



Baylor College of Medicine

Texas Children's Hospital

SABIN VACCINE INSTITUTE

Texas Task Force on Infectious Diseases Preparedness & Response

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Texas Children's Hospital Endowed Chair in Tropical Pediatrics

Dean, National School of Tropical Medicine at Baylor College of Medicine

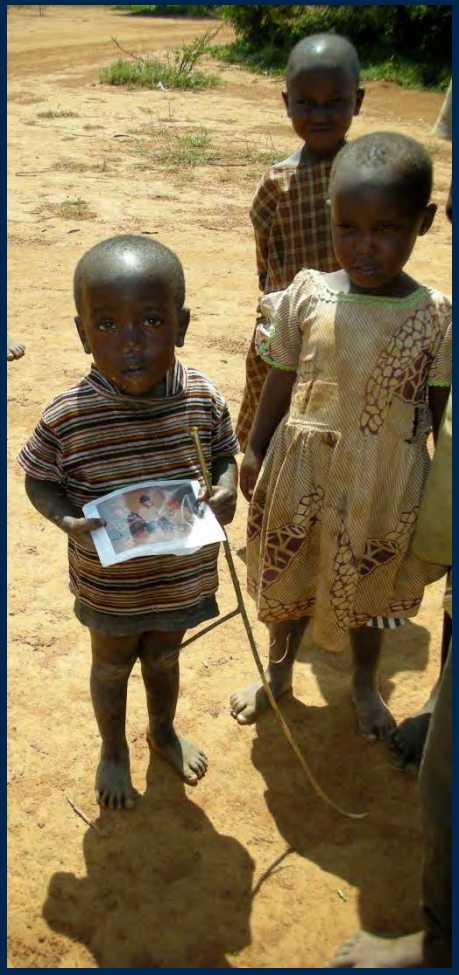
U.S. Science Envoy
@PeterHotez

From the MDGs to the SDGs

2000-15 MDGs

2016 SDGs

The Millennium Development Goals



1. Eradicate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, malaria, and other diseases.
7. Ensure environmental sustainability.
8. Develop a global partnership for development.

The Global Burden of Disease Study

Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010

Rafael Lozano, Mohsen Naghavi, Kyle Foreman, Stephen Lim, Kenji Shibuya, Victor Aboyans*, Jerry Abraham*, Timothy Adair*, Rakesh Aggarwal*, Stephanie Y Ahn*, Miriam Alvarado*, H Ross Anderson*, Laurie M Anderson*, Kathryn G Andrews*, Charles Atkinson*, Larry M Baddour*, Suzanne Barker-Collo*, David H Bartels*, Michelle L Bell*, Emelia J Benjamin*, Derrick Bennett*, Kavi Bhalla*, Boris Bikbov*, Aref Bin Abdulhak*, Gretchen Birbeck*, Fiona Blyth*, Ian Bolliger*, Soufiane Boufous*, Chiara Bucello*, Michael Burch*, Peter Burney*, Jonathan Carapetis*, Honglei Chen*, David Chou*, Sumeet S Chugh*, Luc E Coffeng*, Steven D Colan*, Samantha Colquhoun*, K Ellicott Colson*, John Condon*, Myles D Connor*, Leslie T Cooper*, Matthew Corriere*, Monica Cortinovis*, Karen Courville de Vaccaro*, William Couser*, Benjamin C Cowie*, Michael H Criqui*, Marita Cross*, Kaustubh C Dabhadkar*, Nabila Dahodwala*, Diego De Leo*, Louisa Degenhardt*, Allyne Delossantos*, Julie Denenberg*, Don C Des Jarlais*, Samath D Dharmaratne*, E Ray Dorsey*, Tim Driscoll*, Herbert Duber*, Beth Ebel*, Patricia J Erwin*, Patricia Espindola*, Majid Ezzati*, Valery Feigin*, Abraham D Flaxman*, Mohammad H Forouzanfar*, Francis Gerry R Fowkes*, Richard Franklin*, Marlene Fransen*, Michael K Freeman*, Sherine E Gabriel*, Emmanuela Gakidou*, Flavio Gaspari*, Richard F Gillum*, Diego Gonzalez-Medina*, Yara A Halasa*, Diana Haring*, James E Harrison*, Rasmus Havmoeller*, Roderick J Hay*, Bruno Hoen*, Peter J Hotez*, Damian Hoy*, Kathryn H Jacobsen*, Spencer L James*, Rashmi Jasrasaria*, Sudha Jayaraman*, Nicole Johns*, Ganesan Karthikeyan*, Nicholas Kassebaum*, Andre Keren*, Jon-Paul Khoo*, Lisa Marie Knowlton*, Olive Kobusingye*, Adofo Koranteng*, Rita Krishnamurthi*, Michael Lipnick*, Steven E Lipshultz*, Summer Lockett Ohno*, Jacqueline Mabweijano*, Michael F MacIntyre*, Leslie Mallinger*, Lyn March*, Guy B Marks*, Robin Marks*, Akira Matsumori*, Richard Matzopoulos*, Bongani M Mayosi*, John H McAnulty*, Mary M McDermott*, John McGrath*, George A Mensah*, Tony R Merriman*, Catherine Michaud*, Matthew Miller*, Ted R Miller*, Charles Mock*, Ana Olga Mocumbi*, Ali A Mokdad*, Andrew Moran*, Kim Mulholland*, M Nathan Nair*, Luigi Naldi*, K M Venkat Narayan*, Kiumarss Nasseri*, Paul Norman*, Martin O'Donnell*, Saad B Omer*, Katrina Ortblad*, Richard Osborne*, Doruk Ozgediz*, Bishnu Pahari*, Jeyaraj Durai Pandian*, Andrea Panozo Rivero*, Rogelio Perez Padilla*, Fernando Perez-Ruiz*, Norberto Perico*, David Phillips*, Kelsey Pierce*, C Arden Pope III*, Esteban Porrini*, Farshad Pourmalek*, Murugesan Raju*, Dharani Ranganathan*, Jürgen T Rehm*, David B Rein*, Guiseppe Remuzzi*, Frederick P Rivara*, Thomas Roberts*, Felipe Rodriguez De León*, Lisa C Rosenfeld*, Lesley Rushton*, Ralph L Sacco*, Joshua A Salomon*, Uchechukwu Sampson*, Ella Sanman*, David C Schwebel*, Maria Segui-Gomez*, Donald S Shepard*, David Singh*, Jessica Singleton*, Karen Sliwa*, Emma Smith*, Andrew Steer*, Jennifer A Taylor*, Bernadette Thomas*, Imad M Tleyjeh*, Jeffrey A Towbin*, Thomas Truelsen*, Eduardo A Undurraga*, N Venketasubramanian*, Lakshmi Vijayakumar*, Theo Vos*, Gregory R Wagner*, Mengru Wang*, Wenzhi Wang*, Kerrianne Watt*, Martin A Weinstock*, Robert Weintraub*, James D Wilkinson*, Anthony D Woolf*, Sarah Wulf*, Pon-Hsiu Yeh*, Paul Yip*, Azadeh Zabetian*, Zhi-Jie Zheng*, Alan D Lopez†, Christopher J L Murray†‡

The Global Burden of Disease 2013

Expanded use of vaccines

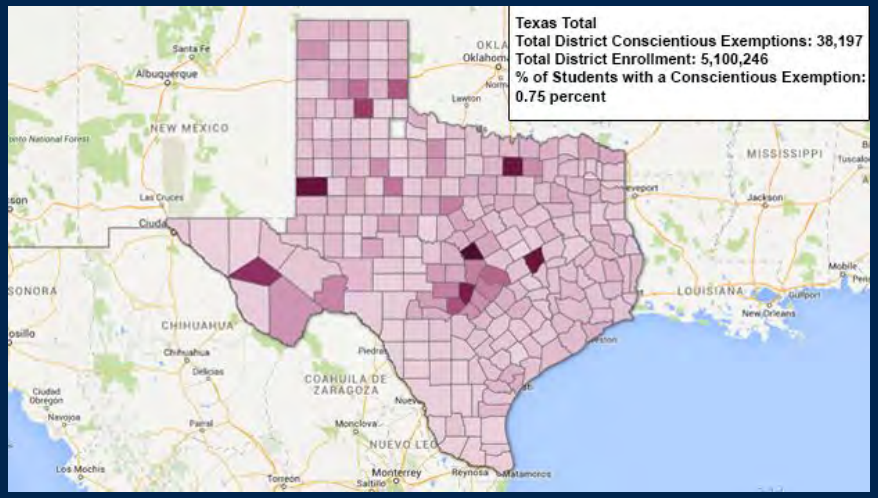
- 83% reduction in measles deaths
- 82% reduction in tetanus deaths
- 57% reduction in diphtheria/pertussis deaths
- 45% reduction in Hib deaths

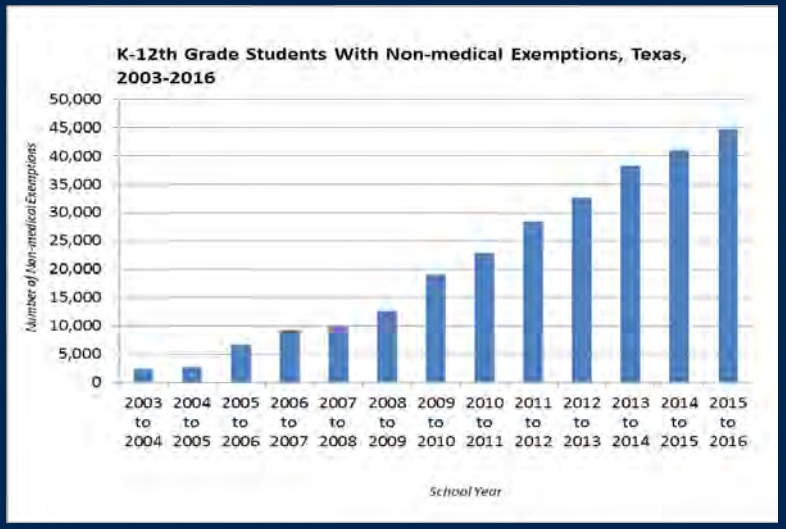
Development new vaccines

- Pneumococcal disease (36% reduction in deaths)
- Rotavirus (63% reduction in deaths)

2.5 million childhood lives saved through these initiatives

TEXANS for Vaccine Choice





- Texas ranks at the bottom of fully immunized children
- 45,000 Personal Belief Exemptions in Texas

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The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Patches of Disorganization in the Neocortex of Children with Autism

Rich Stoner, Ph.D., Maggie L. Chow, Ph.D., Maureen P. Boyle, Ph.D., Susan M. Sunkin, Ph.D., Peter R. Mouton, Ph.D., Subhojit Roy, M.D., Ph.D., Anthony Wynshaw-Boris, M.D., Ph.D., Sophia A. Colamarino, Ph.D., Ed S. Lein, Ph.D., and Eric Courchesne, Ph.D.

ABSTRACT

BACKGROUND

Autism involves early brain overgrowth and dysfunction, which is most strongly evident in the prefrontal cortex. As assessed on pathological analysis, an excess of neurons in the prefrontal cortex among children with autism signals a disturbance in prenatal development and may be concomitant with abnormal cell type and

The Millennium Development Goals

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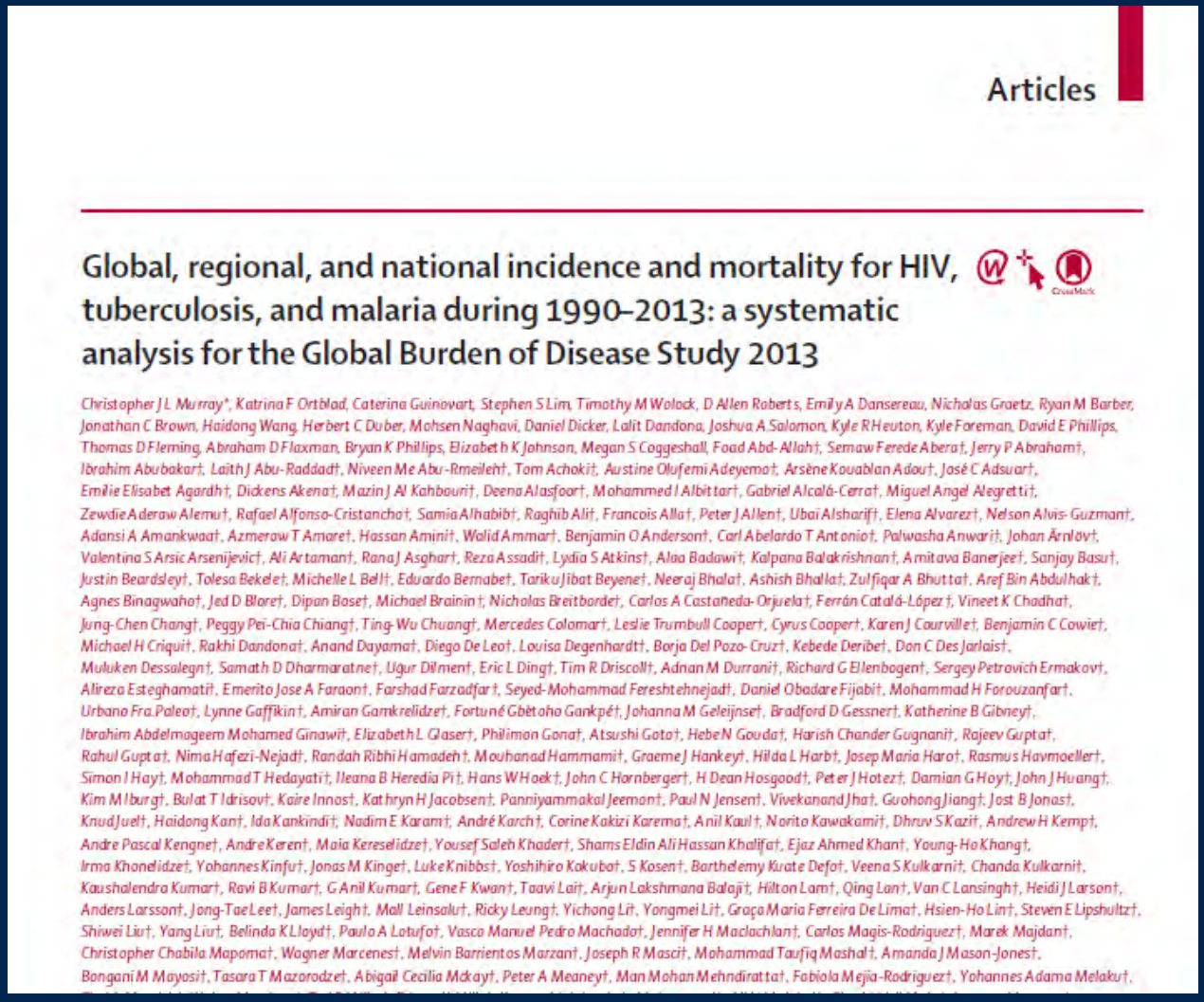

Articles

Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013

Christopher J L Murray*, Katrina F Ortblad, Caterina Guinovart, Stephen S Lim, Timothy M Wolock, D Allen Roberts, Emily A Dansereau, Nicholas Graetz, Ryan M Barber, Jonathan C Brown, Haidong Wang, Herbert C Duber, Mohsen Naghavi, Daniel Dicker, Lalit Dandona, Joshua A Salomon, Kyle R Heuton, Kyle Foreman, David E Phillips, Thomas D Fleming, Abraham D Flaxman, Bryan K Phillips, Elizabeth K Johnson, Megan S Coggeshall, Foad Abd-Allah, Semaw Ferede Aberat, Jerry P Abraham, Ibrahim Abubakar, Laith J Abu-Raddad, Niveen Me Abu-Rmeileh, Tom Achoki, Austine Olufemi Adeyemo, Arsène Kouablan Adou, José C Adsuar, Emilie Elisabet Agardh, Dickens Akena, Mazin J Al Kahbouri, Deena Alasfoor, Mohammed I Albittar, Gabriel Alcalá-Cerra, Miguel Angel Alegretti, Zewdie Aderaw Alemu, Rafael Alfonso-Cristancho, Samia Alhabib, Raghib Ali, Francois Allal, Peter J Allen, Ubai Alsharif, Elena Alvarez, Nelson Alvis-Guzman, Adansi A Amankwaa, Azmeraw T Amare, Hassan Amini, Walid Ammar, Benjamin O Anderson, Carl Abelardo T Antonio, Palwasha Anwari, Johan Ärnlöv, Valentina S Arsic Arsenijevic, Ali Artaman, Rana J Asghar, Reza Assadi, Lydia S Atkins, Alaa Badawi, Kalpana Balakrishnan, Amitava Banerjee, Sanjay Basu, Justin Beardsley, Tolesa Bekele, Michelle L Bell, Eduardo Bernabe, Tariku Jibat Beyene, Neeraj Bhala, Ashish Bhalla, Zulfiqar A Bhutta, Aref Bin Abdulhak, Agnes Binagwaho, Jed D Blore, Dipan Bose, Michael Brainin, Nicholas Breitborde, Carlos A Castañeda-Orjuela, Ferrán Catalá-López, Vineet K Chadha, Jung-Chen Chang, Peggy Pei-Chia Chiang, Ting-Wu Chuang, Mercedes Colomar, Leslie Trumbull Cooper, Cyrus Cooper, Karen J Courville, Benjamin C Cowie, Michael H Criqui, Rakhi Dandona, Anand Dayama, Diego De Leo, Louisa Degenhardt, Borja Del Pozo-Cruz, Kebede Deribe, Don C Des Jarlais, Muluken Dessalegn, Samath D Dharmaratne, Ugur Dilmen, Eric L Ding, Tim R Driscoll, Adnan M Durrani, Richard G Ellenbogen, Sergey Petrovich Ermakov, Alireza Esteghamati, Emerito Jose A Faraon, Farshad Farzadfar, Seyed-Mohammad Fereshtehnejad, Daniel Obadare Fijabi, Mohammad H Forouzanfar, Urbano Fra Paleo, Lynne Gaffikin, Amiran Gamkrelidze, Fortuné Gbètoho Gankpé, Johanna M Geleijnse, Bradford D Gessner, Katherine B Gibney, Ibrahim Abdelmageem Mohamed Ginawi, Elizabeth L Glaser, Philimon Gona, Atsushi Goto, Hebe N Gouda, Harish Chander Gugnani, Rajeev Gupta, Rahul Gupta, Nima Hafezi-Nejad, Randah Ribhi Hamadeh, Mouhanad Hammami, Graeme J Hankey, Hilda L Harb, Josep Maria Haro, Rasmus Havmoeller, Simon I Hay, Mohammad T Hedayati, Ileana B Heredia Pi, Hans W Hoek, John C Hornberger, H Dean Hosgood, Peter J Hotez, Damian G Hoy, John J Huang, Kim M Iburg, Bulat T Idrisov, Kaire Innos, Kathryn H Jacobsen, Panniyammakal Jeemon, Paul N Jensen, Vivekanand Jha, Guohong Jiang, Jost B Jonas, Knud Juel, Haidong Kan, Ida Kankindi, Nadim E Karam, André Karch, Corine Kakizi Kerma, Anil Kaul, Norito Kawakami, Dhruv S Kazi, Andrew H Kemp, Andre Pascal Kengne, Andre Keren, Maia Kereselidze, Yousef Saleh Khader, Shams Eldin Ali Hassan Khalil, Ejaz Ahmed Khan, Young-Ho Khang, Irma Khonelidze, Yohannes Kinfu, Jonas M Kinge, Luke Knibbs, Yoshihiro Kokubo, S Kosen, Barthelemy Kuate Defo, Veena S Kulkarni, Chanda Kulkarni, Kaushalendra Kumar, Ravi B Kumar, G Anil Kumar, Gene F Kwan, Taavi Lai, Arjun Lakshmana Balaji, Hilton Lam, Qing Lan, Van C Lansingh, Heidi J Larson, Anders Larsson, Jong-Tae Lee, James Leigh, Mall Leinsalu, Ricky Leung, Yichong Li, Yongmei Li, Graça Maria Ferreira De Lima, Hsien-Ho Lin, Steven E Lipshultz, Shiwei Liu, Yang Liu, Belinda K Lloyd, Paulo A Lotufo, Vasco Manuel Pedro Machado, Jennifer H Maclachlan, Carlos Magis-Rodriguez, Marek Majdan, Christopher Chabila Mapoma, Wagner Marcenes, Melvin Barrientos Marzan, Joseph R Mascie, Mohammad Taufiq Mashal, Amanda J Mason-Jones, Bongani M Mayosi, Tasara T Mazorodze, Abigail Cecilia Mckay, Peter A Meaney, Man Mohan Mehndiratta, Fabiola Mejía-Rodriguez, Yohannes Adama Melaku,

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COMBAT HIV/AIDS, MALARIA AND OTHER DISEASES

- 19 million lives saved from AIDS
- 30% reduction in Malaria

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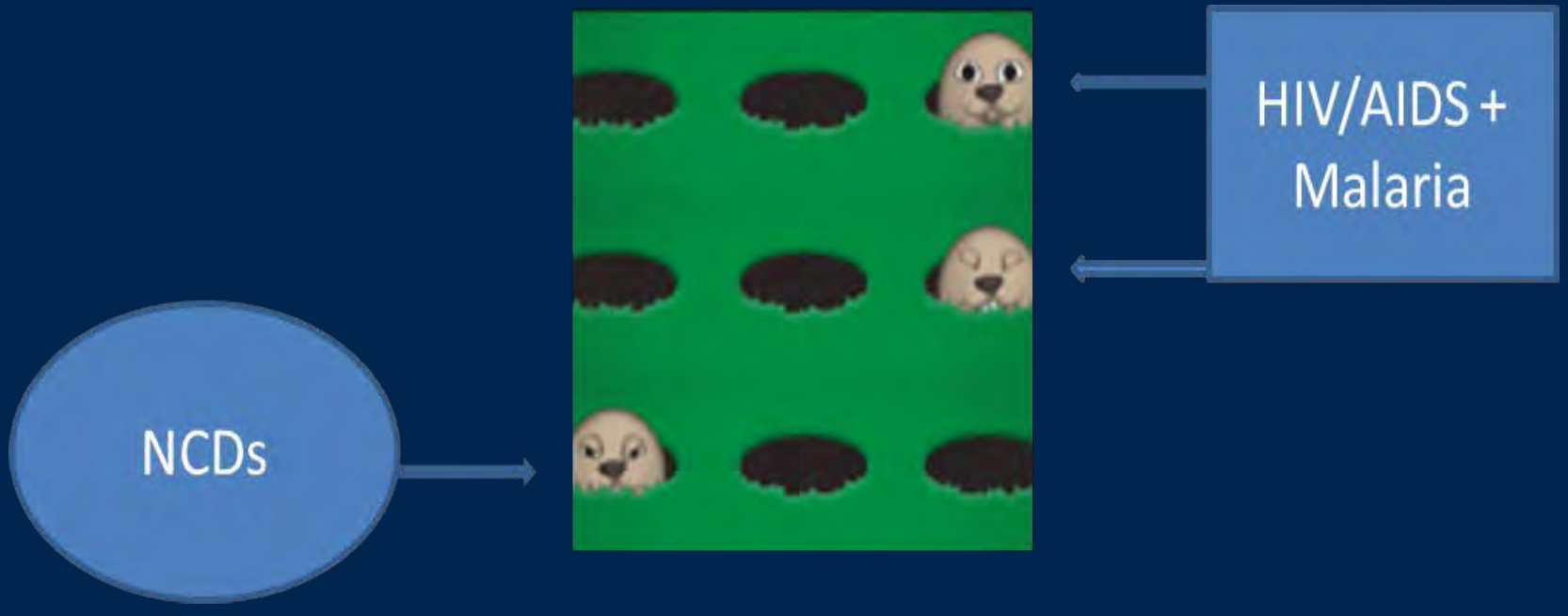
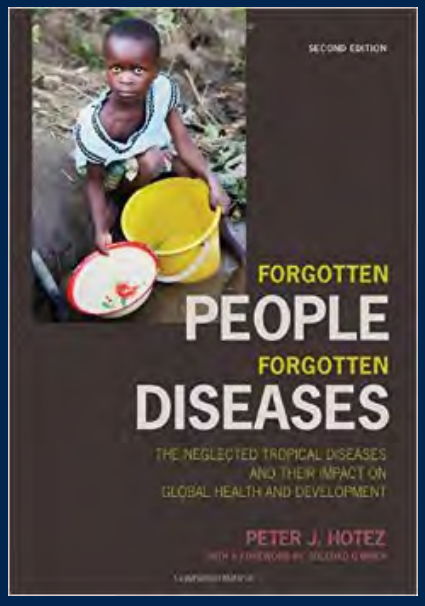
Global Health Whack-a-Mole



“Other Diseases”

The Neglected Tropical Diseases

- 13-14 tropical infections:
  - Highly prevalent among the poor
  - Endemic in rural areas of low-income countries
  - Ancient afflictions
  - Chronic
  - Disabling (growth delays, blindness or disfigurement)
  - Stigmatizing
  - Poverty promoting



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NTDs Global Burden Disease Study 2013-14

• Ascariasis	804.4 million
• Trichuriasis	477.4 million
• Hookworm Disease	471.8 million
• Schistosomiasis	290.6 million
• Food-borne Trematodiases	80.2 million
• Dengue	58.4 million
• Lymphatic Filariasis	43.8 million
• Onchocerciasis	17.0 million
• Chagas disease	9.4 million
• Leishmaniasis	4.0 million
• Zika	4.0 million*
• Trachoma	2.4 million
• Cysticercosis	1.0 million
• Echinococcosis	0.8 million
• Ebola	28,000
• Rabies	23,500
• African Trypanosomiasis	19,700
• Yaws	Not determined
• Buruli ulcer	Not determined

PLOS | NEGLECTED TROPICAL DISEASES

NTD Scale up with the U.S. Government


"Rapid-Impact Interventions": How a Policy of Integrated Control for Africa's Neglected Tropical Diseases Could Benefit the Poor


Incorporating a Rapid-Impact Package for Neglected Tropical Diseases with Programs for HIV/AIDS, Tuberculosis, and Malaria

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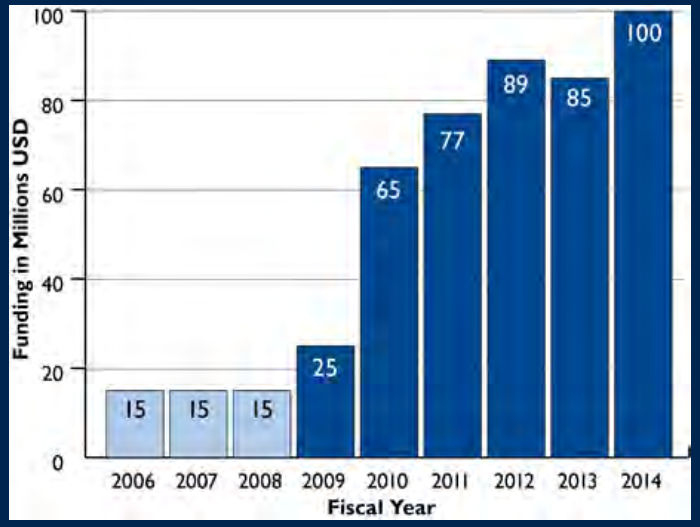
USAID NTD Program



Africa:

Benin
Burkina Faso
Cameroon
DRC
Ghana
Guinea
Mali
Mozambique
Niger
Nigeria
Sierra Leone
Senegal
Tanzania
Togo
Uganda

Asia:

Bangladesh
Cambodia
Indonesia
Philippines
Lao PDR
Nepal
Vietnam

Americas:

Haiti

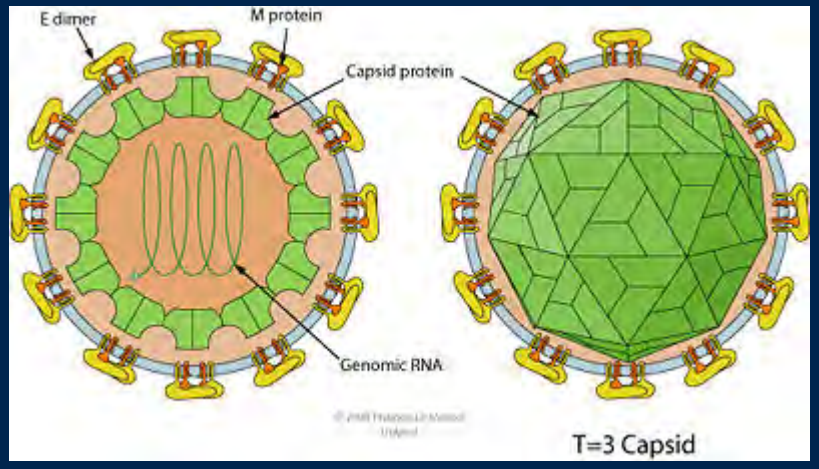
>450 million People Rx

Emergence of Dengue, Zika, and Chikungunya

Zika is an arbovirus and a flavivirus

FLAVIVIRUSES (ss +RNA)

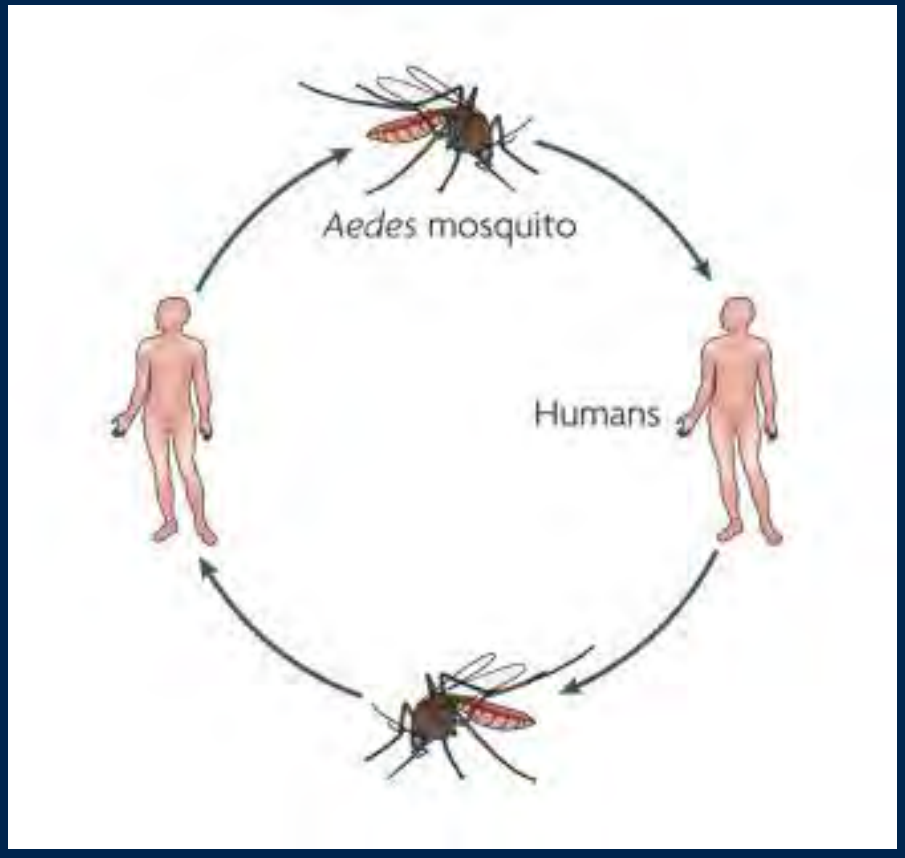
- Dengue Virus
- Yellow Fever Virus
- Japanese Encephalitis Virus
- West Nile Virus
- St. Louis Encephalitis Virus
- Zika Virus



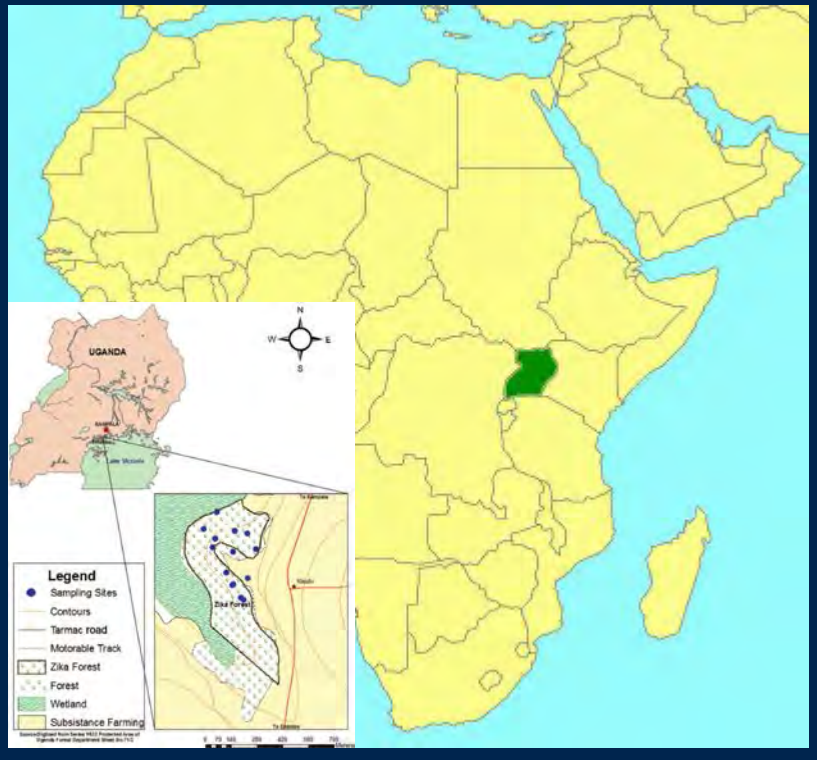
TRANSMITTED BY AEDES MOSQUITOES

- Dengue, YF but NOT WNV

Aedes mosquitoes including *Aedes aegypti (humans)* and *Ae. albopictus (mammals, birds)* in New World



Origins in the Zika Forest of Uganda



Zika means “Overgrowth”
Aedes africanus vector

Found in 1947
Virus Isolation published in 1952
First human case in Nigeria in 1954

14 cases in Africa

Zika Path: Explosive Pacific Outbreaks

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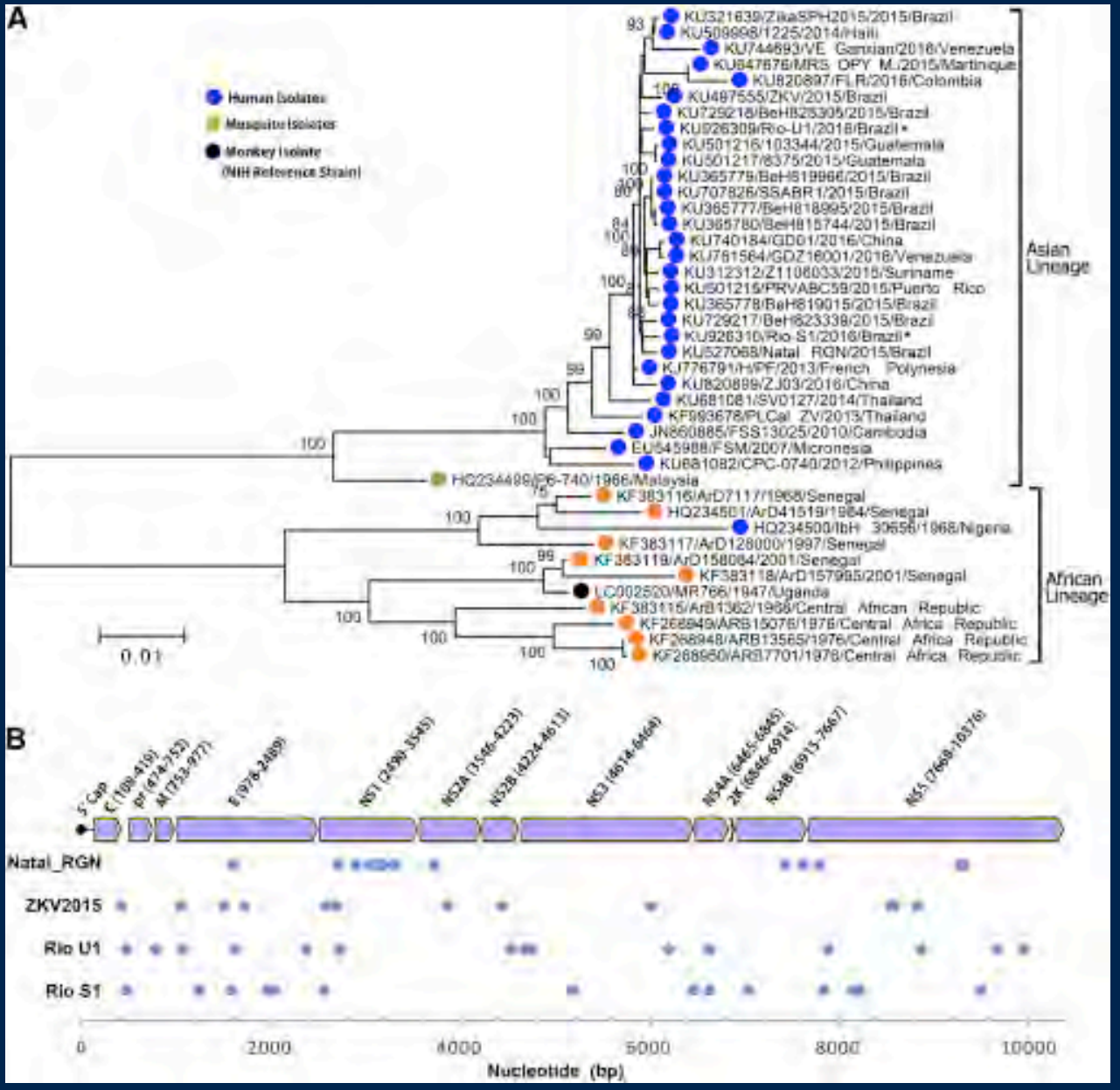
What made Zika spread so quickly?

- Hypothesis 1: Something uniquely Zika*
  - "Pandemic strain" of Zika vs. African strain
  - Codon usage of NS1 gene
  - Increases fitness for replication in human host without changes in protein sequence
  - Codon usage by pandemic strains is optimized for replication in human cells
  - Higher viremias and increased infectivity for mosquitoes
  - Evolutionary strain

*Maj Gen Philip K Russell MD

Asian vs African Lineage

Nucleotide sequences from 41 strains were included in the analysis: 30 human isolates (including two newly reported here), ten mosquito isolates, and one monkey isolate.



From Mosquitos to Humans: Genetic Evolution of **Zika** Virus.
Wang L, Valderramos SG, Wu A, Ouyang S, Li C, Brasil P, Bonaldo M, Coates T, Nielsen-Saines K, Jiang T, Aliyari R, Cheng G. **Cell Host Microbe**. 2016 Apr 14. pii: S1931-3128(16)30142-1. doi: 10.1016/j.chom.2016.04.006. [Epub ahead of print]

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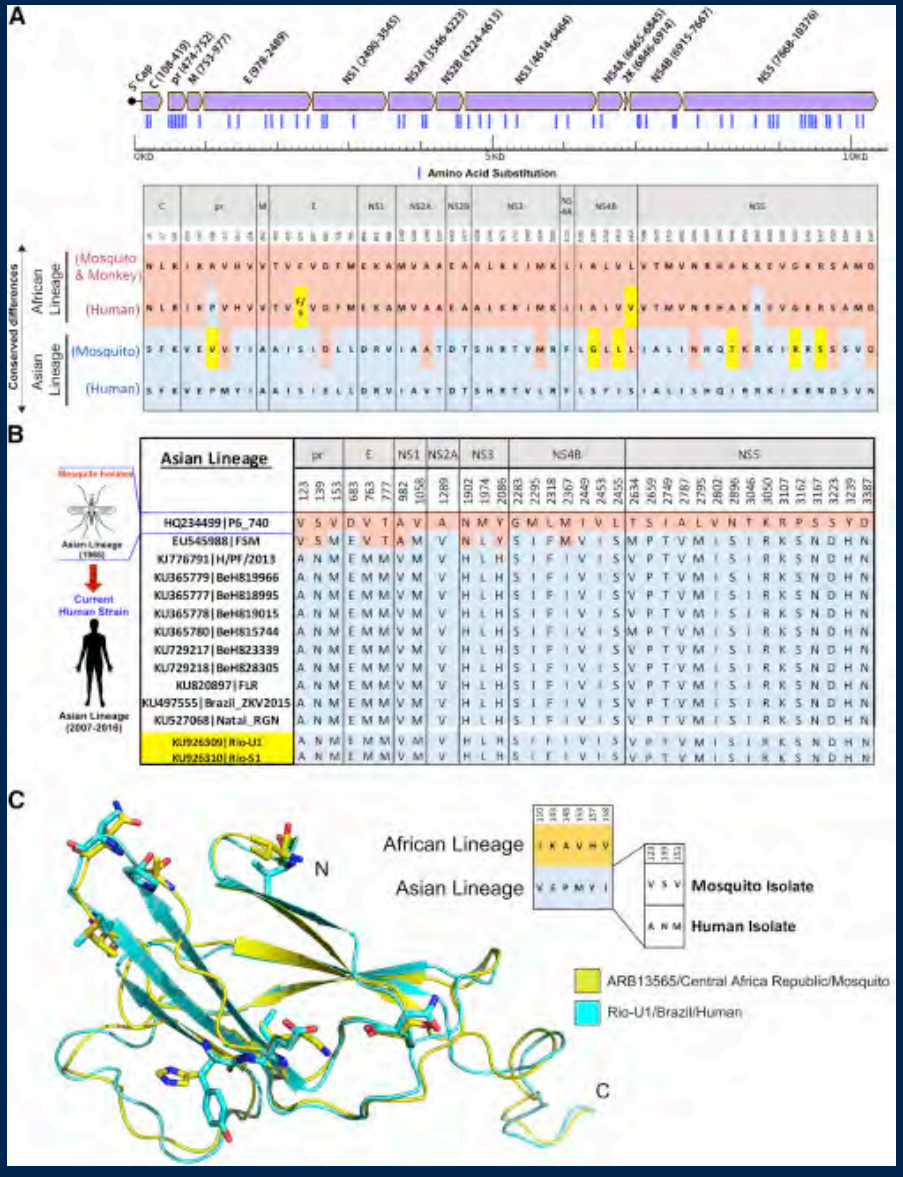
Pre-M Protein

PrM protein of ZIKV shows significant structural alterations

PrM forms a heterodimer with the main viral surface protein, E, in the neutral pH of the lumen of the endoplasmic reticulum (ER)

The role of prM in viral pathogenesis has been under extensive investigation over the past few years. It has been shown that prM plays a critical role in viral assembly, maturation, heterodimer formation with the E protein, particle secretion, and virulence



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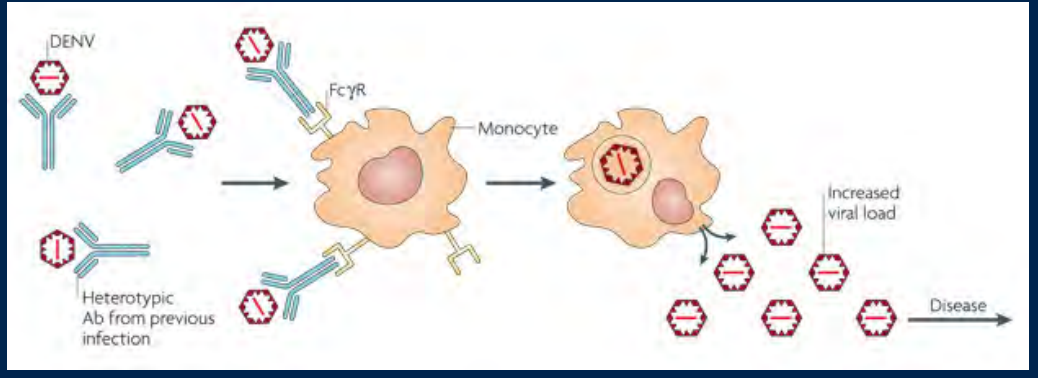
What made Zika spread so quickly?

- Hypothesis 2: Immune enhancement*
  - Previous flavivirus epidemics – dengue or chikungunya
  - Non-neutralizing cross reactive antibodies
  - Penetration of cells through Fc receptor
  - Increased virus replication
  - Zika virus enhanced in culture by heterologous flaviviruses
  - Dengue overlap



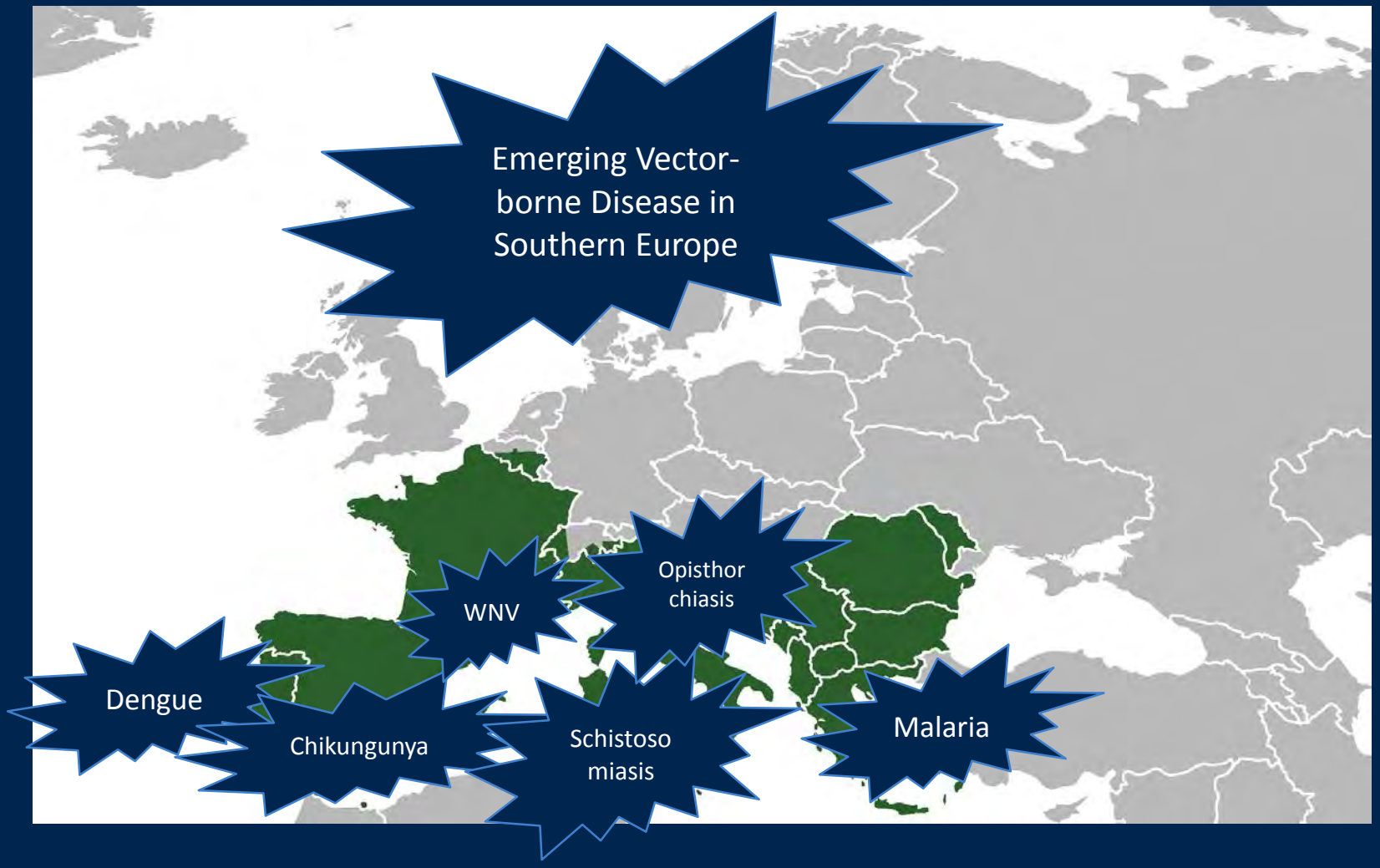
*Maj Gen Philip K Russell MD

What made Zika spread so quickly?

- Hypothesis 3:

- Zika is going by the same playbook used by dengue and chikungunya

- Part of a general expansion of insect and snail-transmitted diseases into the Americas and Europe

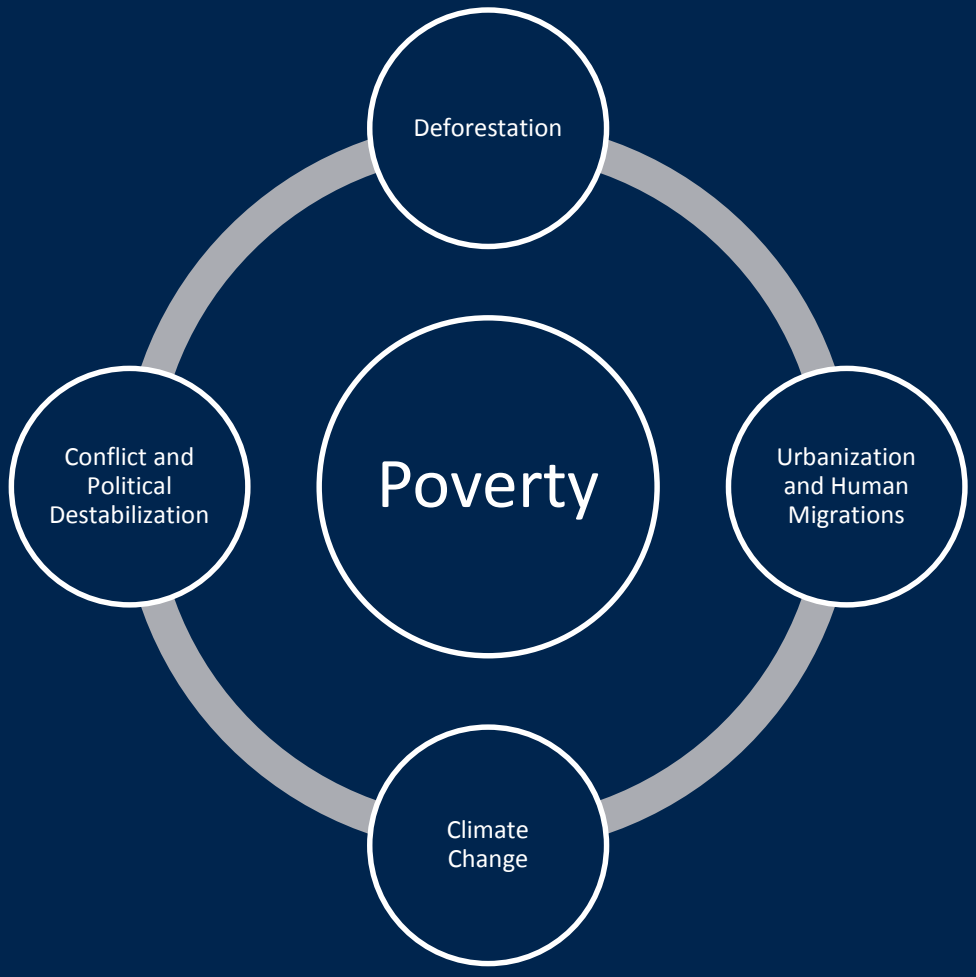


Same thing happening in Southern Europe, Why?

The Anthropocene

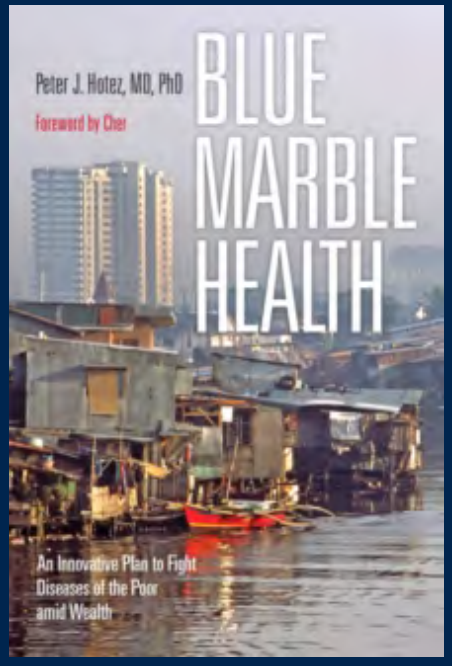
The **Anthropocene** is a proposed epoch that begins when human activities started to have a significant global impact on Earth's geology and ecosystems.

Anthropocene forces promoting NTDs



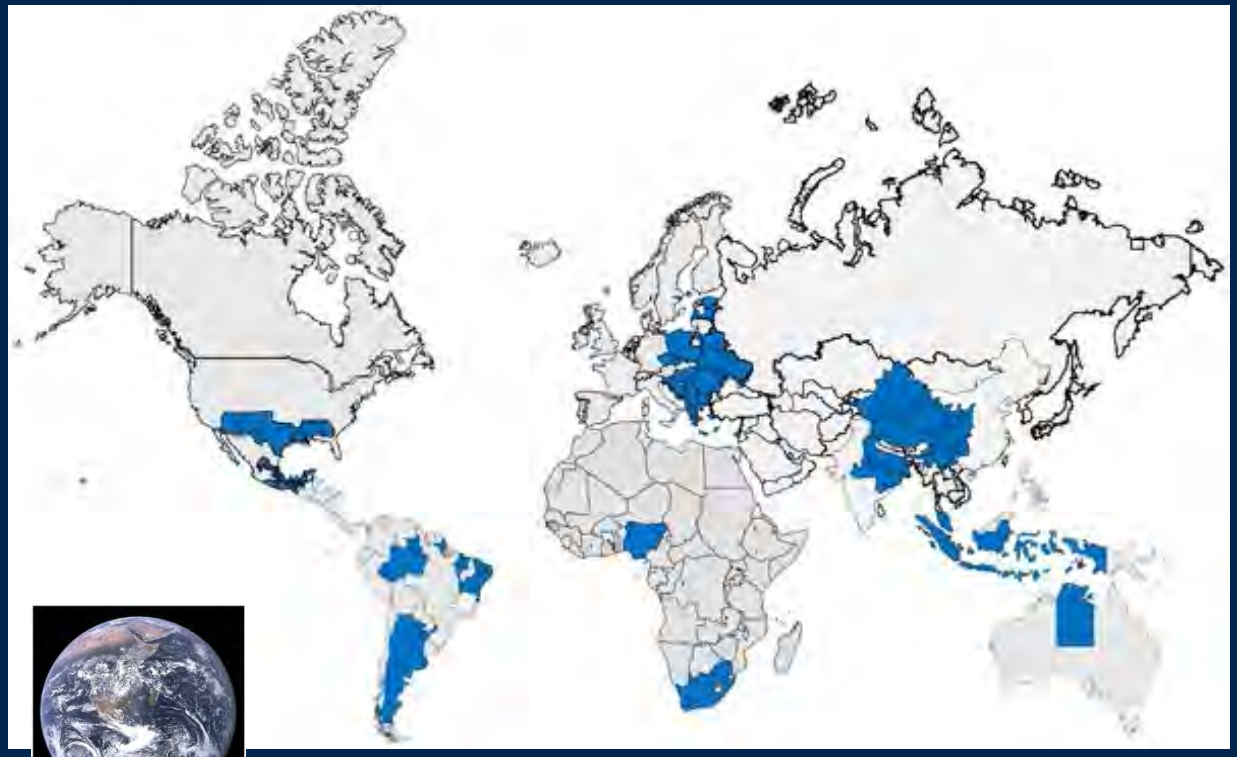
POVERTY: "Blue Marble Health"

- Neglected diseases of the poor living amidst wealth
- A new framework for global science policy and the poverty-related diseases



Blue Marble Health:

The poor living among the wealthy (G20 + Nigeria)



G20 + Nigeria = 54% Population and 86% Global Economy

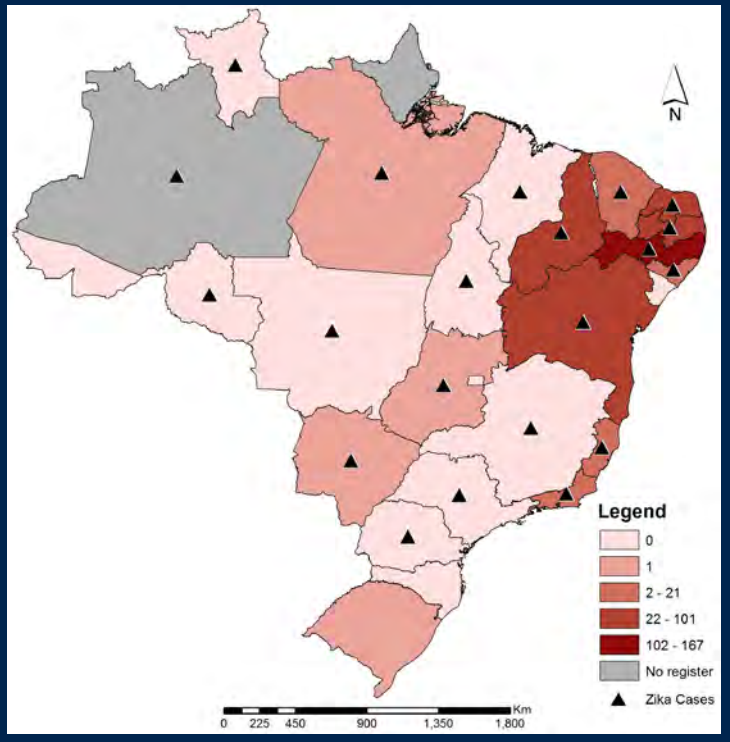
WHO + GBD 2013

- 73-78% Leprosy
- 61-78% Chagas
- 60-61% Dengue
- 57-60% TB
- 45-67% VL
- 50-52% Helminths

- STH
- Schistosomiasis
- Lymphatic Filariasis
- Onchocerciasis

Hotez PJ (2013) NTDs V.2.0: "Blue Marble Health"—Neglected Tropical Disease Control and Elimination in a Shifting Health Policy Landscape. PLoS Negl Trop Dis 7(11): e2570. doi:10.1371/journal.pntd.0002570
http://www.plosntd.org/article/info:doi/10.1371/journal.pntd.0002570

Brazil and Blue Marble Health



Poverty & Disease NE Brazil:
Schistosomiasis, Leishmaniasis, Chagas, Dengue

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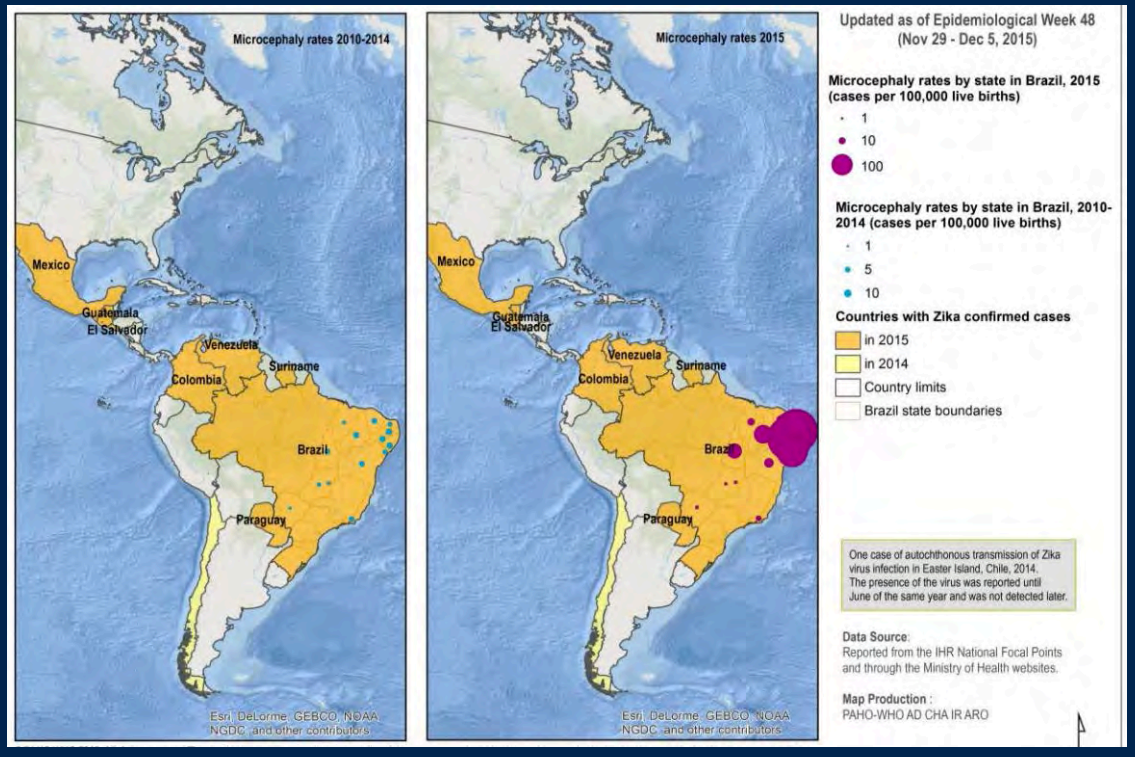
Zika Microcephaly cases in NE Brazil



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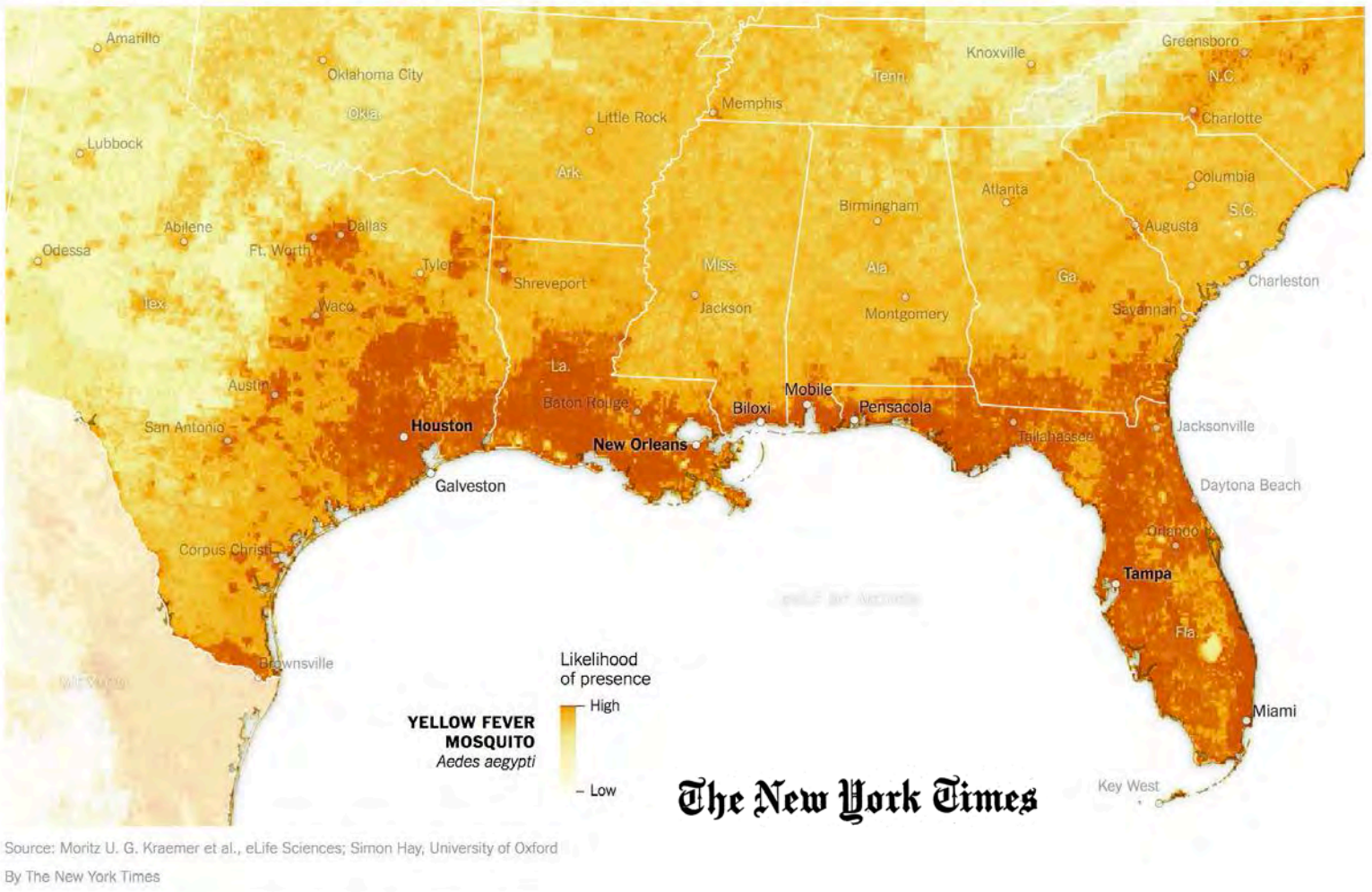
Poverty in Northeastern Brazil

Recife

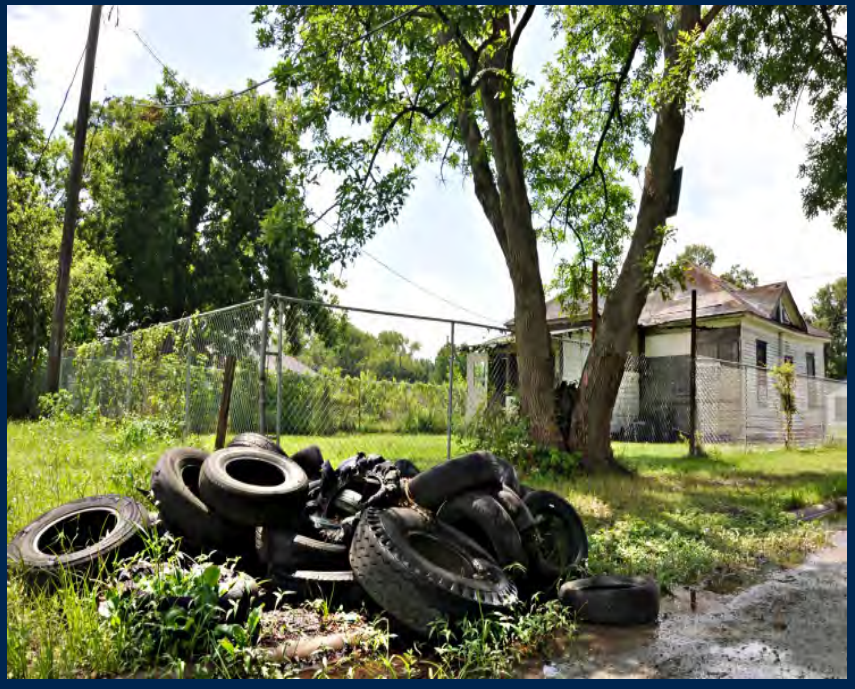
Salvador de Bahia

Spread of Zika in the Americas

Hotez PJ "Zika is Coming"
The New York Times April 9, 2016



Poverty in Houston TX



Houston's Historic Wards

Anna Grove Photographer

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NTDs in Texas & Southern United States

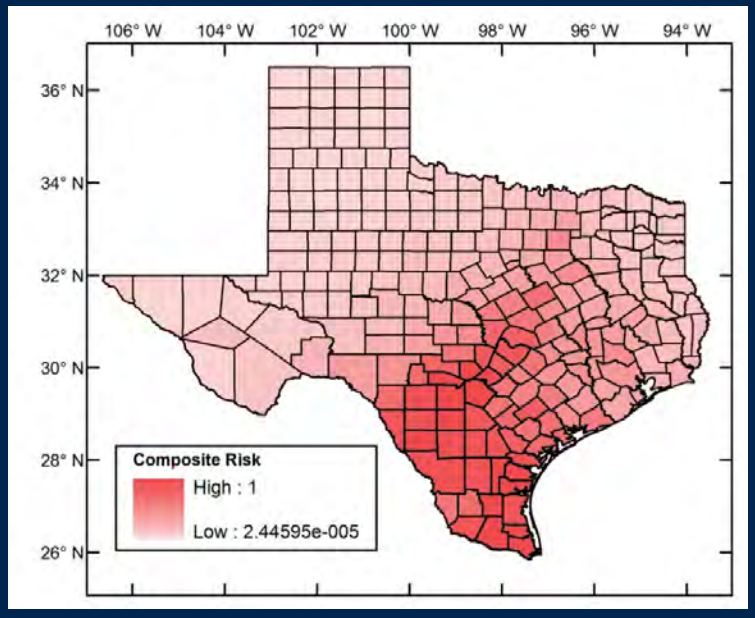
Neglected Infections of Poverty in the United States of America

Peter J. Hotez*

The New York Times
SundayReview | The Opinion Pages

Tropical Diseases: The New Plague of Poverty

By PETER J. HOTEZ



<u>>12 million Americans with NTDs</u>

Toxocariasis 3 million

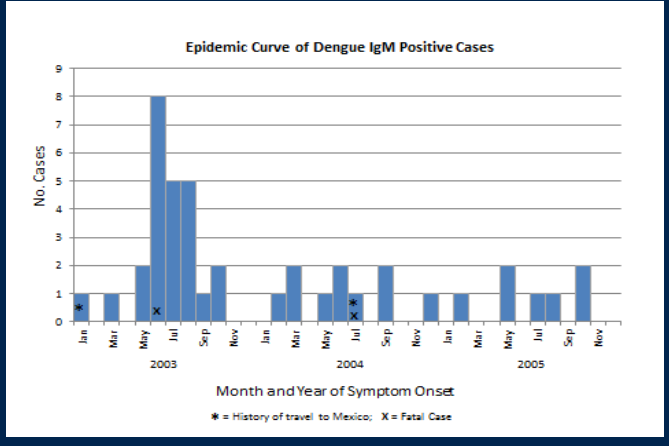
Chagas disease 1 million

Trichomoniasis 7 million

Cysticercosis 0.2 million

Toxoplasmosis 1 million

Dengue 0.1 million



TROPICAL MEDICINE CLINIC at Smith Clinic

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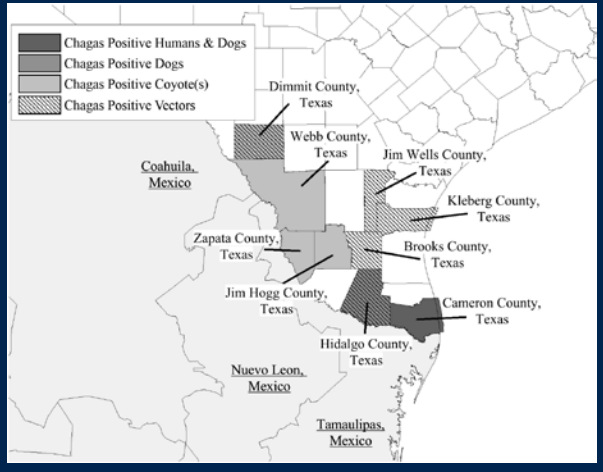
Chagas disease in Texas

New CDC Estimates

- 36,977 cases
- Not including undocumented
- Manne-Goehler J, et al (2016) Estimating the Burden of Chagas Disease in the United States. PLoS Negl Trop Dis 10(11): e0005033. pntd.0005033

Samples tested	Number tested	Chagas positive N (%)
Coyote (*Canis latrans*)	200	16 (8.0%)
Shelter dogs (*Canis lupus familiaris*) < 6 months of age	209	8 (3.8%)
Human adult cohort	841	3 (0.36%)
Triatoma species vectors	115	65 (56.5%)

doi:10.1371/journal.pntd.0005074.t001



One Health Interactions of Chagas Disease Vectors, Canid Hosts, and Human Residents along the Texas-Mexico Border Melissa N. Garcia et al PLoS Negl Trop Dis 2016

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Zoonotic Helminth Infections & Brain: Toxocariasis & Cysticercosisin Texas

Opinion

VIEWPOINT

Neglected Infections of Poverty in the United States and Their Effects on the Brain

Peter J. Hotez, MD, PhD
National School of Tropical Medicine, Baylor College of Medicine, Houston, Texas; Sabin Vaccine Institute, Texas Children's Hospital Center for Vaccine Development, Houston; and Department of Biology, Baylor University, Waco, Texas.

A group of neglected infections are emerging as important causes of psychiatric and mental illness among vulnerable populations living in extreme poverty in the United States. These chronic infections may partially account for the achievement gap noted among socioeconomically disadvantaged students.

The neglected tropical diseases (NTDs) are a group of chronic parasitic and related infections that can last decades or even the lifetime of an individual. During this time, they produce long-lasting and debilitating effects that impair productive capacity and child development. Indeed, the NTDs have actually been shown to trap people in poverty through these adverse effects.

The NTDs are not rare diseases. Quite the opposite—the NTDs are now recognized as the most common afflictions of impoverished people living in low- and middle-income countries of Africa, Asia, and Latin America. The NTDs are also considered a major reason [illegible] the 1.3 billion) people living [illegible] escape poverty.

In 2008, I [illegible] neglected parasitic and related infections of po[illegible] extreme poor [illegible] United States that closely [illegible] NTDs in term[illegible] their abil[illegible] produce chro[illegible], and p[illegible]-prom[illegible] effects.[1] A new r[illegible] that t[illegible] neglect[illegible] ctions remain wides[illegible] [illegible] vulnerable [illegible] Am[illegible] and Hispanic p[illegible] [illegible] meless.[2] Texas, the [illegible] of the southern U[illegible] [illegible] cted areas, most likely [illegible] th the extreme povert[illegible]

[illegible] tion has determined that [illegible] erty also cause important [illegible] ffects on vulnerable po[illegible] [illegible] d States (Table). Toxoc[illegible] [illegible] m infection of the b[illegible] [illegible] accidental ingestion [illegible] [illegible] y dogs and cats. T[illegible] gs are [illegible] dvantaged urb[illegible] rural an[illegible] [illegible] prevalence [illegible] disadvan[illegible] [illegible] popula[illegible] ceeds 20%.[1,2] An estimated 2.8 million African American individuals have toxocariasis.[1] In a large survey of the US population,[3] it [illegible] for toxocara infection [illegible] scored significantly lower on the Wechsler Intelligence Scale for Children-Revised and the Wide Range Achievement Test-Revised than did seronegative children. Toxocariasis is also associated with epilepsy and [illegible] important cause of [illegible] American children.[2]

Persons with toxocariasis are also more likely to be co-infected with *Toxoplasma gondii*, a parasitic protozoan that causes toxoplasmosis. Both of these zoonotic infections can be acquired from cats. Like toxocariasis, toxoplasmosis also disproportionately occurs among non-Hispanic black individuals and is linked to poverty.[4] Approximately 1 million new cases occur annually in the United States.[2] A recent body of literature has identified provocative associations between toxoplasmosis and adult psychiatric illness, possibly a long-term consequence from congenital *Toxoplasma* infection and the resulting disruptions in fetal neurodevelopment.[5,6] Specifically, seropositivity for toxoplasmosis has been strongly linked to bipolar mood disorder and schizophrenia.[5,6] Still another congenital infection that causes intellectual disabilities (as well as losses in hearing and vision) and disproportionately affects African American children is congenital cytomegalovirus (CMV) infection.[1] In pregnancy, non-Hispanic black women are at substantially increased risk of acquiring primary CMV infection compared with non-Hispanic white women, especially during teen pregnancies.[1] An estimated 27 000 new cases of congenital CMV infection occur annually.[1]

Beyond African American individuals, 2 neglected infections of poverty also affect other vulnerable populations in the United States. Neurocysticercosis, a larval pork tapeworm infection, is an important cause of epilepsy and chronic headaches in mostly Hispanic individuals.[2] My previous estimate indicates that between 41 000 and 169 000 people are living with cysticercosis in the United States.[1] Several studies have identified cognitive impairments in patients with neurocysticercosis and even dementia. In addition, the largest numbers of new cases of West Nile virus (WNV) infection are currently found in Texas—during a 2012 WNV outbreak there, almost 2000 cases were reported. Homeless populations are considered at risk for acquiring WNV infection. Neuroinvasive WNV infection has now been linked to chronic depression in a high proportion of patients.[7]

The links between these neglected infections of poverty and psychiatric and neurologic illnesses have potentially important implications for mental health care providers. [illegible] neglected infections outlined here are not rare diseases [illegible] of people in this country [illegible] estimated to [illegible] toxoc[illegible], toxoplasmosis, [illegible] cysticercosis, and WNV infect[illegible] together, they likely account for a substantial yet hidden burden of mental illness in the United States. These infections can be [illegible] prevent. A national awareness [illegible]

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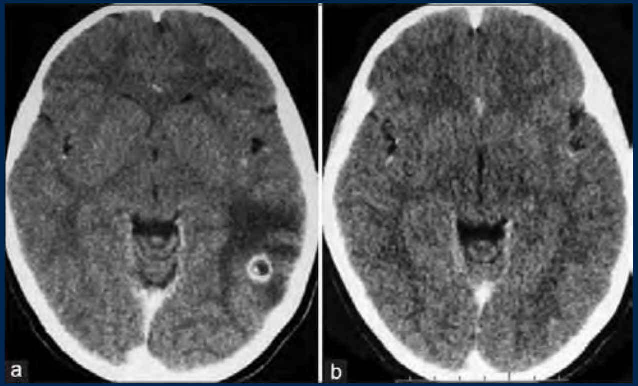

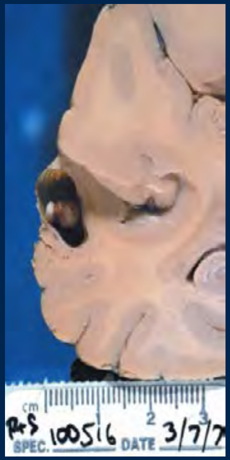

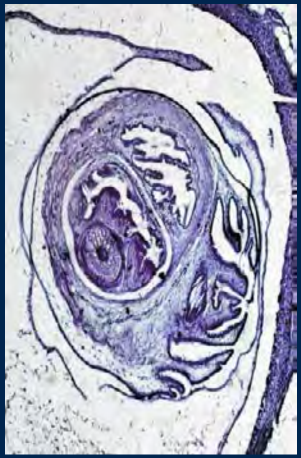

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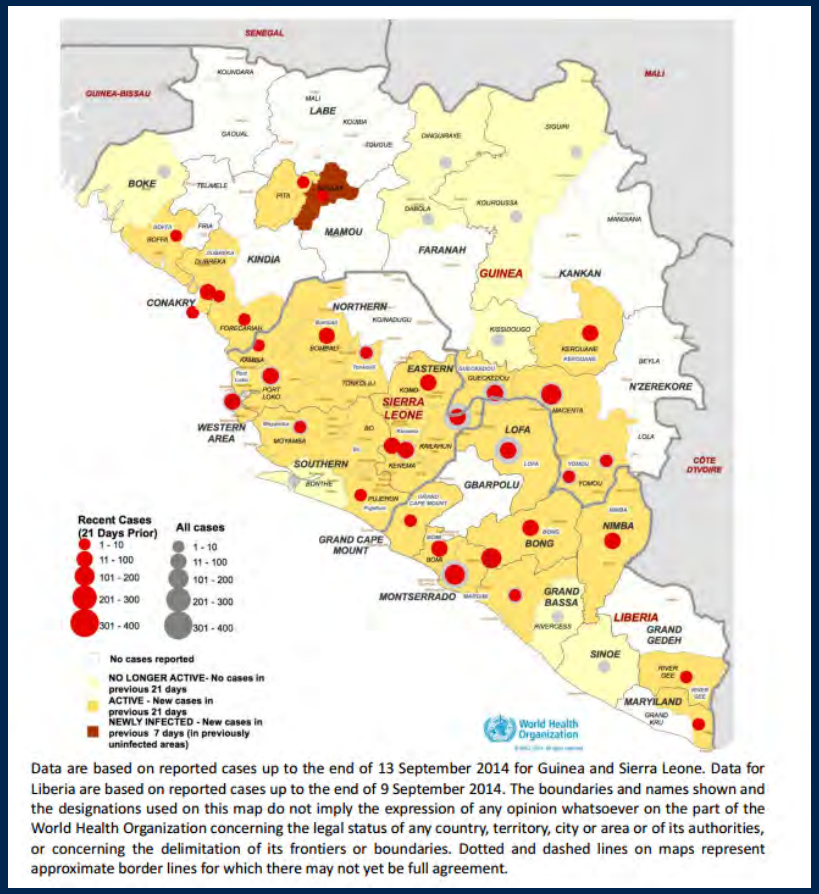
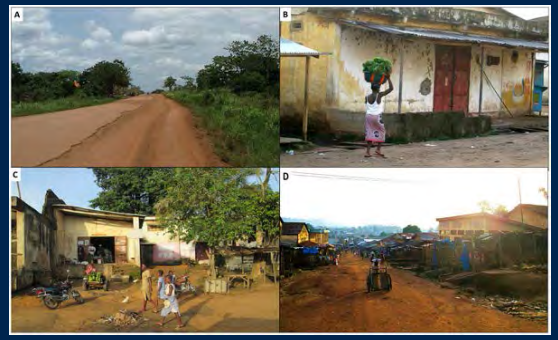
WAR & POLITICAL DESTABILIZATION: Ebola



Data are based on reported cases up to the end of 13 September 2014 for Guinea and Sierra Leone. Data for Liberia are based on reported cases up to the end of 9 September 2014. The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.



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ISIS-Occupied Syria, Iraq, Libya Yemen

Measles/Polio

Leishmaniasis

Schistosomiasis

Brucellosis

MERS CoV

Dengue

Malaria/TB

Rift Valley Fever

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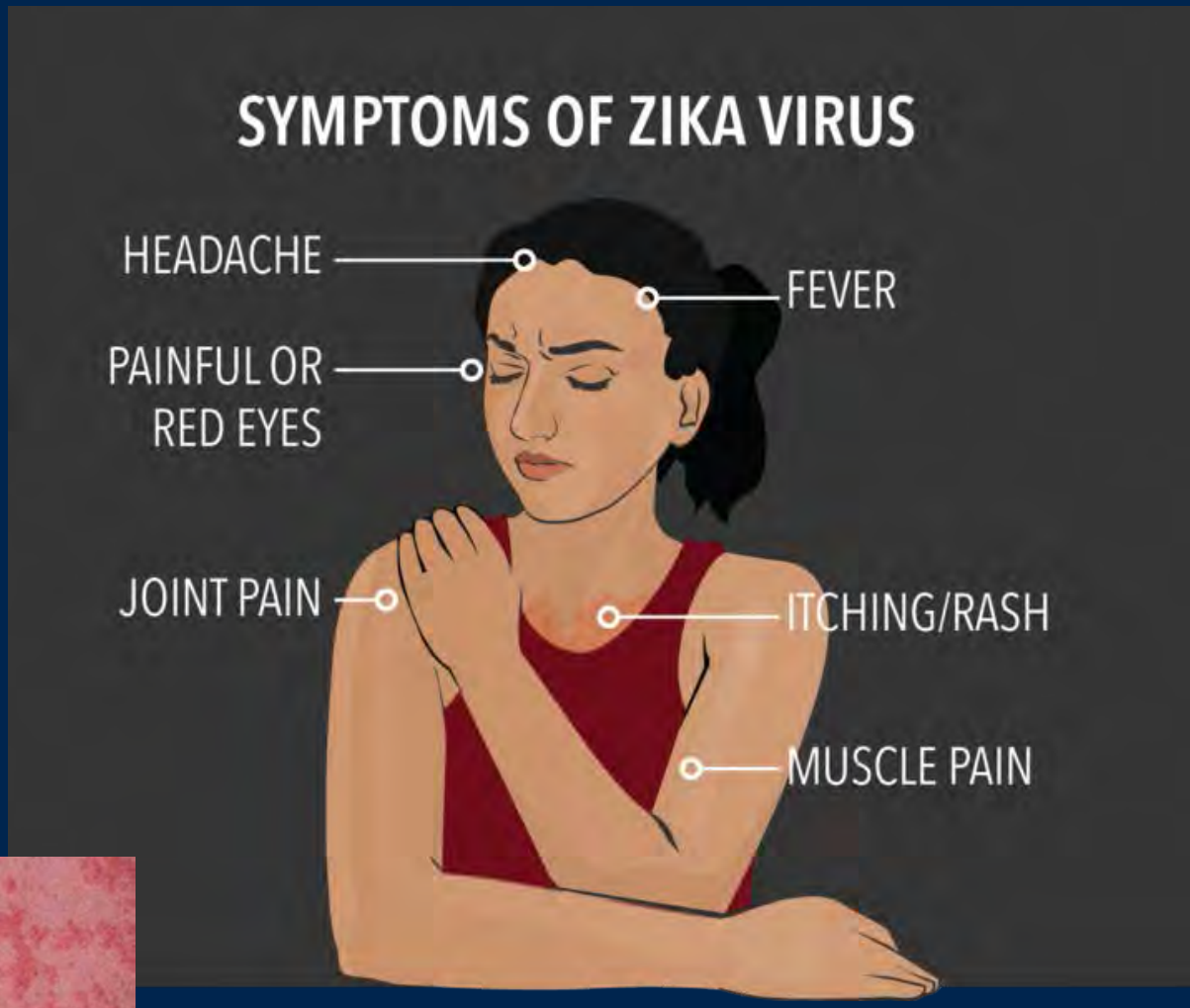
Clinical Zika

Fever
Maculopapular Rash (pruritic)
Headache
Conjuncitivits
Retroorbital pain



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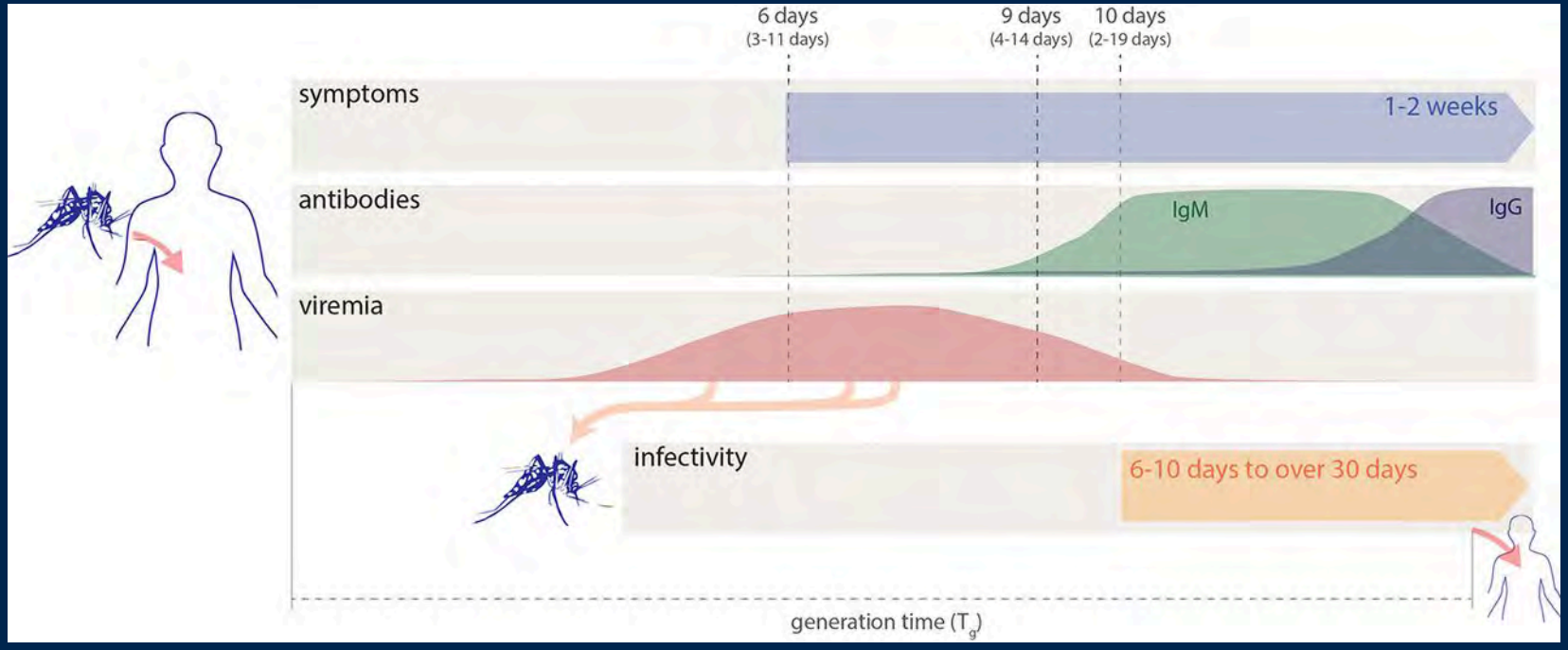
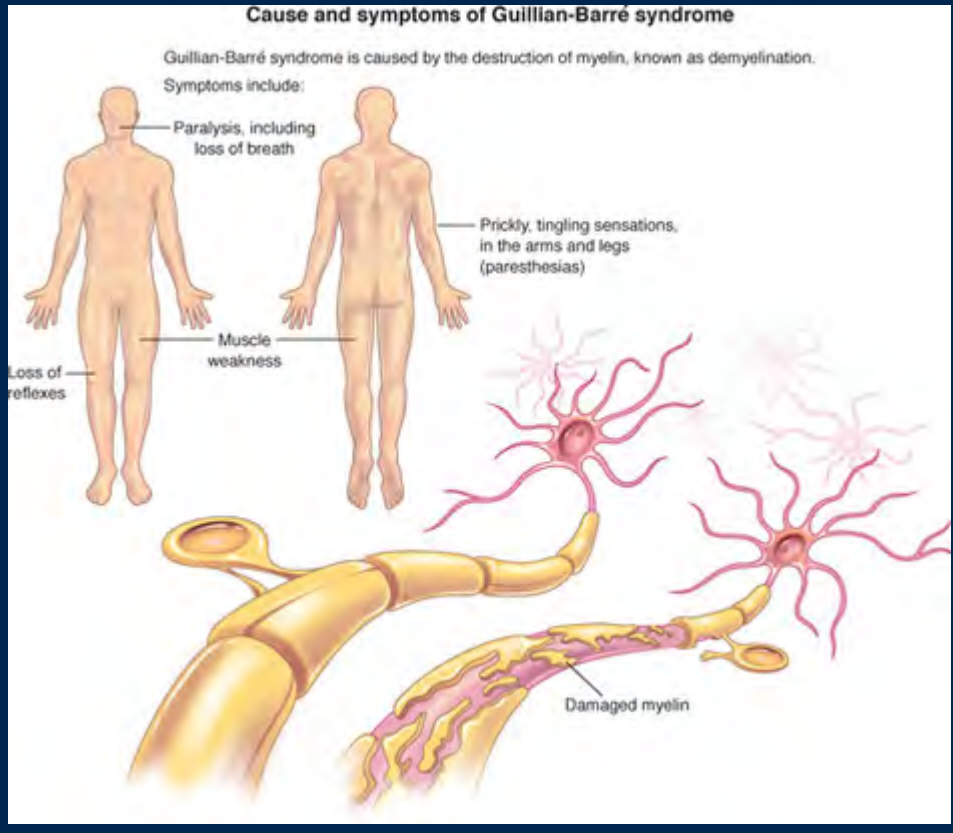
3 Schematic of the course of human and mosquito infection.



Justin Lessler et al. Science 2016;science.aaf8160

Guillain-Barre syndrome

- Recent history of zika (within 6 days)
- Zika IgM/IgG
- 1/3 respiratory assistance
- Anti-glycolipid antibody (GA1)
- Guillain Barre
  - 1/1,000 French Polynesia
  - 554 cases in Brazil
  - Increase in El Salvador



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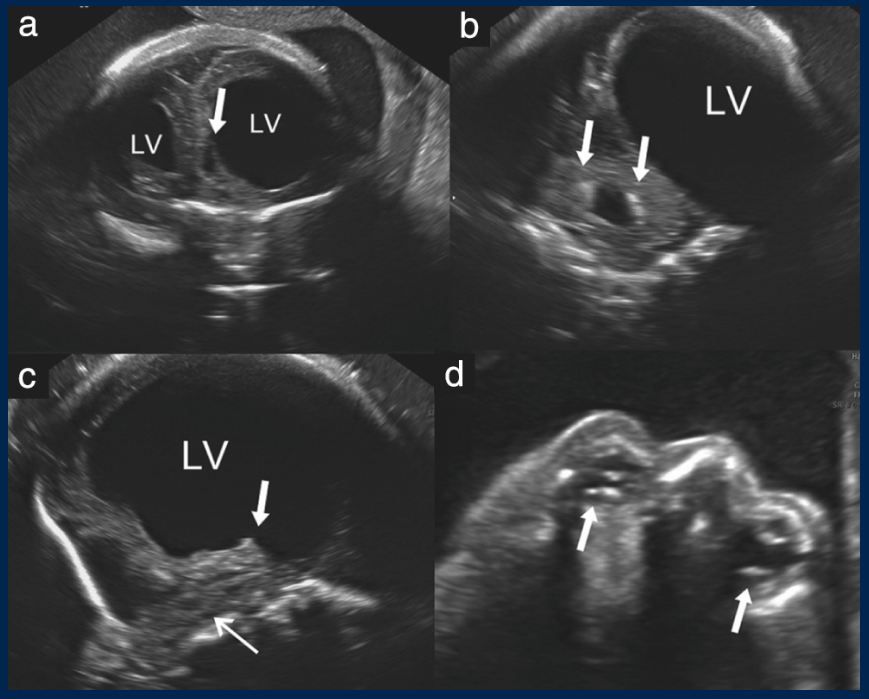
MICROCEPHALY
MICROCEPHALY
Normal Size
South America
Zika Fever Virus from Aedes aegypti mosquito is linked to microcephaly birth defect cases mostly in South America

Fetal Brain Disruption Sequence

- The fetal brain disruption sequence is a recognizable pattern of defects that includes moderate to profound microcephaly, overlapping sutures, occipital bone prominence, and scalp rugae. The condition is postulated to arise from partial brain disruption….with subsequent fetal skull collapse resulting from decreased intracranial hydrostatic pressure. Recognition of this phenotype is critical because the condition has a uniformly poor prognosis for infants but the recurrence risk in future pregnancies is low.



- Moore, Weaver, Bull et al (1990) J Pediatrics

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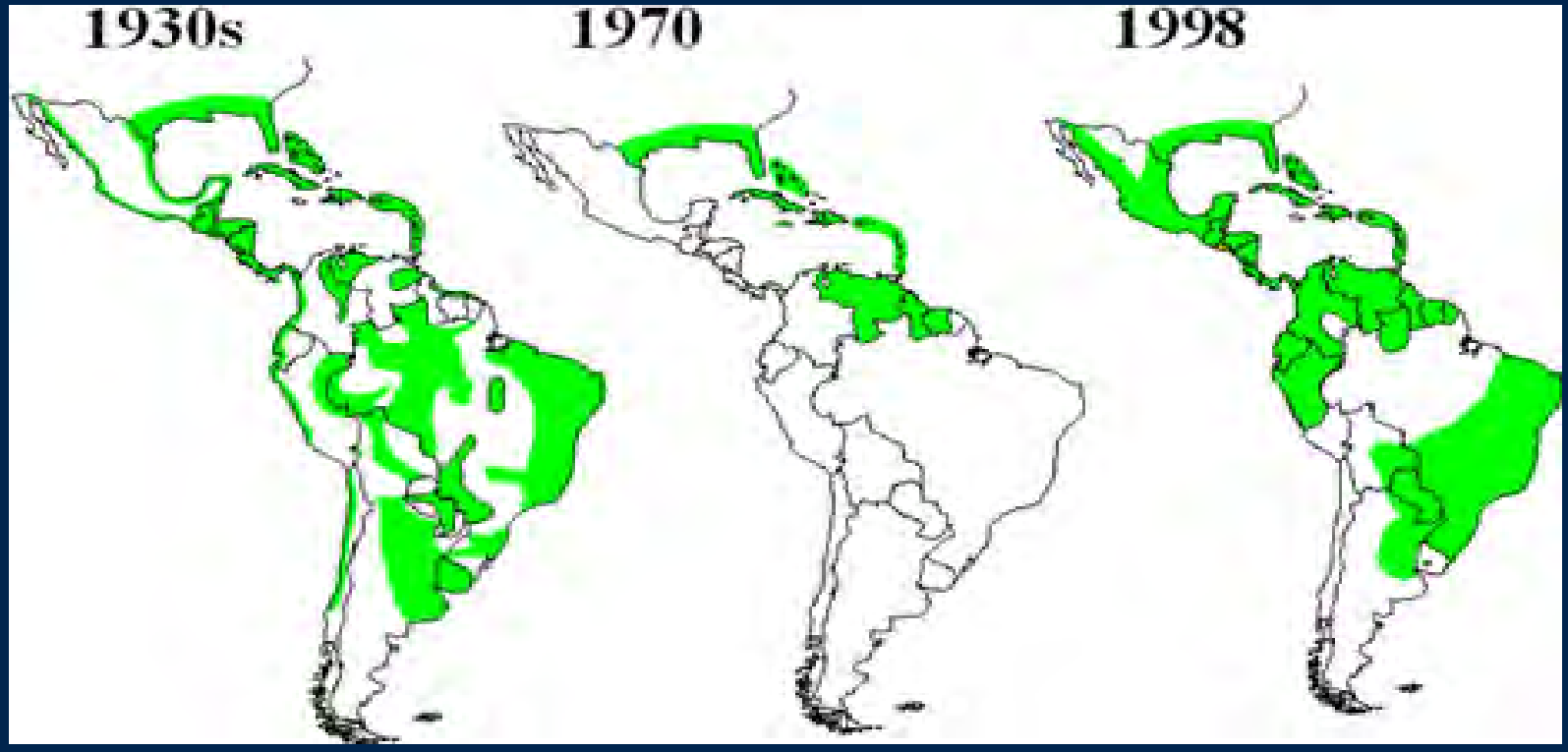
IS ZIKA MICROCEPHALY RESTRICTED TO BRAZIL?

Country	Total Zika Cases	Microcephaly Cases
Brazil	196,976	2,001
Colombia	95,639	42
Venezuela	58,212	0
Martinique	36,445	12

PAHO/WHO Mosquito Eradication Campaign 1947-1962

US has no track record in *Aedes aegypti* control

- US did not participate in PAHO Eradication Program
- Began in 1965 halted in 1969



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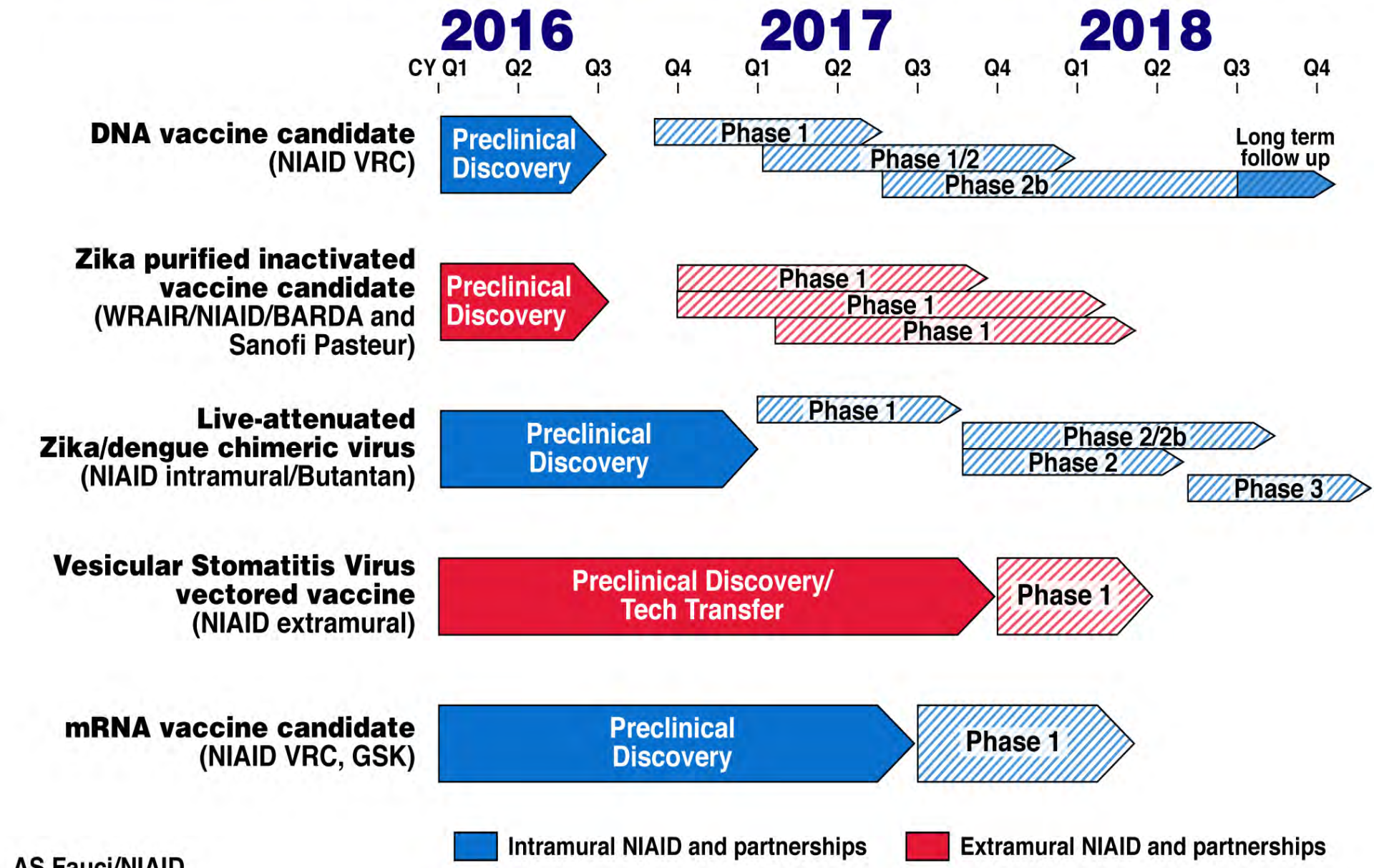
GMO Aedes Mosquitoes “The company's scientists genetically alter the male mosquitoes so that any offspring they father don't develop properly. These genetically modified males mate with the females, which lay dud eggs.”

Zika Vaccine Development Timeline



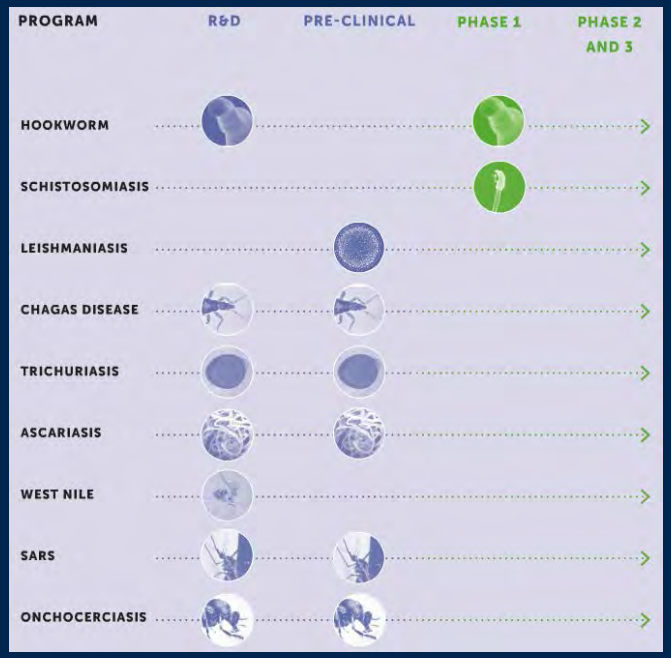
AS Fauci/NIAID

Sabin PDP Pipeline and Disease Portfolio

2000 to 2004
- Built structure
- Launched Hookworm Program

2004 to 2011
- Expanded Hookworm Program
- Schisto Program
- Relocated to TMC

2011 to 2015
- Added 7 additional programs
- Expansion of capabilities



FIGHTING CRITICAL DISEASES

By Peter Hotez

A Handful Of 'Antipoverty' Vaccines Exist For Neglected Diseases, But The World's Poorest Billion People Need More

ABSTRACT So-called neglected tropical diseases are the most common infections of the world's poor. Almost all of the "bottom billion"—the 1.4 billion people who live below the poverty level defined by the World Bank—suffer from one or more neglected diseases including hookworm infection, sleeping sickness, or Chagas disease. These diseases are actually a cause of poverty because of their adverse effects on child growth and development and worker productivity. Vaccines to combat such diseases have come to be known as "antipoverty vaccines." Unfortunately, the recent surge in the development and delivery of vaccines to combat the major childhood killers—such as pneumococcal pneumonia and measles—has bypassed neglected diseases. Nevertheless, some vaccines for these neglected diseases are now entering the clinical pipeline. In this article I describe how some antipoverty vaccine development is proceeding and offer recommendations for stimulating further development such as through pooled funding for innovation, developing-country manufacturers, and public-private partnerships for product development.

A full year has passed since the launch of the "Decade of Vaccines," which was articulated when the Bill & Melinda Gates Foundation made a ten-year commitment to ensuring the development and delivery of new vaccines for the poorest people living in the world's low- and middle-income countries. Since then, enormous progress has been made in increasing global access to vaccines that combat the great childhood killer diseases such as pneumococcal pneumonia, rotavirus, *Haemophilus influenzae* type b, and measles.

That progress was made possible through enhanced cooperation between the GAVI Alliance, the multinational pharmaceutical companies, and organizations supported by the Bill & Melinda Gates Foundation such as the Program for Appropriate Technology in Health, known as PATH. New financial incentives including a $1.5 billion advance market commitment have also contributed to the progress.[1]

Lagging far behind these global efforts against the major killer childhood diseases, are parallel activities to produce and deliver a new generation of vaccines for so-called neglected diseases (these are sometimes known as neglected tropical diseases).[2] These neglected diseases are the most common infections of the world's poor, and almost all of the "bottom billion"—the 1.4 billion people who live below the poverty level defined by the World Bank—suffer from one or more of the neglected diseases.[3,4]

The World Health Organization now identifies seventeen conditions as "neglected tropical diseases."[4] The most common neglected diseases are caused by parasitic worms, including hookworm infection, ascariasis (intestinal roundworm), trichuriasis (whipworm), schistosomiasis (bilharzia), lymphatic filariasis (elephantiasis), and onchocerciasis (river blindness); by parasitic protozoa, including Chagas

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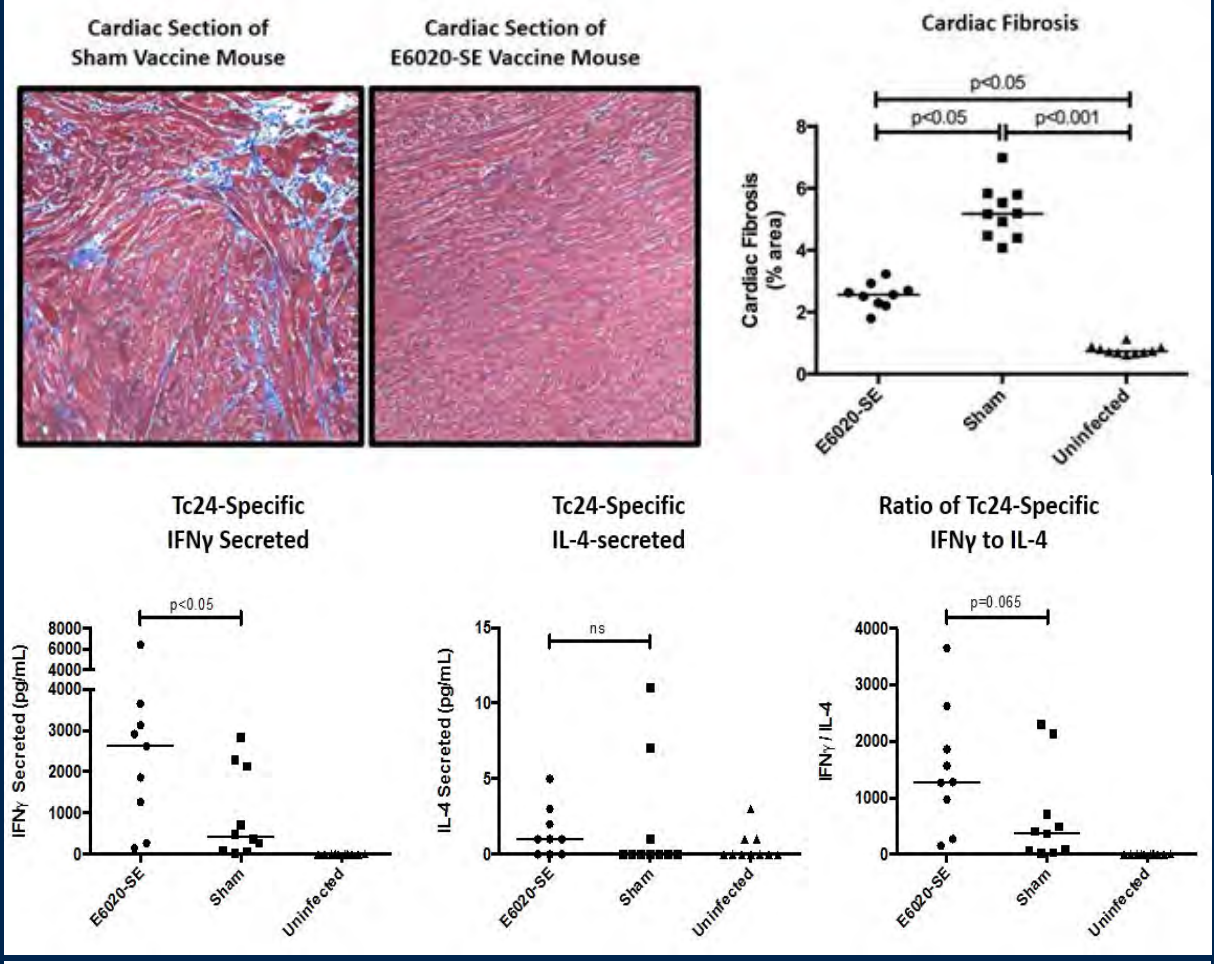
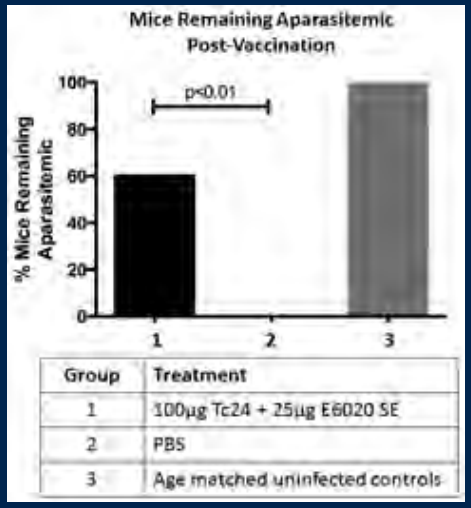
Therapeutic Chagas Disease Vaccine





Group	Treatment
1	100µg Tc24 + 25µg E6020 SE
2	PBS
3	Age matched uninfected controls

Figure 9: Immune response of chronically infected female ICR mice vaccinated therapeutically. IFNγ and IL-4 release from acutely infected and therapeutically vaccinated ICR splenocytes restimulated in vitro with 100µg/mL Tc24 protein.

Increased Ag-specific IFNγ
Decreased T. cruzi burden
Decreased Cardiac fibrosis

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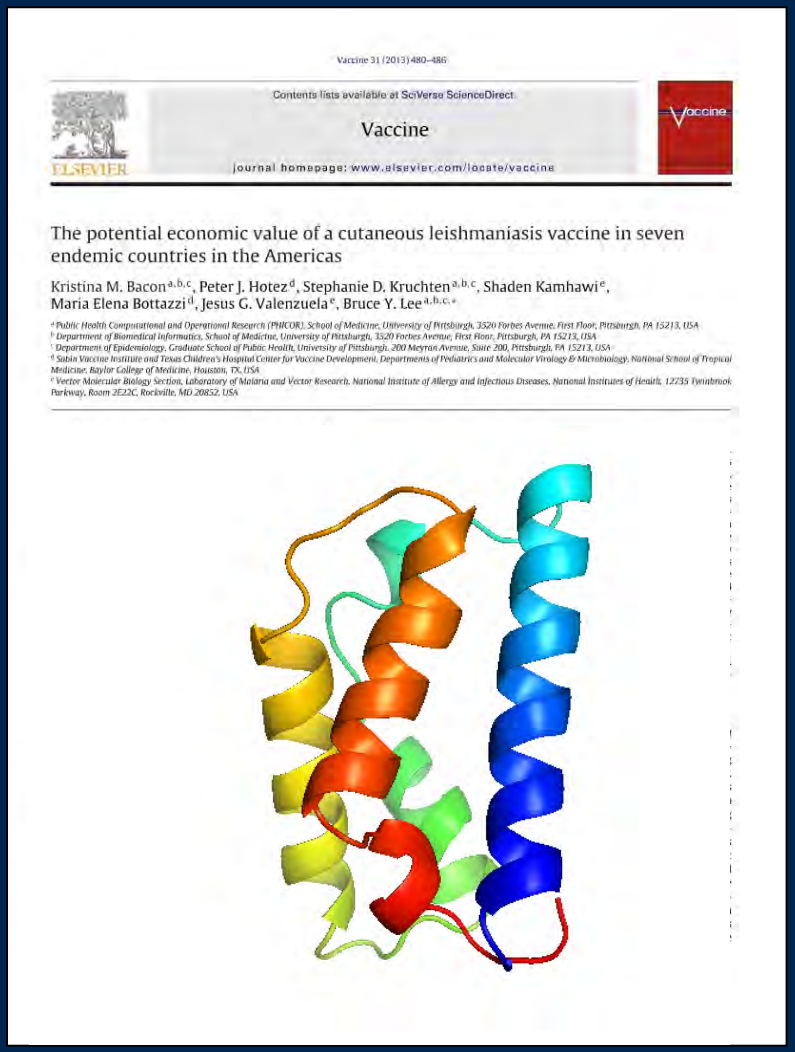
Leishmaniasis Vaccine

- Bivalent recombinant vaccine
  - NH36
  - Sandfly antigens: LJM19 LJM143
  - GLA or CpG



Vaccine 31 (2013) 480–486

Contents lists available at SciVerse ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

The potential economic value of a cutaneous leishmaniasis vaccine in seven endemic countries in the Americas

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