

Climate Change, Social Determinants, and the Global Threat of Infectious Diseases

ICTS Community Engagement

Sanghyuk Shin
January 24, 2020

BIG STORY 10 AUGUST 28, 2019 / 10:20 AM / 5 MONTHS AGO

As the climate shifts, Central America confronts a deadly dengue outbreak

Anastasia Moloney

5 MIN READ

BOGOTA (Thomson Reuters Foundation) - Central America is grappling with its worst outbreak of dengue fever in decades - and scientists say the disease is likely to spread and become more frequent in the future due to climate change.

The New York Times



How Hard Is It to Quit Coal? For Germany, 18 Years and \$44 Billion



Hoping to Shape the Conversation at Davos

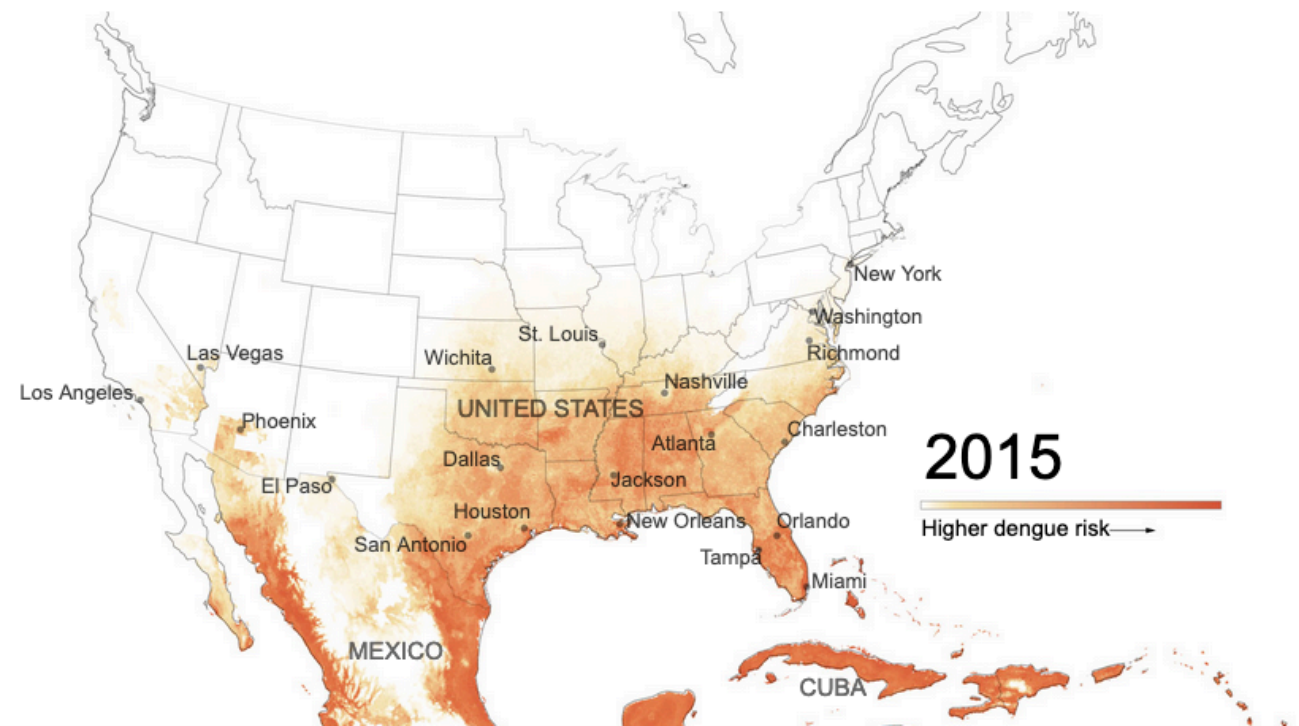


A Climate Show Was Canceled. Then Came the Finger-Pointing.



How Dengue, a Deadly Mosquito-Borne Disease, Could Spread in a Warming World

By KENDRA PIERRE-LOUIS and NADJA POPOVICH JUNE 10, 2019



Tickborne Diseases — Confronting a Growing Threat

Catharine I. Paules, M.D., Hilary D. Marston, M.D., M.P.H., Marshall E. Bloom, M.D., and Anthony S. Fauci, M.D.



Article **Figures/Media**

Metrics

5 References 18 Citing Articles

EVERY SPRING, PUBLIC HEALTH OFFICIALS PREPARE FOR AN UPSURGE IN vectorborne diseases. As mosquito-borne illnesses have notoriously surged in the Americas, the U.S. incidence of tickborne infections has risen insidiously, triggering heightened attention from clinicians and researchers.

According to the Centers for Disease Control and Prevention (CDC), the number of reported cases of tickborne disease has more than doubled over the past 13 years.¹ Bacteria cause most tickborne diseases in the United States, and Lyme disease accounts for 82% of reported cases, although other bacteria (including *Ehrlichia chaffeensis*, *Anaplasma phagocytophilum*, and *Rickettsia rickettsii*) and parasites (such as *Babesia microti*) also cause substantial morbidity and mortality. In 1982, a spirochete was identified as the causative organism of Lyme disease and was subsequently named *Borrelia burgdorferi*. *B. burgdorferi* (which causes disease in North America and Europe) and *B. afzelii* and *B. garinii* (found in Europe and Asia) are the most common agents of Lyme disease. The recently identified *B. mayonii* has been described as a cause of Lyme disease in the upper midwestern United States. Spirochetes that cause Lyme





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F Potential Impact of Climate Change on Schistosomiasis Transmission in China

Xiao-Nong Zhou^{1,*}, Guo-Jing Yang¹, Kun Yang¹, Xian-Hong Wang¹, Qing-Biao Hong¹, Le-Ping Sun¹, John B. Malone¹, Thomas K. Kristensen¹, N. Robert Ber

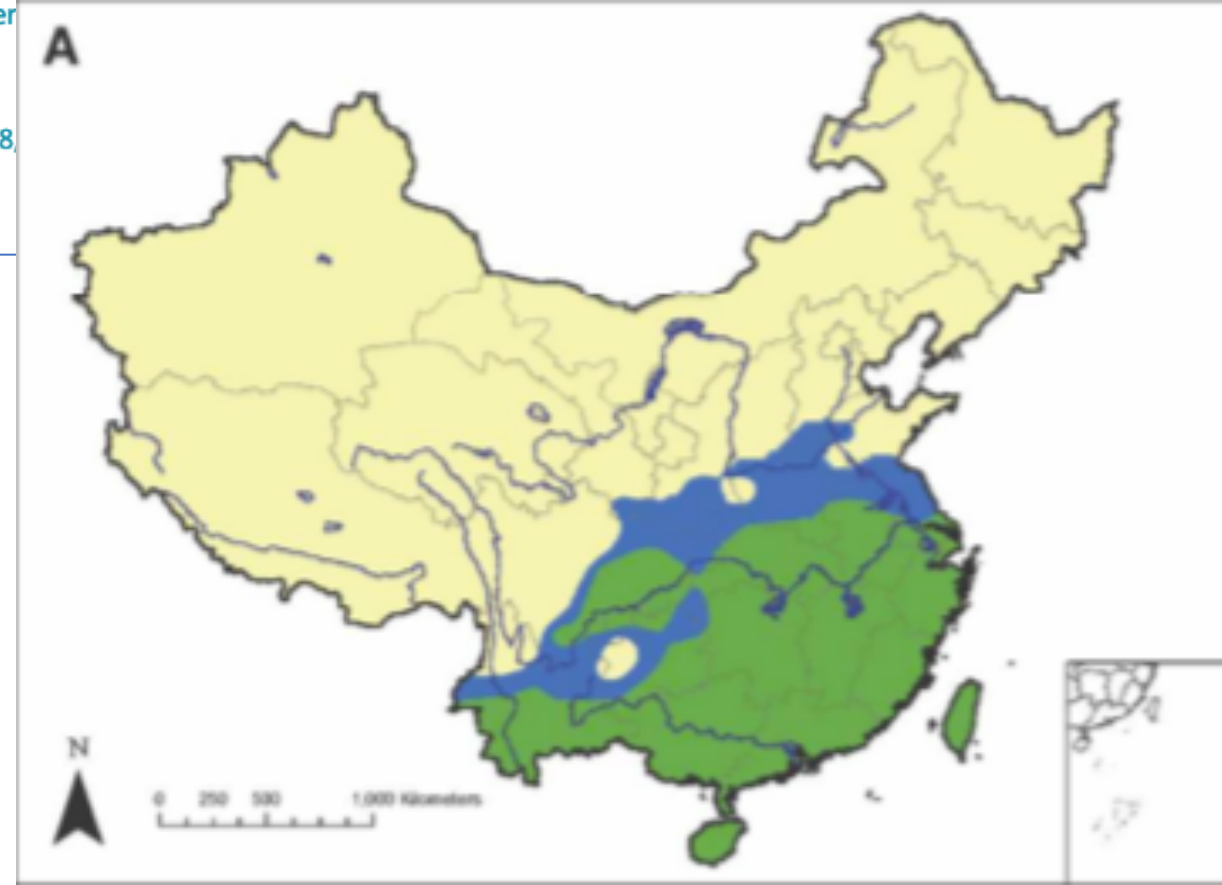
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Publisher: [The American Society of Tropical Medicine and Hygiene](#)

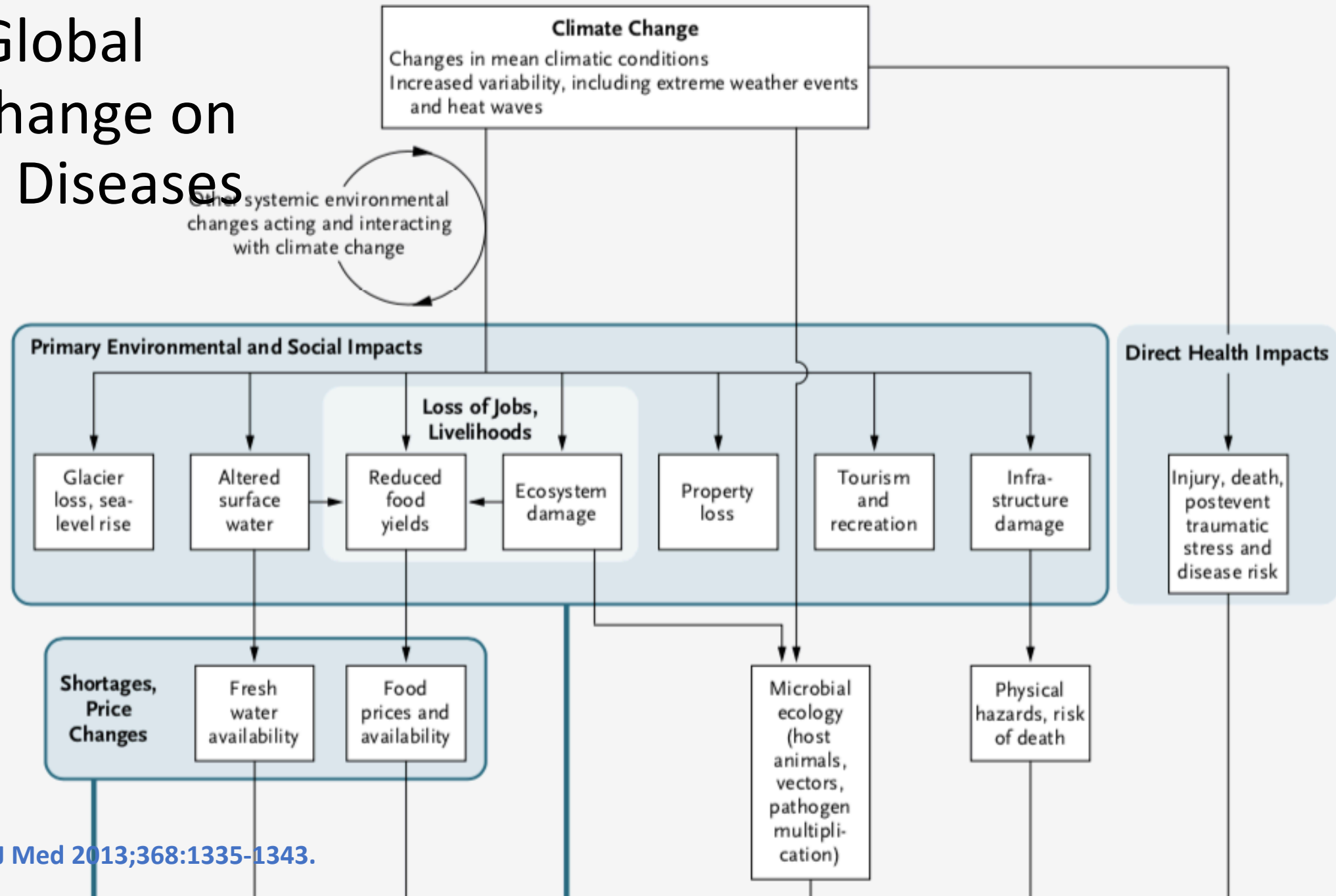
Source: [The American Journal of Tropical Medicine and Hygiene](#), Volume 78, 194

DOI: <https://doi.org/10.4269/ajtmh.2008.78.188>

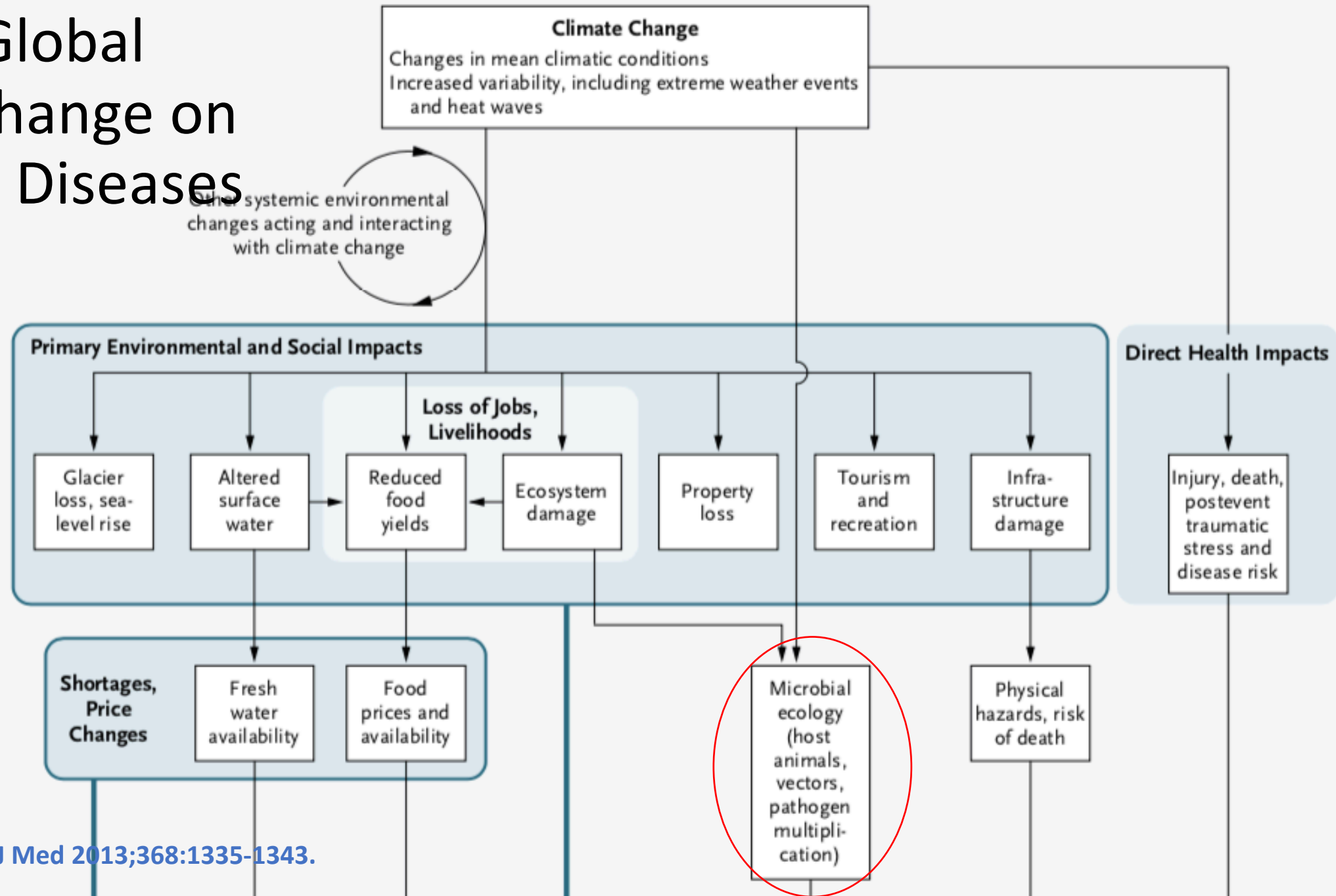
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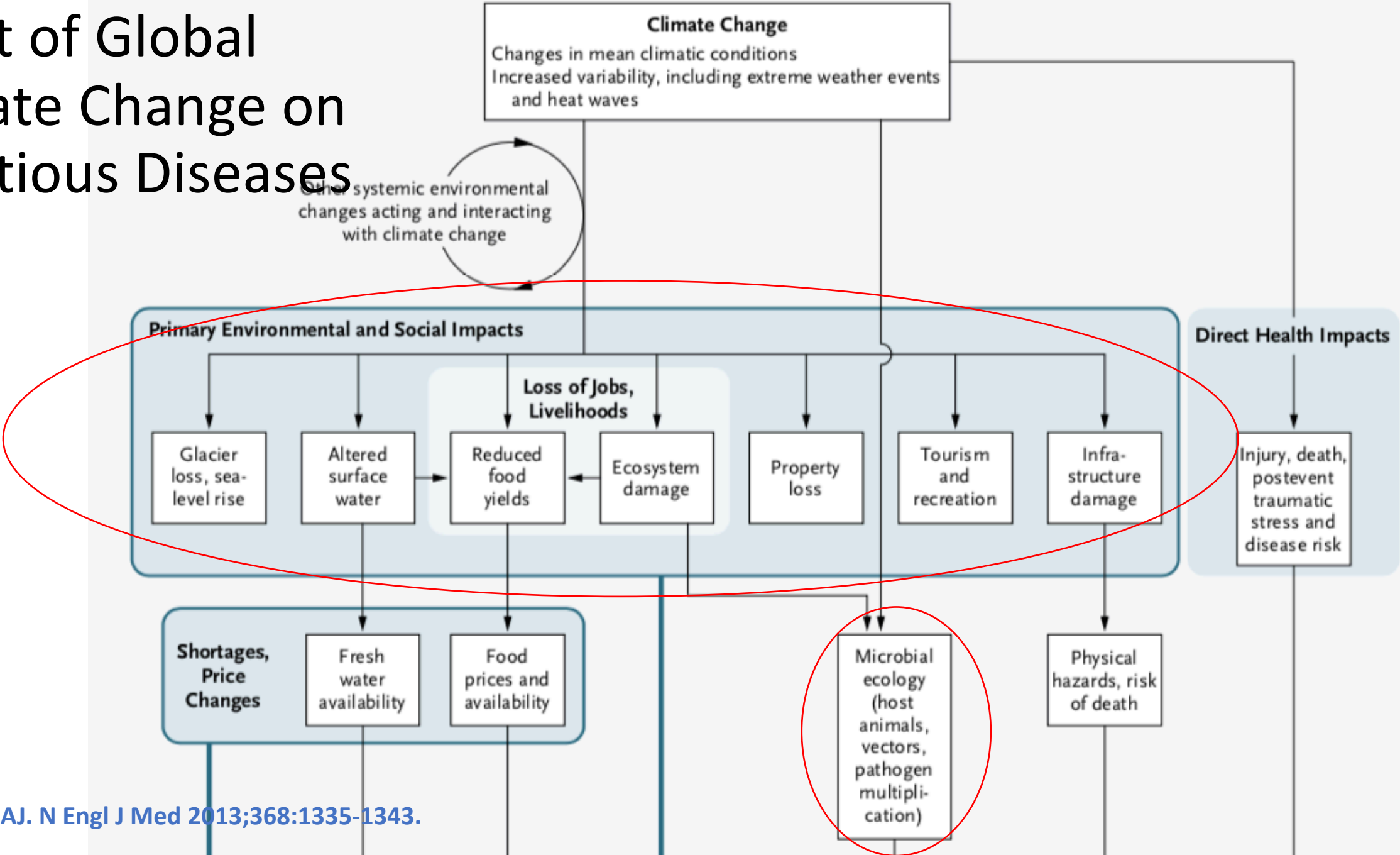
Effect of Global Climate Change on Infectious Diseases



Effect of Global Climate Change on Infectious Diseases



Effect of Global Climate Change on Infectious Diseases



Outline of Presentation

1. **Social determinants of infectious diseases**
2. **Impact of climate change on social determinants**
3. **Food insecurity among people affected by HIV and TB**
4. **Housing crisis and infectious diseases**
5. **Path forward**

Typhus Outbreak in Prussia, 1847

- Polish minority region with high rates of poverty
- Investigated by Rudolf Virchow, young German physician and anthropologist



Taylor and Rieger. Rudolf Virchow on the typhus epidemic in Upper Silesia: an introduction and translation. *Sociology of Health and Illness* 1984;6:201-217

Typhus Outbreak in Prussia, 1847

- Conclusion: social factors responsible
- Recommendations
 - Universal access to free education
 - Improved wages
 - Industrial and agricultural development

*"Medicine is a social science, and politics
nothing but medicine on a grand scale"*

Rudolph Virchow 1850

Wealthy Los Angeles grapples with outbreak of typhus among its poorest

Concern focuses on homeless population as 64 cases reported a year after hepatitis A infected hundreds



▲ A person sleeps beside a tree on the sidewalk in Skid Row, downtown Los Angeles. Typhus is considered a particular risk to the large homeless population. Photograph: Frederic J Brown/AFP/Getty Images

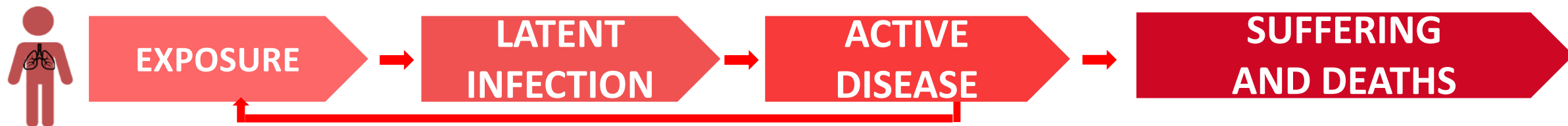
“Tuberculosis is the prototypical disease of poverty”



Photo: South African township [www.https://creatorsdocumentary.wordpress.com/tag/south-african-township/](https://creatorsdocumentary.wordpress.com/tag/south-african-township/)

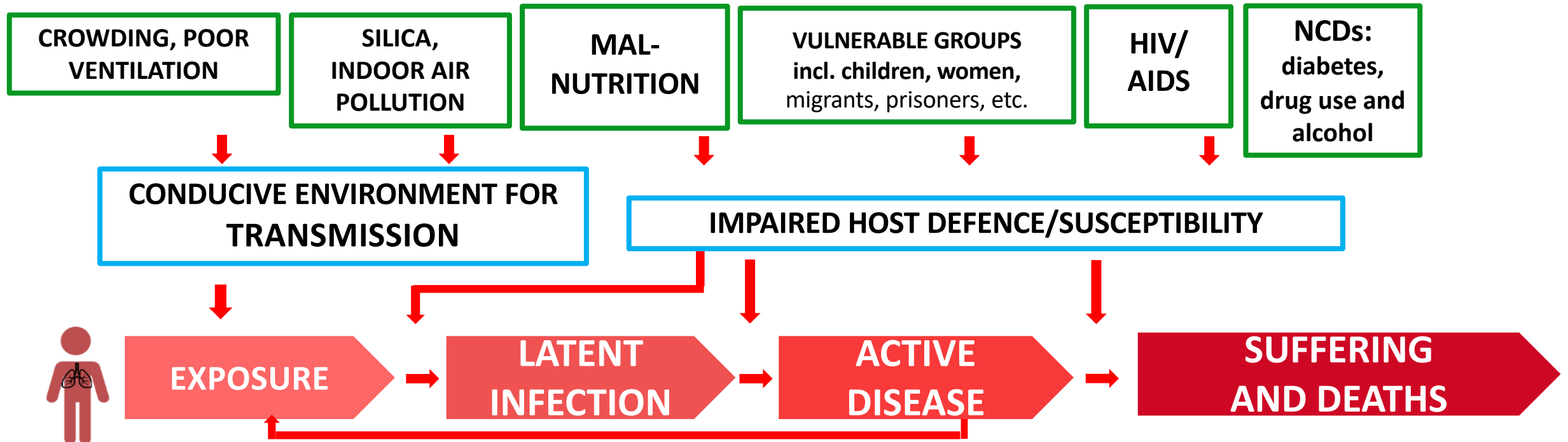


Spectrum of TB Disease in Context



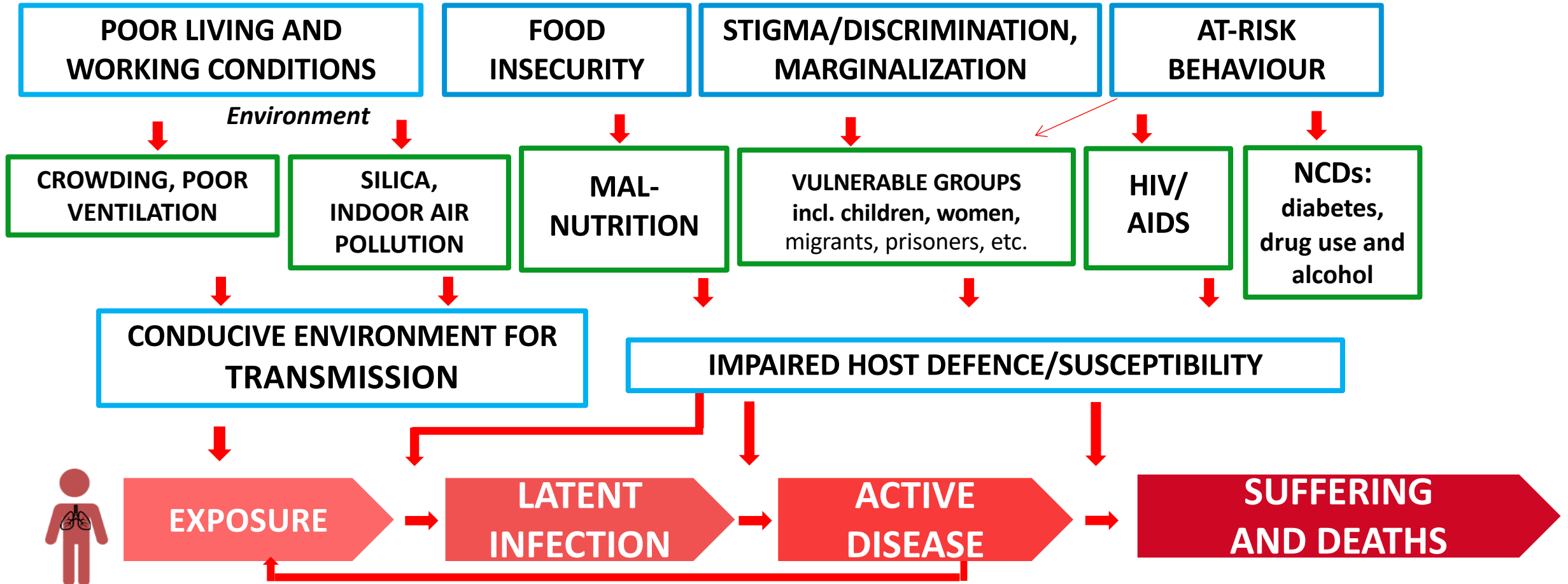


Spectrum of TB Disease in Context





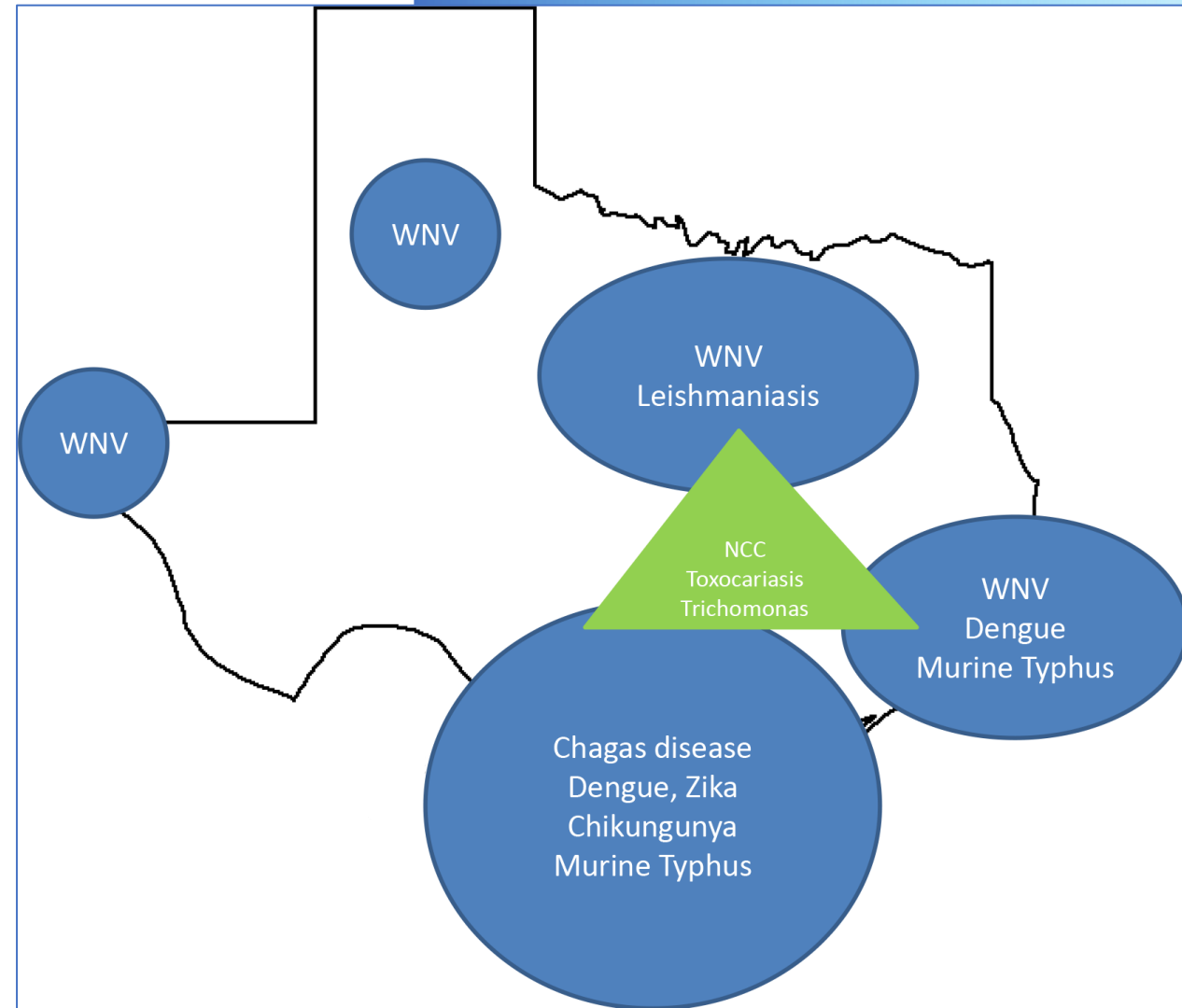
Spectrum of TB Disease in Context



Poverty and infectious diseases in Texas



Hotez PJ (2018) The rise of neglected tropical diseases in the "new Texas". PLoS Negl Trop Dis 12(1): e0005581.



Social Determinants of Neglected Tropical Diseases

BOX 8.2 Social determinants of neglected tropical diseases considered in this chapter

- Water and sanitation
- Housing and clustering (including building design, peri-domestic area and crowding of people)
- Environment (including ecological and topographical factors, land coverage, climatic change and water resource development schemes)
- Migration (including refugees, nomads, migrant workers and resettlers)
- Disasters and conflicts (comprising elements of migration and breakdown of health care systems)
- Sociocultural factors
- Gender
- Poverty (including inadequate income, subsistence and wealth)

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Climate change exacerbates existing vulnerabilities



Artwork by Angelica Alzona

Food Insecurity and Undernutrition as Determinants of Infectious Diseases

Food insecurity

- “lack of consistent access to enough food for an active, healthy life”

US Department of Agriculture, (2019). Definitions of Food Security. Available online at: <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx>

CLIMATE CHANGE & FOOD SYSTEMS

GHG EMISSIONS

CLIMATE & ATMOSPHERIC

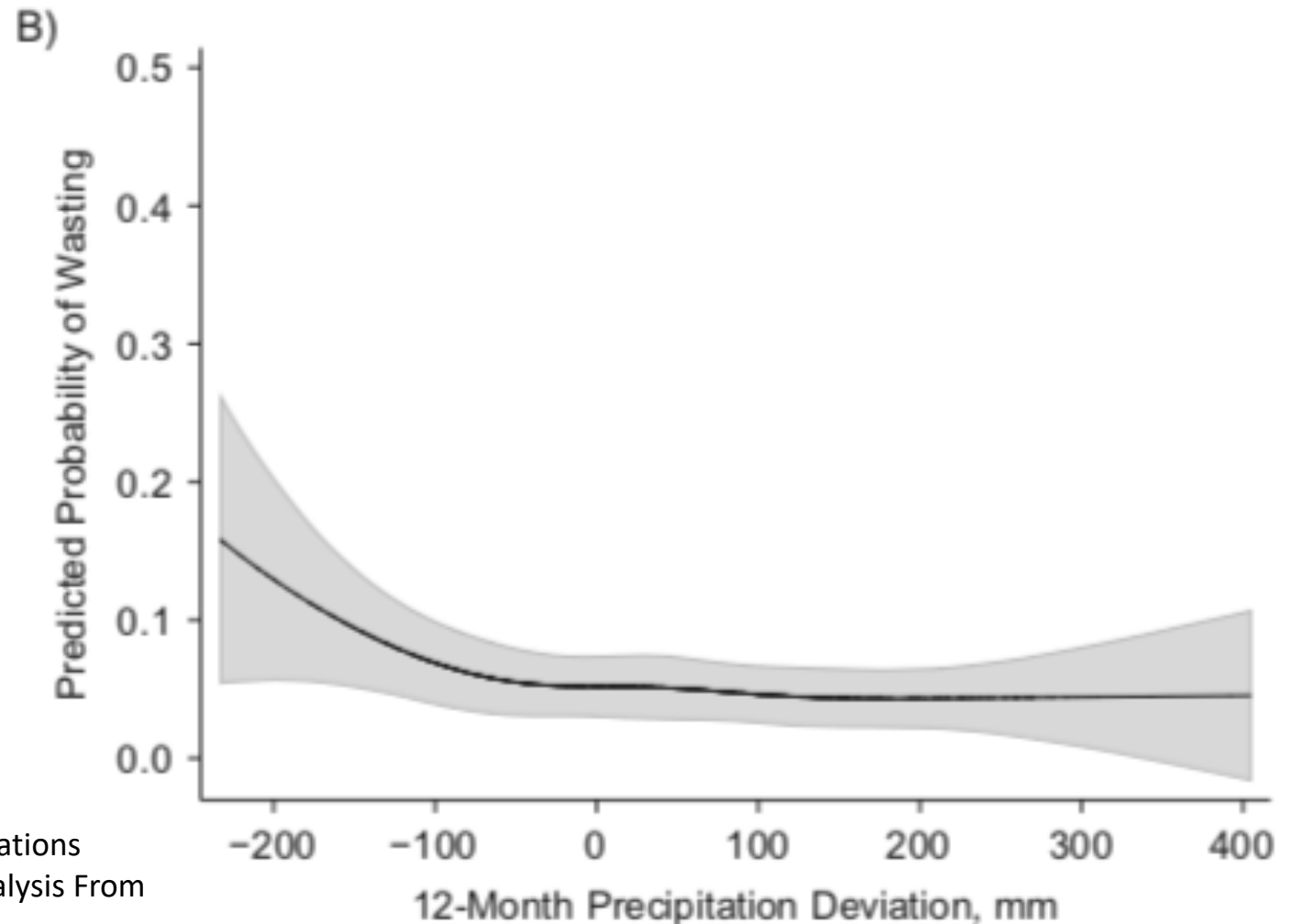
- ↑ Temperature
- Rainfall change
- Extreme weather events
- ↑ CO2 ozone levels
- ↑ Ocean acidification

SOCIOECONOMIC

- Altered crop yields & fish catch
- Altered livestock productivity
- ↓ Nutrient content
- ↑ Food prices
- ↑ Conflict
- ↓ GDP growth
- ↓ Purchasing power of vulnerable pops

Population-level Effect of Drought

Lower levels of rainfall associated with underweight and wasting among children in Uganda



Epstein A, Torres JM, Glymour MM, López-Carr D, Weiser SD. Do Deviations From Historical Precipitation Trends Influence Child Nutrition? An Analysis From Uganda. *Am J Epidemiol.* 2019 Nov 1;188(11):1953–60.

Climate Crisis in Botswana

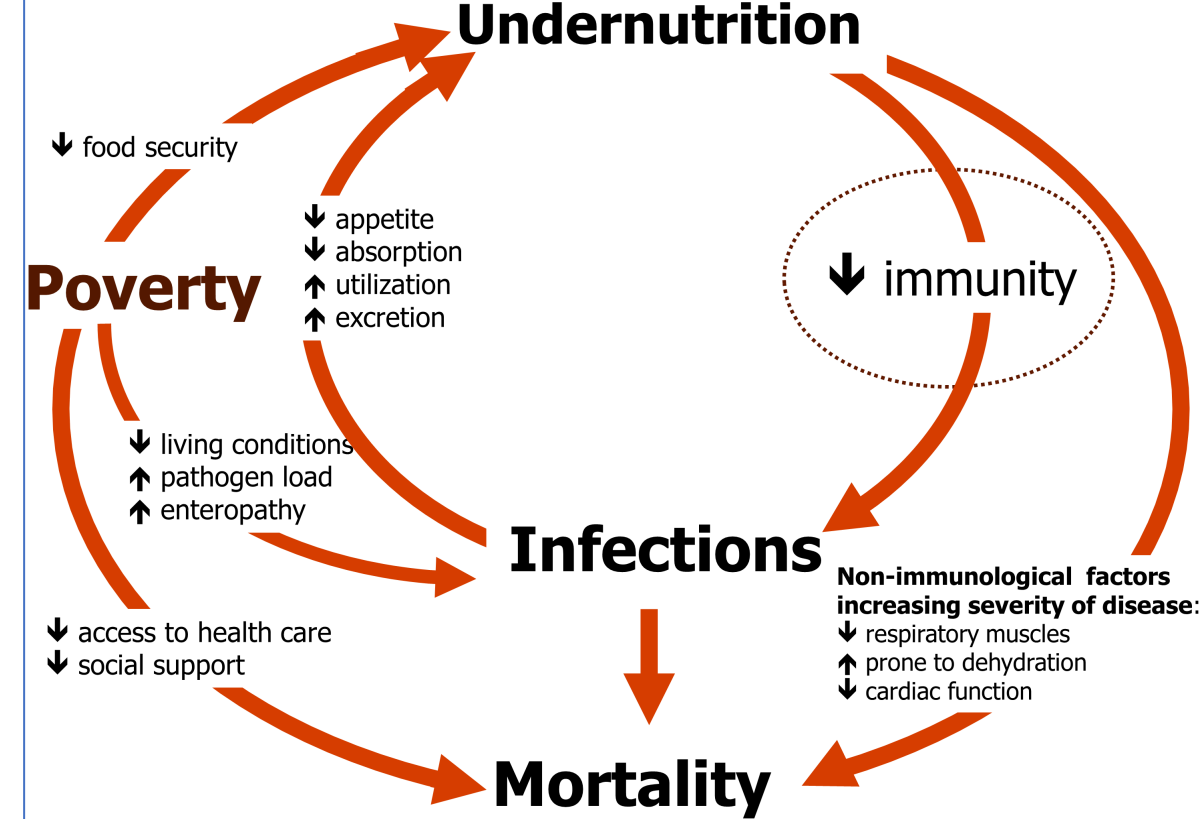
- 2019 - Two thirds of crops failed
- 2019 - 40,000 cattle deaths due to lack of food and water
- Urbanization & internal migration

“you can see the carcasses all over” –
Caster Matsheka
(Rancher in Ngamiland)

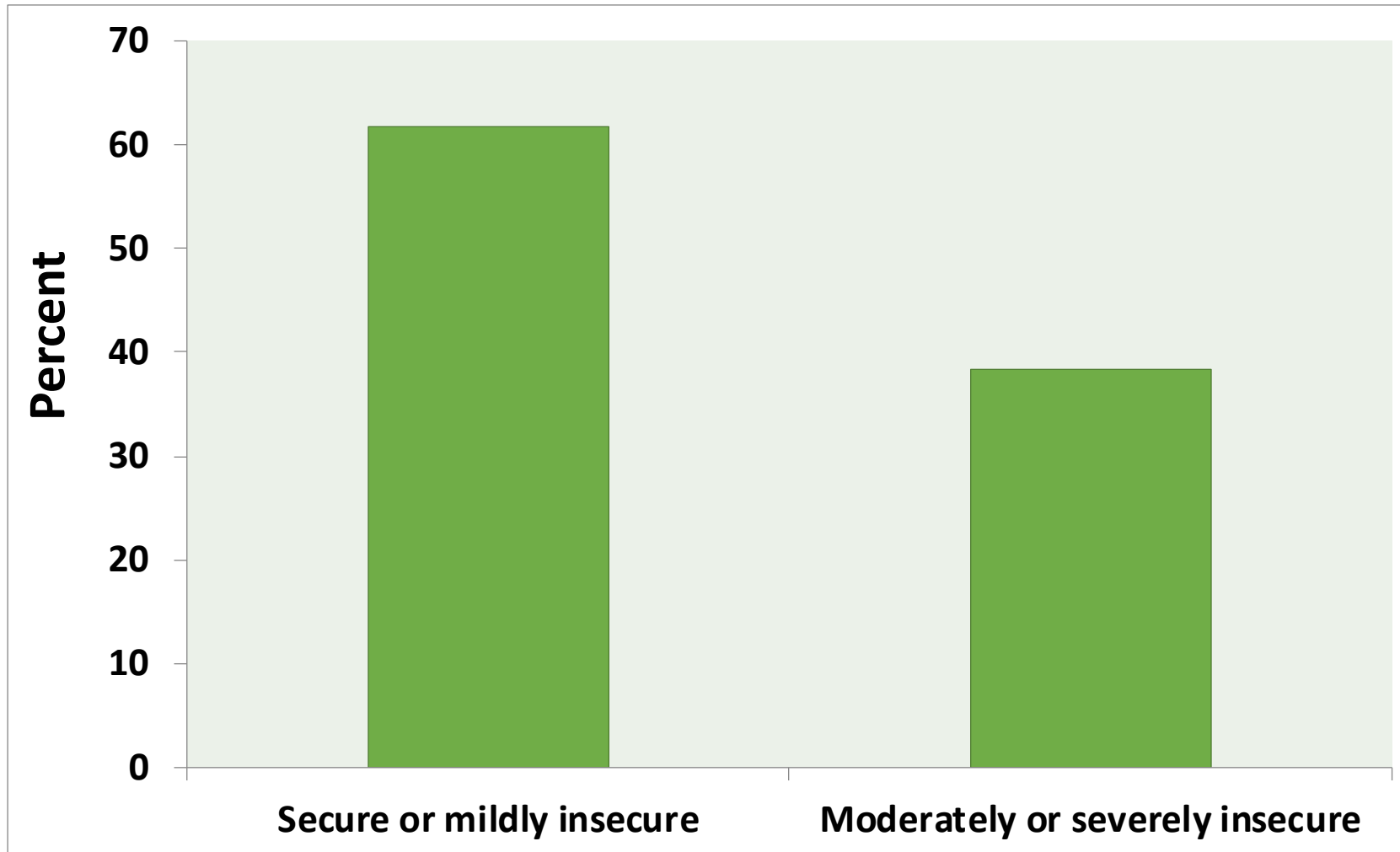


Undernutrition and ID: Vicious Cycle

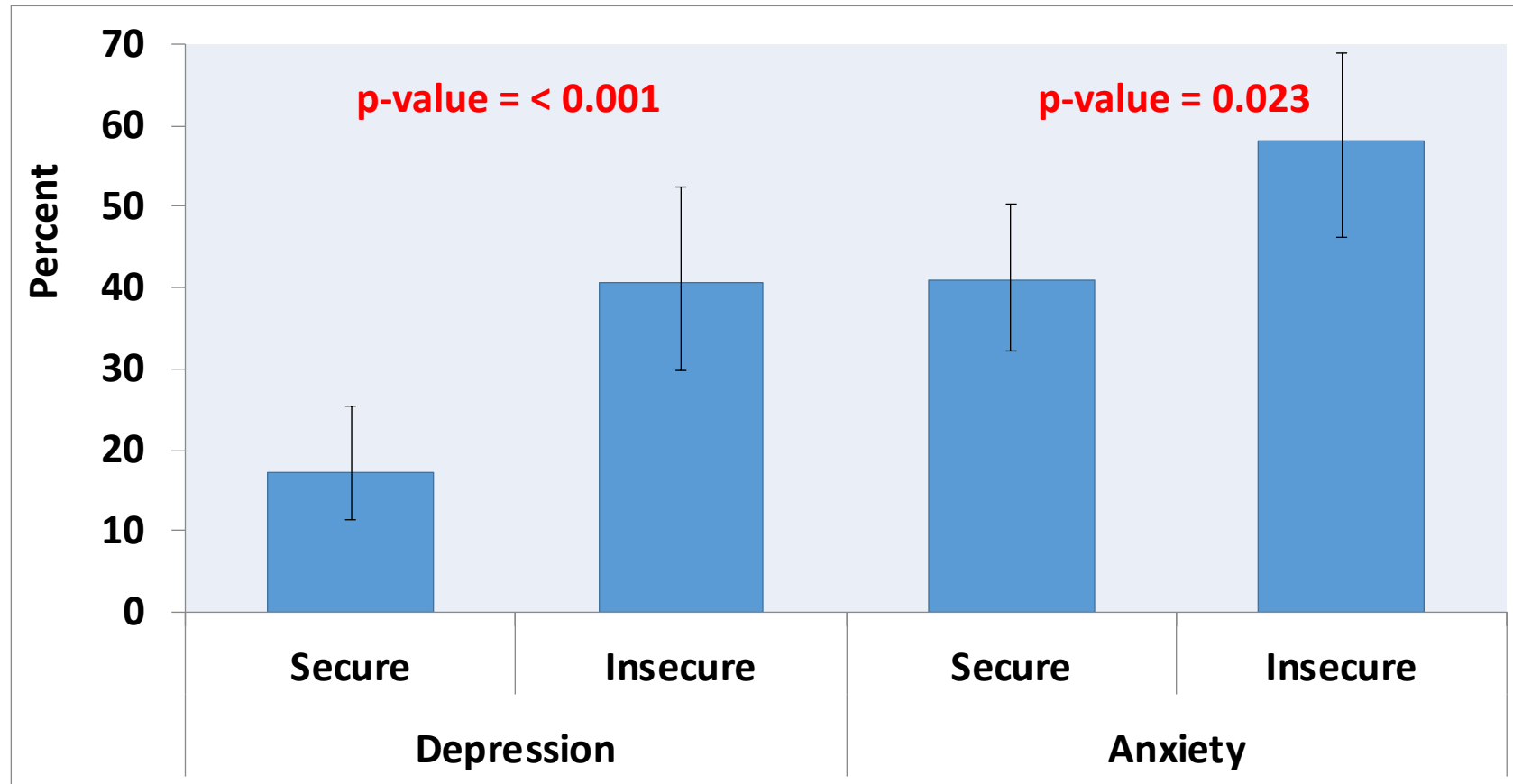
- Malnutrition impairs cellular immunity, which increases mortality and morbidity
 - Increased risk of bloodstream infection
 - Increased mortality and longer hospital stay in children with severe sepsis
 - Increased risk for TB and HIV deaths



Food insecurity among people diagnosed with TB in Botswana



Prevalence of depression and anxiety by food insecurity status



Note: 'Secure' is defined as those who indicated 'food secure' and 'mildly insecure'; 'Insecure' is defined as those who indicated 'moderately insecure' and 'severely insecure'

Risk Factors for Depressive and Anxiety Symptoms

Variables	Depression Adjusted PR (95% CI)	Anxiety Adjusted PR (95% CI)
Age	1.01 (0.99-1.03)	1.01 (0.99-1.02)
Female	1.45 (0.89-2.36)	1.40 (0.87-2.26)
Living with HIV	1.33 (0.80-2.22)	1.21 (0.73-1.99)
Moderate/severe food insecurity (vs. secure or mildly insecure)	2.35 (1.43-3.87)	2.28 (1.39-3.74)

Conclusions

- Food insecurity is highly prevalent among people with TB in Botswana
- Food insecurity is associated with increased prevalence of depression and anxiety symptoms
- “Person-centered” TB care needed
 - Including food supplements and mental health counseling
- Climate change may increase the need for such interventions

Climate change and droughts in India

- **Floods 2015**
 - Multiple torrential rainfall affecting more than 4 million people
 - Economic damages that cost around US\$3 billion.
 - “direct outcome of the increasing global temperature breaking a 100 year old record with one day’s rainfall covering a month’s average”
- **Drought 2016**
 - One of its driest two-year periods in 2016
 - Moisture deficit of at least 50% when compared to previous years
 - Water level in reservoirs at reached 17% of their total storage capacity



Social effect

- Food insecurity
- “Climate refugees”
- Labor migration
- Importation of STDs and HIV in rural areas

○ <http://indiaenvironmentportal.org.in/files/Global%20Climate%20Change.pdf>

○ <https://www.jstor.org/stable/pdf/27807029.pdf?refreqid=excelsior%3A520f38c592247573ee3b08bb4668c92d>

Addressing Food Insecurity among Women Living with HIV in Rural India

- Around 2.1 million people living with HIV/AIDS in India
- One third are women
- Rates of HIV are increasing among women with no known risk factors
- High rates of food insecurity

Challenges Experienced by Women Living with HIV in rural Andhra Pradesh, India

- 50% widowed or divorced
- Lack of sexual decision-making
- Lack of knowledge about HIV and nutrition
- Primary caregiver of sick husband and children
- Little or no time to devote to their own health care

ASHA-Life Intervention Perspectives Voiced by Rural Indian Women Living With AIDS

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PADMA RAMAKRISHNAN
People's Health Society, Nellore, India

SANJEEV SINHA
Department of Medicine, All India Institute of Medical Sciences (AIIMS), New Delhi, India



Community-based HIV/nutritional intervention

- Combined intervention
 - HIV-related treatment support
 - Nutritional education
 - Food supplements
- Delivered by community health workers (ASHA) under nurse supervision
- PI: Dean Adey Nyamathi, UCI School of Nursing

Design

2x2 factorial design with 4 arms

- 1) HIV treatment support alone
- 2) HIV treatment support + nutrition education
- 3) HIV treatment support + food supplements
- 4) HIV treatment support + training + food supplements

Intervention phase: 6 months

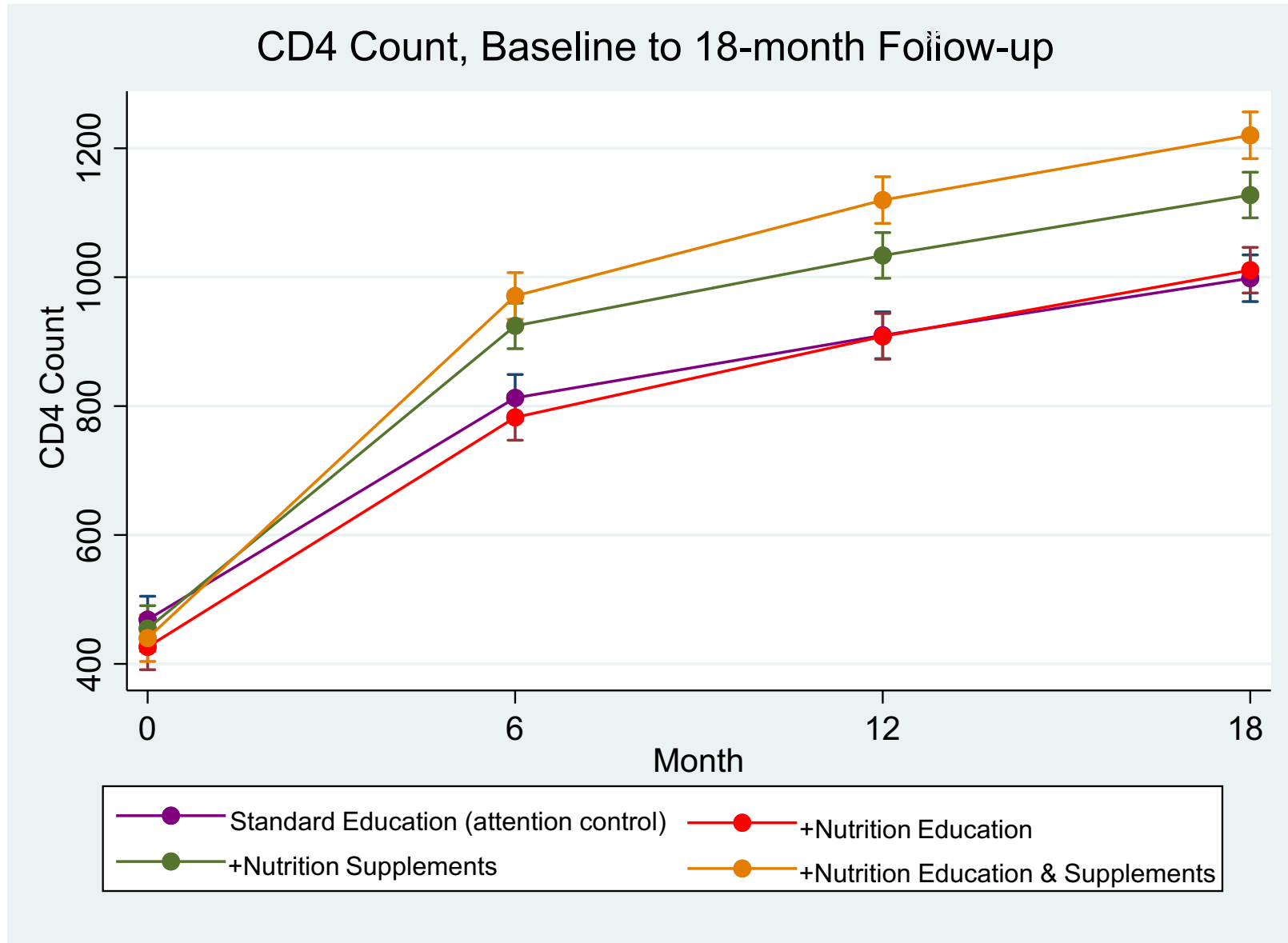
Follow-up phase: 12 months

Food supplements

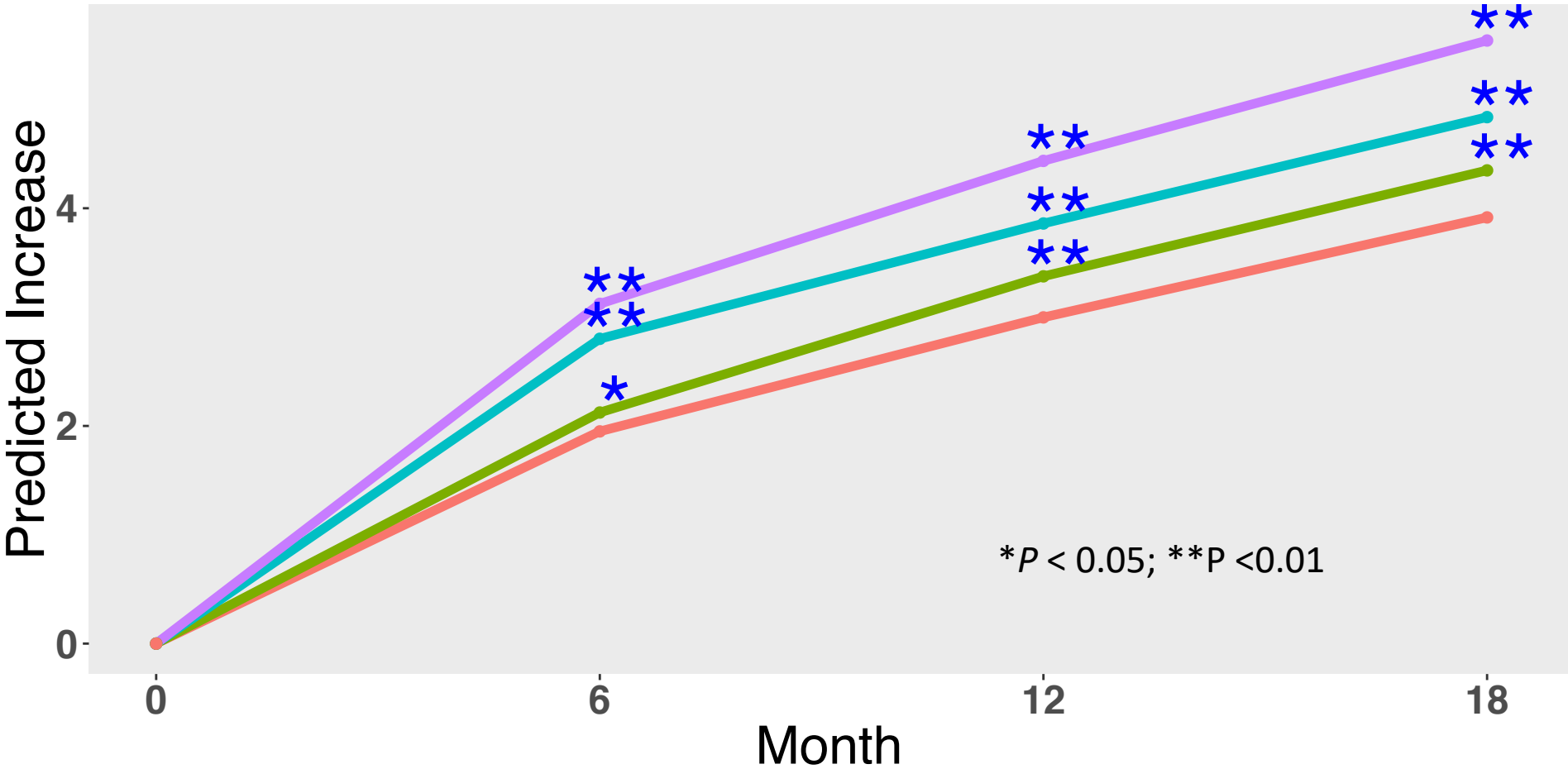
- Locally procured high protein legumes (dal) + vegetable oil
- Amount calculated to provide:
 - 500 kcal (bowl-sized serving) per day for each adult
 - 250 kcal (half-bowl) per day for each child
- Average cost: \$12 per month per family over 6 months



CD4+ T Cell among Women (N = 600)



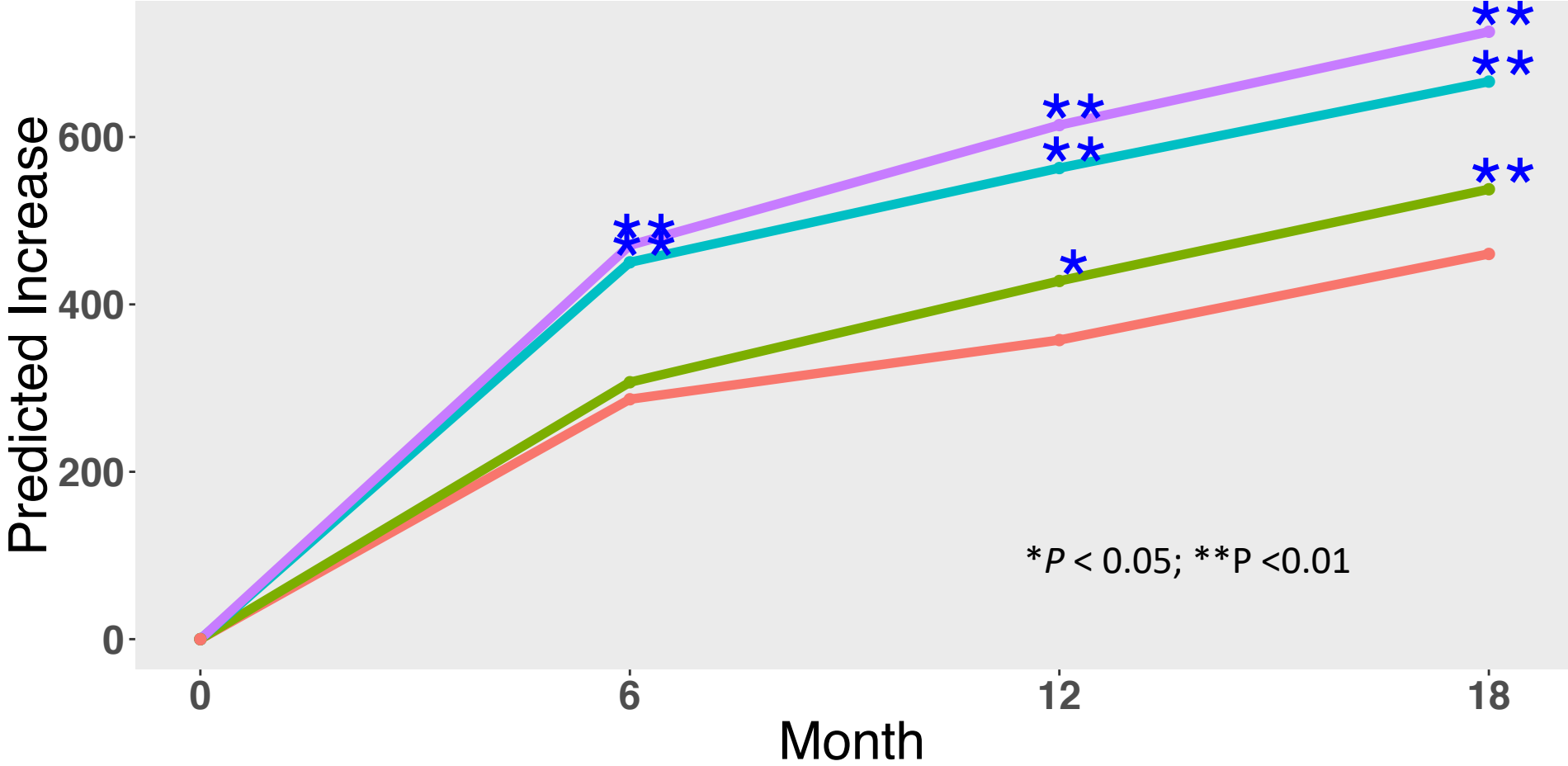
Weight Gain among Children (N = 600)



*P < 0.05; **P < 0.01

Program 1) Standard Education 2) +Nutrition Education 3) +Nutritional Supplements 4) +Nutrition Education and Supplements

CD4+ T Cells among Children (N = 120)



*P < 0.05; **P < 0.01

Program 1) Standard Education 2) +Nutrition Education 3) +Nutritional Supplements 4) +Nutrition Education and Supplements

Conclusions

- Nutritional interventions for mothers living with HIV significantly improved outcomes for mothers and children
- Low-cost locally sourced food should be incorporated into HIV programs
- Climate change likely to increase the need for nutritional interventions in HIV programs

Clinical Infectious Diseases

MAJOR ARTICLE



The Effect of Community-Based Nutritional Interventions on Children of Women Living With Human Immunodeficiency Virus in Rural India: A 2 × 2 Factorial Intervention Trial

Sanghyuk S. Shin,^{1,6} Veena A. Satyanarayana,² Maria L. Ekstrand,^{3,4} Catherine L. Carpenter,^{5,6} Qiao Wang,¹ Kartik Yadav,¹ Padma Ramakrishnan,⁷ Suresh Pamujula,⁸ Sanjeev Sinha,⁷ and Adeline M. Nyamathi¹

¹Sue & Bill Gross School of Nursing, University of California Irvine, Irvine, California, USA; ²Department of Clinical Psychology, National Institute of Mental Health and Neurosciences, Bengaluru, India; ³University of California San Francisco, San Francisco, California, USA; ⁴St John's Research Institute, Bangalore, India; ⁵Department of Epidemiology, University of California Los Angeles, Los Angeles, California, USA; ⁶UCLA Center for Human Nutrition, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, California, USA; ⁷Department of Medicine, All India Institute of Medical Sciences, Delhi, India; and ⁸A.C. Subba Reddy Government Medical College, Nellore, India

Climate change and homelessness

- Destruction of housing & displacement
- Climate refugees
- Urbanization
- Housing shortage
- Rampant real estate speculation
- Lack of rent control

https://link.springer.com/chapter/10.1007%2F978-90-481-9867-2_10

Climate Change Is Making the Affordable Housing Crunch Worse

STATELINE ARTICLE August 30, 2019 By: [Teresa Wiltz](#) Topics: [Safety Net](#) Read time:

Share



Resident Joseph Fudi looks at flood debris and storm damage from Hurricane Florence at a home in New Bern

Why green “climate gentrification” threatens poor and vulnerable populations

Isabelle Anguelovski^{a,b,c,d,e,1}, James J. T. Connolly^{b,c,d,e}, Hamil Pearsall^f, Galia Shokry^{b,c,d,e}, Melissa Checker^{g,h}, Juliana Maantay^{i,j}, Kenneth Gould^{i,k}, Tammy Lewis^{i,k}, Andrew Maroko^{g,l}, and J. Timmons Roberts^m

Cities in the Global North are increasingly adopting green interventions meant to enhance their climate resilience capacity. Plans include Philadelphia, PA’s Growing Stronger, Boston, MA’s Resilient Boston Harbor (Fig. 1), Malmö, Sweden’s Green and Blue Infrastructure Plan, and Barcelona, Spain’s Green Infrastructure and Biodiversity Plan. Such plans and interventions mark the emergence of a new type of climate planning: green climate resilience.

In today’s cities, however, low-income communities, people of color, and migrant communities face well-documented forms of climate injustice. Typically, these populations have contributed the least to climate change, have had the least access to environmental amenities such as green space, are the most exposed to climate hazards and effects (1), and have the fewest resources to adapt (2–4). We argue here that an emerg-



Fig. 1. If not done right, green infrastructure, such as that shown here in East Boston, is potentially a source of climate injustice.

Homelessness and TB in Los Angeles

President Trump's summit with Kim Jong Un ends with no agreement; White House



Fox hit with \$179-million judgment in dispute over profits from 'Bones' TV show



Emma Thompson's letter to Skydance: Why I can't work for John Lasseter



Dodgers need to close the deal and sign Bryce Harper



L.A. NOW LOCAL

L.A.'s homelessness surged 75% in six years. Here's why the crisis has been decades in the making

By GALE HOLLAND FEB 01, 2018 | 3:00 AM



Homelessness in Los Angeles

- From 2012 to 2018 LA's homeless population grew from 32,000 to 55,000
 - 41,000 live in cars, campers, tents and lean-tos
 - 222 encampments
- Single adults, families, children



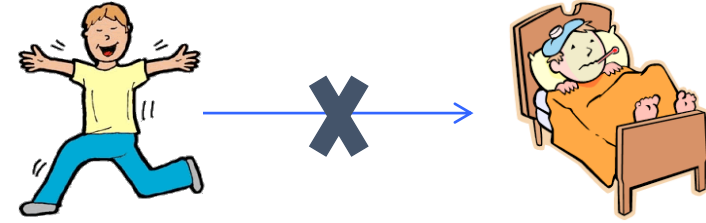
TB outbreak in the homeless community in LA



- 2007 - 2017
- >100 cases
- 17% case fatality
- 21% HIV infected

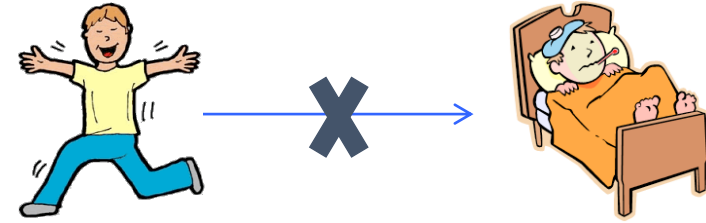
Photograph: Union Rescue Mission (www.urm.org)

Treatment of latent TB infection (LTBI)



- Strategy: treat LTBI before it develops into active TB

Treatment of latent TB infection (LTBI)



- Strategy: treat LTBI before it develops into active TB
 - Traditionally: 6 - 9 months of daily isoniazid
 - New: 3 months of weekly combination therapy (isoniazid and rifapentine; aka 3HP)
 - Only 12 doses!
 - >85% completion in general population
 - **Only <65% completion among homeless population**

Nurse-Led
Community Health Worker
***3HP* Adherence Model**
for Homeless Adults
at Risk for Tuberculosis

UCI 3HP Intervention Project among Homeless Adults in Los Angeles

- Funding from NIH National Institute of Minority Health and Health Disparities (PI: Nyamathi)
- Research Question
 - Can a comprehensive intervention for addressing social and structural issues delivered by nurse/CHW team lead to high 3HP completion rates among homeless adults with LTBI?
 - Premise: Most people who are homeless want to complete their treatment and will do so if provided sufficient support

UCI 3HP Intervention

- CHWs recruited from the homeless community (formerly homeless peers)
- Directly observed therapy of 3HP
 - Pick up meds from clinic and disburse them in the community (e.g. shelter, street, etc.)
- Assist with management of side effects, laboratory testing, etc.
- Referral for housing, mental health, and other health conditions

UCI 3HP Study Design

- Goal: achieve >85% treatment completion
- Assess outcomes
 - 3HP completion
 - Reduced drug use, alcohol use, improved mental health, improved housing
- Preliminary data suggest >90% completion of TB preventive treatment

FINANCIAL ISSUES > FEATURES

The Number-One Barrier to Ending HIV in U.S. Cities Is a Housing Crisis



Tim Murphy
CONTRIBUTING EDITOR
Jan. 23, 2020



stellalevi via [iStock](#)

Conclusions



- Infectious diseases are fueled by social determinants
- Climate change
 - Exacerbates existing vulnerabilities
 - Increases ID-related morbidity and mortality



Path forward

- Protect social and economic rights
 - Food
 - Health care (including mental health)
 - Housing
- Increasingly important due to climate change

Acknowledgements

- Botswana

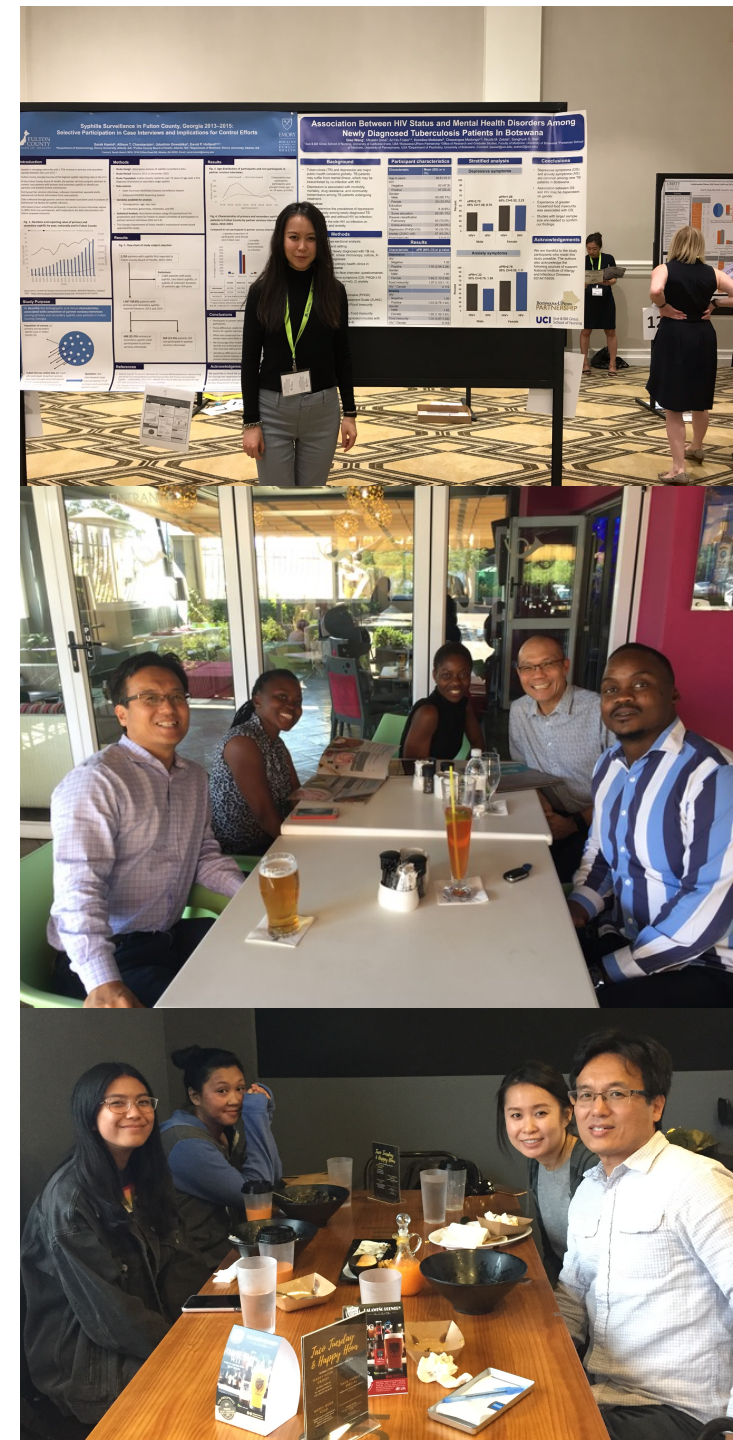
- Nicola Zetola, Chawangwa Modongo, Dima Mbatshi, Fane Othusitse, Patricia Kgaodi, Sithabiso Mkomazana, Tiroyaone Leburu, Tebogo Zulu, Keneilwe Molebatsi, Ari-Ho Foster
- Mental health nurses

- India

- Sanjeev Sinha, Padma Ramakrishnan, Suresh Pamujula

- UC Irvine

- Dean Adey Nyamathi, Kartik Yadav, Qiao Wang, Megan Bersamira, Jacqueline Valera



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