td>
<td>5784</td>
<td>6.5</td>
<td>5.8–7.1</td>
<td>33.43</td>
</tr>
<tr>
<td>Random Effects Pooled Prevalence</td>
<td>604</td>
<td>10884</td>
<td>4.2</td>
<td>0.7–10.8</td>
<td>100.00</td>
</tr>
</tbody>
</table>

TEST FOR HETEROGENEITY

Q Heterogeneity chi-squared = 319.05 (d.f. = 2) p = 0.0000

I² (variation in Prevalence attributable to heterogeneity) = 99.4%

Moment-based estimate of between-study variance Tau² = 0.0479

doi:10.1371/journal.pntd.0003540.t002
Table 4. Pooled *T. cruzi* prevalence by country of origin in Latin American migrants from European countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number screened</th>
<th>Number of seropositives</th>
<th>Country-specific prevalence* (%)</th>
<th>95% CI</th>
<th>Prevalence in country of origin (National level) PAHO (%) [39]</th>
<th>Prevalence ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>875</td>
<td>16</td>
<td>2.2</td>
<td>0.80–4.13</td>
<td>4.13</td>
<td>0.53</td>
</tr>
<tr>
<td>Bolivia</td>
<td>2264</td>
<td>541</td>
<td>18</td>
<td>13.9–22.66</td>
<td>6.75</td>
<td>2.67</td>
</tr>
<tr>
<td>Brazil</td>
<td>954</td>
<td>4</td>
<td>0.6</td>
<td>0.16–1.12</td>
<td>1.02</td>
<td>0.59</td>
</tr>
<tr>
<td>Chile</td>
<td>290</td>
<td>1</td>
<td>1</td>
<td>0.17–2.36</td>
<td>0.99</td>
<td>1.01</td>
</tr>
<tr>
<td>Colombia</td>
<td>1627</td>
<td>6</td>
<td>0.5</td>
<td>0.15–0.92</td>
<td>0.96</td>
<td>0.52</td>
</tr>
<tr>
<td>Ecuador</td>
<td>2131</td>
<td>7</td>
<td>0.4</td>
<td>0.18–0.72</td>
<td>1.74</td>
<td>0.23</td>
</tr>
<tr>
<td>El Salvador</td>
<td>67</td>
<td>2</td>
<td>3.7</td>
<td>1.62–11.7</td>
<td>3.37</td>
<td>1.10</td>
</tr>
<tr>
<td>Honduras</td>
<td>136</td>
<td>3</td>
<td>4.2</td>
<td>1.27–7.36</td>
<td>3.05</td>
<td>1.38</td>
</tr>
<tr>
<td>Mexico</td>
<td>166</td>
<td>0</td>
<td>1.5*</td>
<td>0.24–3.76</td>
<td>1.03</td>
<td>1.46</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>50</td>
<td>1</td>
<td>4.6</td>
<td>0.76–11.3</td>
<td>1.14</td>
<td>4.04</td>
</tr>
<tr>
<td>Paraguay</td>
<td>385</td>
<td>19</td>
<td>5.5</td>
<td>3.46–7.91</td>
<td>2.54</td>
<td>2.17</td>
</tr>
<tr>
<td>Peru</td>
<td>1029</td>
<td>4</td>
<td>0.6</td>
<td>0.23–1.18</td>
<td>0.69</td>
<td>0.87</td>
</tr>
<tr>
<td>Uruguay</td>
<td>248</td>
<td>0</td>
<td>0.8*</td>
<td>0.08–2.24</td>
<td>0.66</td>
<td>1.21</td>
</tr>
<tr>
<td>Venezuela</td>
<td>311</td>
<td>0</td>
<td>0.9*</td>
<td>0.16–2.22</td>
<td>1.16</td>
<td>0.78</td>
</tr>
</tbody>
</table>

CI: Confidence Interval; PAHO: Pan American Health Organization;

*Weighted prevalence with Random effect model;

^ although there was not any reported case of Chagas disease in migrants coming from this country, the weighted prevalence is not “0” due to the Random Effect model.
Chagas Disease in Latin America

- Important Countries with most cases in Latin America:
  - Brazil (rural)
  - Bolivia (any area)
  - Argentina (North)
  - Mexico (rural, southern)
  - Venezuela (any, given recent reports)
  - Colombia (rural)
  - Ecuador (rural)
  - Peru (Arequipa)
  - Paraguay (rural)
  - Costa Rica (rural)
  - Others in Central and South America (rural areas)

Sandoval, 2007

WHO 2006-2009
Climate change in Latin America
Implications in Health & Disease

The socio-ecology of zoonotic infections

A. Cascio1,2, M. Bosilkovski1,3, A. J. Rodriguez-Morales2,4 and G. Pappas2,5
1) Tropical and Parasitological Diseases Unit, Department of Human Pathology, University of Messina, Messina, Italy; 2) Working Group on Zoonoses, International Society of Chemotherapeutics, 3) University Clinic for Infectious Diseases and Febrile Conditions, Skopje, Former Yugoslav Republic of Macedonia, 4) Public Health Division, Department of Preventive and Social Medicine, Pozarelli Medical School, Faculty of Medicine, Central University of Venezuela (UCV), Caracas, Venezuela and 5) Institute of Continuing Medical Education of Ioannina, Ioannina, Greece

Human-related factors

- Modern life trends
  - industrialization
  - urbanization
- Politics
  - state reform
  - conflict
- Global travel
  - global trade intensification
  - human interaction in ecosystems/deforestation
- Scientific advances
  - novel diagnostics
  - novel host/vector populations

EMERGENCE AND RE-EMERGENCE OF ZOONOTIC INFECTIONS

- Ecosystem disruption/population rearrangements
- Genomic variability/species jumping/transport
- Climate/environment related factors
- Local or generalized (ENSO- global warming)

Pathogen-related factors

- Industrialization sequence
- Urbanization/magnitudes
- Agro-industry systems
- Food chain industry industrialization
- Global trade intensification
- Human interaction in ecosystems/deforestation
- Surveillance and public health infrastructure breakdown
- Voluntary and involuntary human immigration
- Interactions

FIG. 1. Factors influencing the resurgence of zoonotic infections and their interplay. ENSO, El Niño southern oscillation.
Coinfection of *Trypanosoma cruzi* and *Mycobacterium tuberculosis* in a patient from Colombia

Wilmer E. Villamil-Gómez¹,²,³
Luz A. Silvera¹
Stefany Henao-Palencia, Julie Contreras-Arrieta, Juan F. Cáceres, Yeimer Ortiz-Martínez, Lisseth Villadiego-Álvarez, Vivian Cantero-Muñoz
Alfonso J. Rodríguez-Moraless, b, c, ▲, 

Figure 1.
Clinical and radiological manifestations of *M. tuberculosis* and *T. cruzi* coinfection in a patient from Colombia.
Fatal Chagas Disease Among Solid-Organ Transplant Recipients in Colombia

Carlos Fernando Gómez-P,1 Julio César Mantilla-H,1 and Alfonso J. Rodríguez-Morales2

1School of Medicine, Faculty of Health and 2Department of Pathology, Faculty of Health, Universidad Industrial de Santander, Bucaramanga, Colombia; and
2Public Health and Infection Research Group, Faculty of Health Sciences, Universidad Tecnológica de Pereira, Risaralda, Colombia

Figure 1. Pathological findings of the 2 fatal reactivation cases of Chagas disease demonstrating acute myocarditis and acute meningoencephalitis. A, case 1, heart showing dilatation of both right and left ventricles, with concentric left ventricular hypertrophy. B, case 1, myocardial tissue with zones of fibrosis, mononuclear infiltrate with pseudocysts containing amastigotes (arrow) (hematoxylin and eosin stain [H&E] stain, ×400 original magnification). C, case 2, Coronal edema, necrohemorrhagic destruction associated with Trypanosoma cruzi was found in the left hemisphere. D, case 2, marked congestion of the choroid plexus, with marked congestion of the leptomeninges, demonstrative extensive parenchymal necrosis associated with Trypanosoma cruzi amastigotes, and pseudocysts (H&E stain, ×400 original magnification).

Ecoepidemiology of Chagas disease in Venezuela

Relación entre las tasas de Seroprevalencia de Infección por Trypanosoma cruzi por localidades y los valores del NDVI, para lugares muestreados en Barinas y Cojedes

Mann-Whitney U=56,50
Wilcoxon W=136,5
p=0,456

Mann-Whitney U=26,00
Wilcoxon W=164,0
p=0,008

$\rho^2 = 1,000$
$p<0,001$

New ways of transmission

- Recently
  - Orally
    - Water and beverages (imported from endemic countries?)
    - Contaminated food (imported from endemic countries?)
      - Countries with orally acquired cases: Brazil, Venezuela, Colombia, Bolivia, others?
  - Linked to acute forms
  - High CFR
    - Body fluids from marsupials?

Brazil

Letter

Chagas disease: an emerging food-borne entity?

Alfonso J. Rodriguez-Morales.

Experimental Institute José Witremundo Torrealba (former Center for Parasitological Research JWT), Universidad de Los Andes, Trujillo, Venezuela.

J Infect Developing Countries 2008; 2(2):149-150.

Venezuela

The Journal of Infectious Diseases 2010; 201(9):1308–1315

MAJOR ARTICLE

Large Urban Outbreak of Orally Acquired Acute Chagas Disease at a School in Caracas, Venezuela

Belkisylé Alarcón de Noya,1,3 Zoraida Díaz-Bello,1 Cecilia Colmenares,1,3 Raiza Ruiz-Guevara,1 Luciano Mauriello,1 Reinaldo Zavala-Jaspe,1 José Antonio Suárez,2 Teresa Abate,3 Laura Naranjo,1,7 Manuel Paiva,7 Lavinia Rivas,8 Julio Castro,7 Juan Márquez,4 Iván Mendoza,4 Harry Acquatella,6 Jaime Torres,2 and Oscar Noya3,5

Departments of *Immunology, Infectology, Molecular Biology, Cardiology, and Bioethics, Instituto de Medicina Tropical, Facultad de Medicina, and *Cátedras de Parasitología, Escuela de Medicina Luis Razetti, Universidad Central de Venezuela, "Dirección de Epidemiología, Alcaldía Mayor de Caracas, "Dirección General de Epidemiología del Ministerio del Poder Popular para la Salud, and "Centro Médico de Caracas, Caracas, Venezuela
Chagas confirmed on the west coast of Vargas

Ministry of Health (MINSA) reiterated the lifting of epidemiologic siege

Yesterday, the Minister of Health, Jesús Manilla, confirmed that Chagas disease is the disease that is attacking the population of Chichiriviche de la Costa, in the western part of the state of Vargas.

The head of the Ministry of Health was in the area and stated that it was transmitted through the ingestion of contaminated guava juice, producing the outbreak of illness in the area, that affected 47 students and three teachers from the morning shift of the Remulo Monasterios state school.
The director of epidemiology at the Ministry of Health, Miriam Morales, said on Friday (7 May 2010) that an outbreak of Chagas disease, confirmed in a community of Caracas, should not generate concern.

After confirming 4 cases and 5 more cases under investigation in the same community, she said that the situation was being controlled by a joint team of the Ministry of Health and the Environmental Health Directorate of the Metropolitan District of Caracas.

"There is an alarming situation, but the outbreak is very focused, and we have determined that there is no food for mass consumption involved. The Ministry and the local health authorities are trying to determine which foods [the most common form of transmission of the disease - MOD EP] were..."
View printable version  Share this post  

Published Date: 2010-11-14 18:00:03
Subject: PRO/AHEDR> Trypanosomiasis, foodborne - Venezuela (03); (TA)
Archive Number: 20101114.4141

TRYPANOSOMIASIS, FOODBORNE - VENEZUELA (03) (TACHIRA)

A ProMED-mail post
<http://www.promedmail.org>
ProMED-mail is a program of the International Society for Infectious Diseases
<http://www.isid.org>

Date: Thu 11 Nov 2010
Source: Google News Spain, Venezuelan News Agency (AVN) report (in Spanish, trans, SrTech.Ed.UJ et al.)
<http://www.avn.info.vamodar/27825>

Authorities from the Health Corporation (Corposalud) of Tachira confirmed an outbreak of Chagas disease in the Andean region Junin municipality (near the border with Colombia), where 6 positive cases (one fatal) were identified. Relatives of the child who died of the disease last Sunday (7 Nov 2010) remain under observation since they were positive with the rapid test.

The information was communicated by the director of Corposalud, Juan de Dios Delgado, who stated that it is probable that the outbreak spread via the oral route, through foods contaminated by the parasite, given that none of the patients presented with bites or scratches.
Orally transmitted Chagas in Venezuela

Brotes Reportados
2007-2011

Vargas, 2009
Chacao, Caracas, 2007
Antimano, Caracas, 2010
Tachira, 2010
Figure. Study area of the AOACD outbreak, Táchira, Venezuela, November 2010
Table. Summary of the cases of the AOACD outbreak, Táchira, Venezuela, November 2010

<table>
<thead>
<tr>
<th>#</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Time living in the area (years)</th>
<th>Occupation</th>
<th>Test performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>F</td>
<td>2</td>
<td>Pre-scholar</td>
<td>BS +, ELISA IgG NT, IFI NT, IH NT</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>F</td>
<td>2</td>
<td>Pre-scholar</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>F</td>
<td>25</td>
<td>University Student</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>F</td>
<td>24</td>
<td>Teacher</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>F</td>
<td>30</td>
<td>Housewife</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>31</td>
<td>M</td>
<td>31</td>
<td>Informatics</td>
<td>-</td>
</tr>
</tbody>
</table>

BS = blood smear; ELISA = enzyme-linked immunosorbent assay; IFI = indirect immunofluorescence; IH = indirect haemagglutination; F = female; M = Male; + = positive; - = negative; NT = not tested

*In this case the necropsy was made (finding amastigotes at myocardium).

Urban outbreak of acute orally acquired Chagas disease in Táchira, Venezuela

Jesús A. Benítez,¹ Benjamín Araujo,² Krisell Contreras,³ Marianela Rivas,⁴ Pedro Ramirez,⁵ Watermo Guerra,⁶ Noel Calderon,⁷ Carlo Ascaso Terren,⁸ Reggie Barrera,⁷ Alfonso J. Rodríguez-Morales.⁹,¹⁰,¹¹
Colombia

Figura 1. Área de estudio (corregimiento Bocas del Atrato, Turbo, Antioquia)

Figura 2. Condiciones de la vivienda. Corregimiento Bocas del Atrato, Turbo, Antioquia

Cuadro 1. Descripción de pacientes que cumplen con la definición de caso agudo de enfermedad de Chagas, corregimiento Bocas de Atrato, Turbo, 2009.

<table>
<thead>
<tr>
<th>Paciente</th>
<th>Edad</th>
<th>Fecha de inicio de los síntomas</th>
<th>Síntomas</th>
<th>PCR ( T. cruzi )</th>
<th>Ig M IFI</th>
<th>Ig G IFI</th>
<th>ELISA Ig M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38</td>
<td>25 de octubre</td>
<td>Fiebre, escalofríos, cefalea, mialgias, artralgias, dolor abdominal, edema generalizado**</td>
<td>No R*</td>
<td>No R*</td>
<td>No R*</td>
<td>No R*</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>30 de octubre</td>
<td>Escalofríos, fiebre, cefalea, dolor abdominal, artralgias</td>
<td>No R*</td>
<td>No R*</td>
<td>1/64</td>
<td>Positivo</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>2 de noviembre</td>
<td>Fiebre y cefalea</td>
<td>Positiva</td>
<td>1/32</td>
<td>1/128</td>
<td>Positivo</td>
</tr>
<tr>
<td>4</td>
<td>52</td>
<td>2 de noviembre</td>
<td>Fiebre, escalofríos, convulsiones, cefalea, náuseas, artralgias, vómito, cardiopatía</td>
<td>Positiva</td>
<td>1/64</td>
<td>1/256</td>
<td>Positivo</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>4 de noviembre</td>
<td>Fiebre, dolor abdominal, náuseas, cardomegalia, edema orbicular bilateral, disnea</td>
<td>Positiva</td>
<td>1/64</td>
<td>1/256</td>
<td>Positivo</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>4 de noviembre</td>
<td>Fiebre, dolor abdominal, náuseas, cardomegalia, edema orbicular bilateral, disnea</td>
<td>Negativa</td>
<td>1/64</td>
<td>1/256</td>
<td>Positivo</td>
</tr>
<tr>
<td>7</td>
<td>19</td>
<td>16 de noviembre</td>
<td>Síndrome febril, cefalea, mialgias, náuseas, vómito; la paciente estaba en embarazo</td>
<td>NR*</td>
<td>1/64</td>
<td>1/128</td>
<td>Positivo</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>18 de noviembre</td>
<td>Fiebre, escalofríos, convulsiones, cefalea, náuseas, disnea, cardomegalia</td>
<td>No R*</td>
<td>No R*</td>
<td>1/128</td>
<td>Positivo</td>
</tr>
<tr>
<td>9</td>
<td>31</td>
<td>19 de noviembre</td>
<td>Fiebre, cefalea, falta de apetito, artralgias, edema orbicular bilateral, orina turbia</td>
<td>No R*</td>
<td>No R*</td>
<td>1/128</td>
<td>Positivo</td>
</tr>
<tr>
<td>10</td>
<td>37</td>
<td>20 de noviembre</td>
<td>Síndrome febril recurrente, mialgias, artralgias, edema orbicular bilateral, dolor abdominal, náuseas, escalofríos</td>
<td>No R*</td>
<td>1/64</td>
<td>1/128</td>
<td>Positivo</td>
</tr>
<tr>
<td>11</td>
<td>20</td>
<td>28 de noviembre</td>
<td>Síndrome febril recurrente, mialgias, artralgias, dolor abdominal, escalofríos</td>
<td>Negativa</td>
<td>1/64</td>
<td>1/128</td>
<td>Positivo</td>
</tr>
</tbody>
</table>

* No R: no realizada
** Paciente con nexos epidemiológicos, fallecido en Medellín el 25 de diciembre de 2009
Se reportan los primeros casos de chagas oral
Beni, 11 son de Guayaramerín y tres de la comunidad San Miguel

Según datos del informe, a principios de octubre se descubrió a personas con síntomas del chagas en el municipio beniano de Guayaramerín, pero ellas habían asegurado que no fueron picadas por la vinchuca. Realizadas las investigaciones y después de los análisis, se evidenció que 14 pobladores dieron positivo al chagas.

El reporte establece que tres personas son oriundas de la comunidad de San Antonio y las otras 11 son de la capital de Guayaramerín. Las tres primeras personas indicaron que ingresaron a la selva a recolectar la planta del maíz, para preparar jugo, en tanto que las de la capital indicaron que nunca fueron al monte, pero tomaron jugos de plantas de frutos silvestres.
REPORTE DE CASOS

Primer brote reportado de la enfermedad de chagas en la Amazonía Boliviana: reporte de 14 casos agudos por transmisión oral de Trypanosoma cruzi en Guayaramerín, Beni-Bolivia

First reported outbreak of Chagas disease in the Bolivian Amazonean zone: a report of 14 cases of oral transmission of acute Trypanosoma cruzi in Guayaramerín, Beni-Bolivia

José Santalla Vargas¹, Patricia Oporto Carrasco¹, Edy Espinoza¹, Tatiana Rios¹, Laurent Brutus²

¹Laboratorio de Parasitología, Instituto Nacional de Laboratorios en Salud, Ministerio de Salud y Deportes, La Paz, Bolivia.
²Instituto de Investigaciones para el Desarrollo IRD, UMR216, Salud de la madre y el niño en medio tropical, Francia.
## Latin America and Orally-TChD

<table>
<thead>
<tr>
<th>País</th>
<th>Región</th>
<th>n casos</th>
<th>Mecanismo</th>
<th>Ano</th>
<th>Referencia</th>
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<tbody>
<tr>
<td>Argentina</td>
<td></td>
<td>1</td>
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<td>(26)</td>
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<td>Sangre quirquincho</td>
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<td>Vegetales</td>
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<td></td>
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<td>3</td>
<td>Jugo de açai</td>
<td>1968-2005</td>
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<td>Jugo de açai</td>
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<td>Pará</td>
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<td>217</td>
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<td>1968-2005</td>
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<td>88</td>
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<td>Guajira, Magdalena</td>
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<td>Vino de palma</td>
<td>1999</td>
<td>(21)</td>
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<td>Bucaramanga</td>
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<td>Ecuador</td>
<td>Secueembios</td>
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<td>Carne de animales</td>
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<td>(14)</td>
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<td>Venezuela</td>
<td>Chinchiniche</td>
<td>50</td>
<td>Jugo de guayaba</td>
<td>2007</td>
<td>(22)</td>
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<tr>
<td></td>
<td>Chacao</td>
<td>128</td>
<td>Jugo de frutas</td>
<td>2007</td>
<td>(20)</td>
</tr>
<tr>
<td></td>
<td>Vargas</td>
<td>88</td>
<td>Jugo de guayaba</td>
<td>2009</td>
<td>(23)</td>
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<tr>
<td>Total casos</td>
<td></td>
<td>845</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Toso et al. Rev Med Chile 2011; 139: 258-266
Parasites in Food: Illness and Treatment

AJ Rodríguez-Morales, Universidad Tecnológica de Pereira, Pereira, Risaralda, Colombia
A Bolívar-Mejía, Universidad Industrial de Santander, Bucaramanga, Santander, Colombia
C Alarcón-Olave, Universidad Autónoma de Bucaramanga, Bucaramanga, Santander, Colombia
LS Calvo-Betancourt, Fundación Cardiovascular de Colombia, Floridablanca, Santander, Colombia

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1. *Taenia solium* (helminth; cestode; pork tapeworm): In pork
2. *Echinococcus granulosus* (helminth; cestode; hydatid worm or dog tapeworm): In fresh produce
3. *Echinococcus multilocularis* (helminth; cestode; a type of tapeworm): In fresh produce
4. *Toxoplasma gondii* (protozoa): In meat from small ruminants, pork, beef, game meat (red meat and organs)
5. *Cryptosporidium* spp. (protozoa): In fresh produce, fruit juice, milk
6. *Entamoeba histolytica* (protozoa): In fresh produce
7. *Trichinella spiralis* (helminth; nematode; pork worm): In pork
8. *Opisthorchis* spp. (helminth; trematode; family of flatworms): In freshwater fish
9. *Ascaris* spp. (helminth; nematode; small intestinal roundworms): In fresh produce
10. *Trypanosoma cruzi* (protozoa): In fruit juices

**Chagas' Disease**

Chagas' disease is caused by the protozoan parasite *Trypanosoma cruzi*. Transmission occurs mainly through triatomine bug vectors typically found in homes built with mud, so the disease tends to affect poor countries. The disease can also be acquired congenitally, by blood transfusions, by organ transplants, through biological accidents, and orally due to the intake of food contaminated with the parasite (due to feces of triatomine and complete triatomines). This has been particularly reported in fruit juice in Brazil and Venezuela, but also in other South American countries.
Chagas disease vectors – Colombia

R. prolixus

T. dimidiata
Triatomines species in Colombia

*Rhodnius pallescens*
*Rhodnius prolixus*
*Rhodnius pictipes*
*Rhodnius neivae*
*Rhodnius robustus*
*Rhodnius dalessandroi*

**Panstrongylus geniculatus**
*Panstrongylus humeralis*
*Panstrongylus rufotuberculatus*
*Panstrongylus lignarius*
*Triatoma dispar*
*Triatoma venosa*

**Triatoma maculata**

**Triatoma dimidiata**

*Eratyrus cuspidatus*
*Eratyrus mucronatus*
*Belminus rugulosus*
*Cavernicola pilosa*
*Psammolestes arthuri*
*Microtriatoma trinidadensis*
REVISIÓN DE TEMA

Actualización de la distribución geográfica y ecoepidemiología de la fauna de triatominos (Reduviidae: Triatominae) en Colombia

Felipe Guhl, Germán Aguilar, Néstor Pinto, Daniela Vergara

Figura 1. Distribución de los principales triatominos asociados al hábitat humano según las zonas biogeográficas.
Feeding Sources and Natural Infection of Belminuss herreri (Hemiptera, Reduviidae, Triatominae) from Dwellings in Cesar, Colombia

Claudia Magaly Sandoval, Rosemere Duarte*, Reinaldo Gutierrez, Dayse da Silva Rocha**, Victor Manuel Angulo, Lida Esteban, Marlen Reyes, José Jurberg**, Cleber Galvão*+*

Centro de Investigaciones en Enfermedades Tropicales, Universidad Industrial de Santander, Santander, Colombia

Fig. 1: department of Cesar, Colombia

Fig. 2: panoramic view, municipality of San Martin, Cesar, Colombia

Fig 3: polymerase chain reaction results, agarose gel showing the amplified products. 1 and 10: molecular weight marker; 2 and 7: negative intestinal content; 3, 4, 5, 6: positive intestinal content; 8: positive control (Trypanosoma cruzi parasites); 9: reaction control
Belminus ferroae n. sp. from the Colombian north-east, with a key to the species of the genus (Hemiptera: Reduviidae: Triatominae)

CLAUDIA MAGALY SANDOVAL1,2,5, EULIDES PABÓN3, JOSÉ JURBERG4 & CLEBER GALVÃO4

1. Universidad de Pamplona, Instituto de Investigaciones en Ciencias Biomédicas, INBIOM, Laboratorio de Entomología Médica, Pamplona, Norte de Santander, Colombia. E-mail: msandoval@uniapamplona.edu.co
2. Instituto Experimental José Widorre Torrealba, Universidad de los Andes, Trujillo, Venezuela.
3. Subgrupo de control de vectores, Instituto Departamental de Salud, Cúcuta, Norte de Santander, Colombia.
4. Laboratório Nacional e Internacional de Referência em Taxonomia de Triatomíneos, Departamento de Protozoologia, Instituto Oswaldo Cruz, FIOCRUZ, Av. Brasil 4365, Rio de Janeiro, RJ, Brazil. 21040-900. E-mail: cleberg@uol.com.br

Enzymology

This species is dedicated to Cristina Ferro, a Colombian entomologist. She has dedicated her life to research on the medical importance insects in Colombia.
Actualización de la distribución geográfica y ecoepidemiología de la fauna de triatominos (Reduviidae: Triatominae) en Colombia

Felipe Guhl, Germán Aguilera, Néstor Pinto, Daniela Vergara

Figura 5. Distribución de las diferentes especies de triatominos en los departamentos de Chocó, Caldas y Risaralda.
Actualización de la distribución geográfica y ecoepidemiología de la fauna de triatomíos (Reduviidae: Triatominae) en Colombia

Felipe Guhl, Germán Aguilera, Néstor Pinto, Daniela Vergara

Figura 9. Distribución de las diferentes especies de triatomíos en el departamento de Antioquia.
Chagas Disease in Latin America

- Important Countries with higher prevalence in Latin America:
  - Bolivia (any area)
  - Argentina (North)
  - Honduras
  - El Salvador
  - Paraguay (rural)
  - Brazil (rural)
  - Venezuela (any, given recent reports)
  - Mexico (rural, southern)
  - Ecuador (rural)
  - Colombia (rural)
  - Peru (Arequipa)
  - Costa Rica (rural)
  - Others in Central and South America (rural areas)

Chagas Disease and Linage

*Trypanosoma cruzi* strains

Approximate distributions of *Trypanosoma cruzi* lineages (discrete typing units or DTUs, see The promise of *T. cruzi* genomics, on page S16). Tcl is a principal agent of Chagas disease north of the Amazon. TclII, TclV and TclVI are the main agents of Chagas disease in the Southern Cone region. As yet, TclIII and TclIV only sporadically infect humans. TclIV has divergent genotypes in South America and North America. Maps courtesy of Martin S. Llewellyn and Michael A. Mills.
Chagas Disease and Migration


Chagas Disease and Migration


0.11 to 1.78%
### Chagas Disease Suspicion

<table>
<thead>
<tr>
<th>Geographic distribution</th>
<th>Mode of transmission</th>
<th>Heart involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>South and Central America, Mexico, and Southern United States</td>
<td>Vector-borne; transfusional congenital organ transplant; food borne; accidental</td>
<td>Myocarditis and pericarditis (acute phase); cardiomyopathy (chronic phase)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cardiac manifestation(s)</th>
<th>Etiological treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECG changes (sinus tachycardia, first-degree atrioventricular block, low Q-R-S voltage, primary T-wave changes); cardiomegaly; pericardial effusion; heart failure; sinus node dysfunction; atrioventricular and intraventricular blocks; ventricular arrhythmias; apical aneurysm; heart failure; sudden cardiac death</td>
<td>Benznidazole or nifurtimox (optional, because benefit is not well established)</td>
</tr>
</tbody>
</table>
### TABLE 2. Hallmarks of chronic Chagas’ cardiomyopathy

<table>
<thead>
<tr>
<th>Hallmark of CCC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arrhythmias</strong></td>
</tr>
<tr>
<td>Ventricular extrasystoles</td>
</tr>
<tr>
<td>Nonsustained and sustained ventricular tachycardia</td>
</tr>
<tr>
<td>Bradyarrhythmias</td>
</tr>
<tr>
<td>Ventricular fibrillation</td>
</tr>
<tr>
<td>Atrial fibrillation/flutter</td>
</tr>
<tr>
<td><strong>Conduction abnormalities</strong></td>
</tr>
<tr>
<td>Sick sinus syndrome</td>
</tr>
<tr>
<td>Complete and incomplete right bundle branch block</td>
</tr>
<tr>
<td>Left anterior fascicle block</td>
</tr>
<tr>
<td>Bilascicular and trilascicular blocks</td>
</tr>
<tr>
<td>1st-, 2nd-, and 3rd-degree AV blocks</td>
</tr>
<tr>
<td><strong>Thromboembolic phenomena</strong></td>
</tr>
<tr>
<td>Brain (most frequent)</td>
</tr>
<tr>
<td>Lungs, kidneys, spleen</td>
</tr>
<tr>
<td><strong>Cardiac failure</strong></td>
</tr>
<tr>
<td>Diastolic dysfunction initially</td>
</tr>
<tr>
<td>Isolated left heart failure in the early stages of cardiac decompensation</td>
</tr>
<tr>
<td>Biventricular with a predominance of right-sided failure in advanced stages</td>
</tr>
<tr>
<td><strong>Apical aneurysm</strong></td>
</tr>
<tr>
<td>Found in 52% of autopsy series</td>
</tr>
<tr>
<td>More frequent in men</td>
</tr>
<tr>
<td>80% in the LV apex</td>
</tr>
<tr>
<td><strong>Sudden death secondary to</strong></td>
</tr>
<tr>
<td>Ventricular fibrillation (most frequent)</td>
</tr>
<tr>
<td>Bradyarrhythmias</td>
</tr>
<tr>
<td>Rupture of apical aneurysm (exceptional)</td>
</tr>
</tbody>
</table>

**FIG. 1.** ECG of a patient with CCC showing the three most typical alterations: right bundle branch block, left anterior fascicular block (large blue arrow), and ventricular extrasystole (small blue arrow). aVR, aVL, and aVF are the right lead-augmented vector, left lead-augmented vector, and lead-augmented vector foot, respectively, of the 12-lead ECG.
Chagas Disease and Migration

- **Epidemiological History in Migrant and Travelers**
  - Rural areas in Latin American countries
  - Countries with endemic areas
  - Some urban areas in Latin America
  - Dwelling or house conditions
  - Bugs presence
  - Disease presence in the family or community
  - Blood transfusions history
  - Recipient of transplant organ
  - Seropositive mother


Chagas Disease and Migration

- **Diagnosis**
  - Clinical and epidemiological
  - Parasitological
  - Serological
  - Molecular
  - Pathology: biopsy/necropsy

- **Phases**
  - Acute
  - Indeterminate
  - Chronic
  - Asymptomatic/Symptomatic
Chagas Disease and Migration

- Cardiovascular Diagnosis: Los Andes Classification

Chagas Disease and Migration

- According to the modified Kuschnir classification (KC), the Brazilian Consensus classification (BCC), the modified Los Andes classification (MLAC), and the classification incorporating American College of Cardiology/American Heart Association (ACC/AHA) staging (A–AAA/AHA)

---

**TABLE 3. Summary of classification schemes/staging systems for heart involvement in chronic Chagas’ disease**

<table>
<thead>
<tr>
<th>Classification scheme or staging system (reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First stage, indeterminate form</td>
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<tr>
<td>No evidence of heart involvement by:</td>
</tr>
<tr>
<td>ECG and CXR (stage 0 KC) (177)</td>
</tr>
<tr>
<td>ECG, echocardiogram, and signs of CHF (stage IA MLAC) (69)</td>
</tr>
<tr>
<td>ECG, echocardiogram, CXR, and NYHA functional class (stage A-ACC/AHA) (15, 151)</td>
</tr>
<tr>
<td>Second stage: CCC without signs or symptoms of heart failure</td>
</tr>
<tr>
<td>Evidence of structural heart disease by:</td>
</tr>
<tr>
<td>ECG +/- CXR (stage I-II KC) (177)</td>
</tr>
<tr>
<td>ECG +/- echocardiogram (stage A-B2 BCC) (3)</td>
</tr>
<tr>
<td>Echocardiogram +/- ECG (stage IB-II MLAC) (69)</td>
</tr>
<tr>
<td>ECG (stage B A-ACC/AHA) (15, 151)</td>
</tr>
<tr>
<td>Third stage: compensated CCC</td>
</tr>
<tr>
<td>Takes into account symptoms</td>
</tr>
<tr>
<td>Compensated CHF (stage C BCC) (3)</td>
</tr>
<tr>
<td>NYHA II–III (stage C A-ACC/AHA) (15, 151)</td>
</tr>
<tr>
<td>Fourth stage: overt, refractory, or advanced CCC</td>
</tr>
<tr>
<td>Includes:</td>
</tr>
<tr>
<td>Stage III from the KC and the MLAC (69, 177)</td>
</tr>
<tr>
<td>Stage D from the BCC and the A-ACC/AHA classification (3, 15, 151)</td>
</tr>
</tbody>
</table>
Chagas Disease and Migration

• **Serological Diagnosis**
  - Acute Phase
    - High levels of IgM (> 1:512)
    - Low levels of IgG (< 1:256)
  - Chronic Phase
    - High levels of IgG (> 1:512)
    - Low levels of IgM (< 1:256)
  - Indeterminate Phase (asymptomatic)
    - Low levels of IgM (< 1:256)
    - Low levels of IgG (< 1:256)

Chagas Disease and Migration

- **Acute Phase Clinical Features**
  - Incubation period of 7 to 15 days
  - Chagoma
  - Conjunctival inoculation: triad of conjunctivitis, periorbital edema, and preauricular lymphadenopathy (Romaña sign)
  - Systemic dispersion of multiplying parasites during the acute phase may be asymptomatic or may manifest as
    - fever, tachycardia, malaise, lymphadenopathy, hepatosplenomegaly, edema, vomiting, diarrhea, anorexia, and/or rash.

Von et al, J Infect Develop Countr 2007
Chagas Disease and Migration

• Importance of *T. cruzi* in chronic phase:
  - Britto C et al. Mem Inst Oswaldo Cruz 2001

![Moderate myocarditis - no T. cruzi](image1)

![T. cruzi antigen (arrows)](image2)

Chagas Disease Pathogenetic Mechanisms in Chronic Chagas Cardiomyopathy

Marin-Neto, Circulation 2007

Figure 7. Schematic view of main pathogenetic mechanisms in chronic Chagas cardiomyopathy.
Chagas Disease and Migration

- **Medical Antiparasite Therapy**
  - Only two drugs are widely available and approved for use in Chagas Disease:
    - Nifurtimox (Bayer 2502, Lampit®)
    - Benznidazol (Rochagam®, Radanil®)
  - Other experimental therapies
    - Drugs used in other medical conditions
      - Itraconazole, Ravaconazole, Posaconazole, Fluconazole
      - Alendronate, risedronate, pamidronate, ibandronate
    - Allopurinol, Verapamil
Chagas Disease and Migration

- **Trypanosoma cruzi** and transplantation
  - Reactivation of latent infection in immunosuppressed individuals, such as the HIV-infected and transplant recipients
  - Reactivates from the donated organ or in a previously infected host due to immunosuppression in transplant recipients
  - Transmitted through blood transfusion.

Chagas Disease and Migration

• Reactivation Clinical Features:
  • Myocarditis (acute)
  • Meningoencephalitis
  • Dermatologic lesions associated to the use of high dose corticosteroids
  • Clinically, cutaneous Chagas disease may produce
    • indurated erythematous plaques with necrosis
    • erythematous papules
    • nodules
    • panniculitis
    • skin ulcerations.

Chagas Disease and Migration

- Overall integrative screening recommendations for tropical infections in transplant donors/recipients:
  - Comprehensive medical history, history of travel, residence, occupation, animal exposure is critical to have a suspicion of latent or active tropical infectious diseases*
  - Laboratory values (eosinophilia, elevated liver enzymes, and other parameters) can help to assess the risk for latent or active tropical parasitic, viral, bacterial, or fungal infections
  - Indications of screening for strongyloidiasis and schistosomiasis in donors and recipients should be based on having a history of travel or residence in an endemic area; having a history of eosinophilia or a history of unexplained gastrointestinal symptoms

*Some of these are for screening for elective organ transplantation and some should be considered as diagnostic testing for those who have received transplantation and who may be suffering from a tropical infectious disease
Chagas Disease and Migration

- Overall screening recommendations for tropical infections in transplant donors/ recipients:
  - Screening for *Trypanosoma cruzi* infection should be based on having a history of travel or residence in an endemic area (not necessarily a country with endemic areas), or having cardiac or gastrointestinal symptoms that may suggest Chagas disease.
  - Serologic testing for viral infections, particularly HTLV–1 and dengue, should be considered when there is a clinical suspicion or if the patient has resided in a highly endemic area.
Chagas Disease and Migration

- Overall screening recommendations for tropical infections in transplant donors/recipient:
  - Blood cultures, peripheral blood smears (T. cruzi infection, malaria), cultures of respiratory specimens (penicilliosis), serologic testing (strongyloidiasis or schistosomiasis), and biopsies of lymph nodes (paracoccidioidomycosis) or affected tissues (free-living pathogenic amoebas) may be useful for diagnosis of tropical infections in transplant recipients depending on clinical history and previous epidemiologic exposures.

Chagas Disease and Migration

• Public Health Implications
  • Blood bank surveillance
  • Testing looking for antibodies against *Trypanosoma cruzi*
  • Recombinant antigens serologies (eg. TESA-blot)
  • Focused tested based on latin american migration patterns vs routine testing in any blood bank (eg. AABB in USA)
  • Rapid tests
  • PCR-based techniques are preferred for confirmation
Figure 2. Main stakeholders and associated activities involved in the implementation of the vector control intervention. Different strategies for implementation were discussed in an iterative process over several meetings until the stakeholders reached an agreement on what was perceived as the best implementation strategy. Each stakeholder played a different role in the implementation process and was responsible for the specific activities indicated in each box.
Bibliometric Assessment of the Contributions of Literature on Chagas Disease in Latin America and the Caribbean

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Received: November 19, 2014; Revised: February 17, 2015; Accepted: March 27, 2015.
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Juan C. Dib (Universidad Cooperativa, Colombia)
Wilmer Villamil-Gómez (HUS, Sincelejo, Colombia)
Angel A. Escobedo (HUPB, La Habana, Cuba)
Gracias

Thanks

Pereira, Risaralda, Colombia

Bedankt