Emerging Infectious Diseases in a Wetter, Hotter, more Urban World

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Water-borne diseases: Cholera, typhoid, leptospirosis

Vector-borne diseases: Dengue, chikungunya, zika
Strengthening climate-health surveillance and research capacities in Ecuador

**Aim:** Create a long-term research platform for climate-sensitive diseases and other priority areas, e.g., other pathogens, clinical trials, vector control interventions.

**Approach:**
- Strong institutional partners and formalized MOUs.
- A social-ecological systems approach to study design and analysis.
- Strengthening of virus-vector-climate surveillance systems (diverse data streams) and ongoing training and capacity building.
- Integration of data through spatiotemporal modeling.
- Service to improve the health of local communities.

**Outcome:**
- Generate the evidence base for the effects of climate on health
- Identify and test effective public health responses and interventions.
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Phase 1 (2007-2012): Establishing the evidence base for climate and social-ecological risk factors for dengue transmission
Machala, Ecuador (~250,000 pop.)
Dengue is hyperendemic (DENV1-4)
CHIKV emerged in 2015
ZIKV emerged in 2016
Teleconnections:
El Niño (ocean warming) affects local rainfall

Correlation between the Oceanic Niño Index (ONI) in Oct-Nov-Dec and rainfall in Feb-Mar-April

(Stewart Ibarra & Lowe, 2011, ASTMH poster)
The frequency of extreme El Niño events will increase from one event every 20 years, to one event every 10 years.
Figure SPM.6. Projected surface temperature changes for the late 21st century (2090-2099). The map shows the multi-AOGCM average projection for the A1B SRES scenario. Temperatures are relative to the period 1980-1999. (Source: IPCC)
Urban growth and inequity: The impact of climate on health depends on the vulnerability of the population.
Mixed and participatory methods

Stakeholder engagement with communities, climate and health sectors
Entomological surveys
Household surveys
Community focus groups
Spatiotemporal analyses of existing climate and health data
Predictors:
- ONI (3 mon lag)
- Tmin (2 mon lag)
- Rainfall (1 mon lag)
- Num. serotypes (3 mon lag)
- Aedes indices (1 mon lag)
Evidence of multiyear cycles of climate & dengue in Machala

Wavelet coherence spectrum
Dengue - Rainfall

Dengue – Min Temp

(Stewart Ibarra, Muñoz, et al. 2014, BMC Infectious Disease)
Improved seasonal climate forecasts and ENSO forecasts for better dengue predictions.
Evidence that the effect of climate on dengue varies within the city of Machala.

(Stewart Ibarra, et al. 2013, PLOS ONE)
Participatory methods to assess:
• Causal pathways
• Risk factors
• Misconceptions
• Roles of the community & government

Perceptions govern behavior, influencing people’s ability & willingness to respond to public health interventions.

Stewart Ibarra et al. 2014. BMC Public Health
Social-ecological system for dengue

Household risk factors:
- Water storage behavior
- Condition of patio and house
- Knowledge of breeding sites

Water source:
- Rain water
- Tap water

Container type:
- Abandoned
- Domestic use

Ae. aegypti density (dengue risk)

Climate:
- Rainfall
- Min temp

Rainy season:
- Rainy season

Dry season:
- Dry season

Access to potable water:
- Number of families
- Water storage behavior
- Risk perception

(Stewart Ibarra et al, 2013, PLOS ONE)
Phase II (2012-present): Creation of a research and training platform for climate-sensitive infectious diseases
Capacity Strengthening in Ecuador: Partnering to improve surveillance of febrile vector-borne diseases

High resolution longitudinal spatiotemporal data on human infections, virus serotypes and genotypes, mosquito vector, human nutrition, social-ecological risk factors, microclimate data

PI: T. Endy, co-PIs: M. Polhemus, S. Ryan, C. King, A. Stewart, S. Mehta, J. Finkelstein
In-situ Vector Dynamics in a High Burden Region in Ecuador
NSF Zika Rapid; 2016-2017. PI: A Stewart; Co-PIs: Ryan, Endy, Neira

Effects of temperature on vector-borne disease transmission: integrating theory with empirical data
NSF/NIH EEID; 2015-2020; PI: Erin Mordecai, Stanford University

- 3 year cohort study
- 240 households, 4 sites
- ibuttons for temp, RH
- Adult mosquito abundance
- Household risk factors
- Dengue & zika prevalence and incidence in mosquitoes and humans
CLIMATE SERVICES FOR HEALTH

Improving public health decision-making in a new climate

CASE STUDIES
On February 26, 2016, over 170 mm of rain fell in 10 hours, and coincided with high tides, causing the worst flooding since the 1997-1998 El Niño.
ZONAS AFECTADAS POR EL TERREMOTO

EFECTOS DEL TERREMOTO

EPICENTRO
- Richter: 7.8
- Hora local: 18:58 h
- Profundidad: 19.2 km

Severo
Muy fuerte
Fuerte
Moderado

Océano Pacífico
COLOMBIA
ECUADOR
QUITO
Santo Domingo
Esmeraldas
Portoviejo
Mastore
Twelvefold increase in Zika cases since Ecuador earthquake

UNICEF and partners are supporting the national government by raising awareness and providing necessary supplies

NEW YORK/PANAMA/QUITO/TORONTO, July 19, 2016 /CNW/ - Three months after the Ecuador earthquake, the number of Zika Virus cases increased from 92 to 1,106 country-wide, with the sharpest increase in the quake-hit areas.

According to national data, 80 per cent of the Zika cases are in the province of Manabí where the April 16 earthquake left most damage. After the earthquake, the proliferation of stagnant waters, and concentration of displaced persons increased the risk of vector transmission.

Women between 15 and 49 years of age are the worst affected by the virus, accounting for 509 cases in Manabí.
In the face of the emergencies of human-induced climate change, social exclusion, & extreme poverty, we join together to declare that:

Human-induced climate change is a scientific reality, and its decisive mitigation is a moral and religious imperative for humanity.

Pontifical Academies of Sciences and Social Sciences