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**Chagas Disease** Transmission Sources and **Cardiac Outcomes** among Texas Blood Donors

Melissa Garcia, MPH STPRA Chagas Seminar 6 May 2014



- •History of Chagas disease in Texas & US
- •Seroprevalence estimates of Texans
- •Houston area human disease transmission sources
- Cardiac manifestations of Chagas in Texas residents















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# **Sylvatic vs Domestic Transmission Cycles**









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### >30% develop cardiac outcomes



Marin-Neto J A et al. Circulation 2007;115:1109-1123

Pediatrics ftp://ftp.cdc.gov/pub/infectious\_diseases/iceid\_2002/pdf/schmunis.pdf

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### Diagnosis

- Acute Phase
  Microscopic examination
  PCR
  Chronic Phase:
- Two positive test results
  ELISA (multiple), IB, IFA
  Clinical history & exposure
  - Locally acquired cases







# Treatment

Investigative Drug Protocol under CDC regulation

•Approved by CDC for distribution

•Treatment Failure in 19-97% of patients

Drug	Age group	Dosage and duration	
Benznidazole	< 12 years	10 mg/kg per day orally in 2 divided doses for 60 days	
	12 years or older	5-7 mg/kg per day orally in 2 divided doses for 60 days	
Nifurtimox	$\leq 10$ years	15-20 mg/kg per day orally in 3 or 4 divided doses for 90 days	
	11-16 years	12.5-15 mg/kg per day orally in 3 or 4 divided doses for 90 days	
	17 years or older	8-10 mg/kg per day orally in 3 or 4 divided doses for 90 days	

Jackson et al. 2013. BMC Infect Dis. Pinazo MJ et al. 2010. Antimicrobial Agents and Chemotherapy



# **History of Chagas Disease in**

# **Texas and the United States**



### Chagas Disease in a Domestic Transmission Cycle in Southern Texas, USA

Charles B. Beard,\* Greg Pye,† Frank J. Steurer,\* Ray Rodriguez,‡ Richard Campman,† A. Townsend Peterson,§ Janine Ramsey,¶ Robert A. Wirtz,\* and Laura E. Robinson†

After three dogs died from acute Chagas cardiomyopathy at one location, an investigation was conducted of the home, garage, and grounds of the owner. A serologic study was conducted on stray dogs, and an ecologic niche model was developed to predict areas where the vector *Triatoma gerstaeckeri* might be expected.



Figure 5. Genetic Algorithm for Rule-set Prediction-generated ecologic tiche model, predicting distribution of *Triatoma gerstaeckeri*. Small cirsles show actual collection sites. Area in dark red is where high cerainty exists for the specific niche of the species. The area in light red is he zone of moderate certainty, and the area in gray is for low certainty.

Emerging Infectious Diseases • Vol. 9, No. 1, January 2003



### An Estimate of the Burden of Chagas Disease in the United States

#### Caryn Bern and Susan P. Montgomery

Division of Parasitic Diseases, National Center for Zoonotic, Vector-Borne and Enteric Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia

Chagas disease causes the highest burden of any parasitic disease in the Western hemisphere. By applying published seroprevalence figures to immigrant populations, we estimate that 300,167 individuals with *Try-panosoma cruzi* infection live in the United States, with 30,000–45,000 cardiomyopathy cases and 63–315 congenital infections annually. *T. cruzi* causes a substantial disease burden in the United States.

Table 1. Calculated Prevalence of Trypanosoma cruzi Infections in Latin American-

Born Persons living in the United States in 2005						
Country of origin	Immigrant population living in the United States	<i>T. cruzi</i> prevalence in country of origin, %	Estimated no. of immigrants with <i>T. cruzi</i> infection in the United States			
Mexico	16,963,851	1.03	174,388			
El Salvador	1,458,014	3.37	49,164			
Guatemala	1,014,669	1.98	20,131			
Honduras	567,002	3.05	17,311			
Argentina	223,931	4.13	9246			
Ecuador	345,204	1.74	6003			
Colombia	554,821	0.96	5304			
Brazil	501,036	1.02	5106			
Bolivia	61,453	6.75	4149			
Nicaragua	223,931	1.14	2553			
Peru	371,980	0.69	2552			
Venezuela	151,350	1.16	1754			
Chile	92,761	0.99	914			
Costa Rica	95,761	0.53	509			
Paraguay	16,707	2.54	425			
Uruguay	51,737	0.66	339			
Belize	42,130	0.74	312			
Panama	107,601	0.01	6			
Total	22,843,939	1.31	300,167			



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### DONOR INFECTIOUS DISEASE TESTING

### The United States *Trypanosoma cruzi* Infection Study: evidence for vector-borne transmission of the parasite that causes Chagas disease among United States blood donors

Paul T. Cantey, Susan L. Stramer, Rebecca L. Townsend, Hany Kamel, Karen Ofafa, Charles W. Todd, Mary Currier, Sheryl Hand, Wendy Varnado, Ellen Dotson, Chris Hall, Pamela L. Jett, and Susan P. Montgomery

#### TRANSFUSION Volume 52, September 2012

- 23 autochthonous cases
- 28 states have vector
- 17 states have infected reservoir

State	Vector	Infected reservoir
Alabama	Yes	Yes
Arizona	Yes	Yes
Arkansas	Yes	
California	Yes	Yes
Colorado	Yes	
Florida	Yes	Yes
Georgia	Yes	Yes
Hawaii	Yes	
Illinois	Yes	
Indiana	Yes	
Kansas	Yes	
Kentucky	Yes	Yes
Louisiana	Yes	Yes
Maryland	Yes	Yes
Mississippi	Yes	Yes
Missouri	Yes	Yes
Nevada	Yes	
New Jersey	Yes	
New Mexico	Yes	Yes
North Carolina	Yes	Yes
Ohio	Yes	
Oklahoma	Yes	Yes
Pennsylvania	Yes	
South Carolina	Yes	Yes
Tennessee	Yes	Yes
Texas	Yes	Yes
Utah	Yes	
Virginia	Yes	Yes





AABB Chagas Biovigilance Network



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Pediatrics

How many people have *T. cruzi* infection in Texas now?

# And who are they?



# Methods

•Blood center T cruzi testing

- -2008-2012
- Ortho or Abbott Repeat Reactive
- -RIPA confirmation
- •Demographic info

•Zip code data from US Census -Percent Poverty & Rural Land Use





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907,398 tested 261 repeat reactive **140 RIPA** confirmation



### 1 per 6,500 confirmed positive for T. cruzi infection



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# *T cruzi* RIPA positive per 100,000 blood donors by age





















# **Cost estimates for Texas Chagas cases**

•Societal cost for healthcare & lost wages \$2.7 million\*

# •Accrue 104 disability-adjusted life years lost as a result of chronic Chagas disease\*

\*\$91, 531 per case; 3.57 DALYs per year- Lee et al 2013 Lancet Infect Dis Cost estimates: 30% RIPA confirmed



# **Seroprevalence Study Conclusions**

### •1 PER 6,500 BLOOD DONORS confirmed *T. cruzi* infection

-Substantial societal economic burden for care of these persons

### Positive donors associated with POVERTY and RURAL LAND use



### What is the human source of *T. cruzi*

infection?

### What are the routes of disease transmission?



# **Houston Pilot Study: Methods**

Invited RIPA + & RIPA – blood donors from GCRBC

- 57% (17/30) of those who screened positive were confirmed

•The one-time assessment included:

- -1) a questionnaire to evaluate risk factors for infection
  - Co-morbities, travel history, source of disease transmission
- -2) blood draw for biomarker evaluation
- -3) an electrocardiogram

•an echocardiogram for those with an abnormal ECG



### 36% (6/17) were locally acquired

Study ID	Age	Race	Gender	Place of Birth	Occupational Exposure	Hunter	Camper	Travel to Endemic Rural Area	Report Seeing Vector Around TX Residence
Tcruzi- 002	75	Hispanic	Male	Robstown, Texas	No	No	Yes (10+ years)	No	No
Tcruzi- 004	54	White	Female	Halletsville, Texas	No	No	No	No	No
Tcruzi- 006	66	White	Male	Baycity, Texas	Yes (cotton farmer 23 years)	Yes (whole life)	No	No	Yes
Tcruzi- 007	75	White	Male	Rogers, Texas	No	Yes (whole life)	No	No	No
Tcruzi- 012	68	Hispanic	Female	Cerralvo, Mexico	No	No	No	Yes	Yes
Tcruzi- 026	23	White	Male	Pasadena, Texas	No	No	Yes (15 years)	No	No







# Study participant #Tcruzi-006

### •65-year-old Caucasian male

- no history of travel to endemic countries
- cotton farmer for 20+ years
- Avid hunter who never wore gloves during skinning
- reported frequent visits to a nearby deer lease
- Deer lease was infested with vector
  - PCR testing was T. cruzi positive
  - Blood meal analysis was positive for human DNA





# Implications for High-risk Occupational Exposure in US



•5 million with extensive time outdoors

178,000
 working
 during
 nocturnal
 feeding time



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# Implications for Hunting as a High-risk activity for transmission

Direct blood-to-blood
 transmission via skinning

Inadequate lodging

 Increased exposure to vector



Photo credit: Victor Quispe-Machaca



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# Houston transmission conclusions

•1/3 of Houston area confirmed Chagas cases are locally acquired

•High risk populations for transmission

- -Occupational Exposure
  - •Farming, Forestry, Landscaping
- -Camping
- -Hunting



### Are those infected with T. cruzi in

### Texas developing cardiac

# disease?



•41% (7/17) Abnormal ECG Finding

- -72% (5/7) were major abnormalities
- -57% (4/7) were potentially locally acquired
- -14% (1/7) had ECHO abnormality
- -57% (4/7) had Hypertension
- -14% (1/7) had Diabetes
- -None have received treatment prior to study







# Tcruzi-002 ECG

• 75 year old Hispanic Male

•Atrial paced with right bundle branch block

•Left anterior fascicular block

 1st degree atrioventricular block



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# Tcruzi-014 ECG

• 43 year old Hispanic Female

 Right bundle branch block

Left axis deviation



# Tcruzi-003

### Control





# Tcruzi-003

### Control





# Can we predict who is at risk for developing cardiac disease?



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# HsTnT biomarker levels by disease status







High Sensitivity Troponin T could be an important biomarker for advanced Chagas cardiomyopathy



# **Cardiology Pilot Study Conclusions**

• *T. cruzi* infection can cause cardiac manifestations, even in persons without travel to Latin & South America

•High Sensitivity Troponin T could be an important biomarker for stratifying cardiac disease severity

•Idiopathic cardiomyopathy patients should be tested for *T. cruzi* infection



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