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Robert Stempel College of Public Health & Social Work

Beyond the Mosquito: Mapping Anthropogenic Risk Factors

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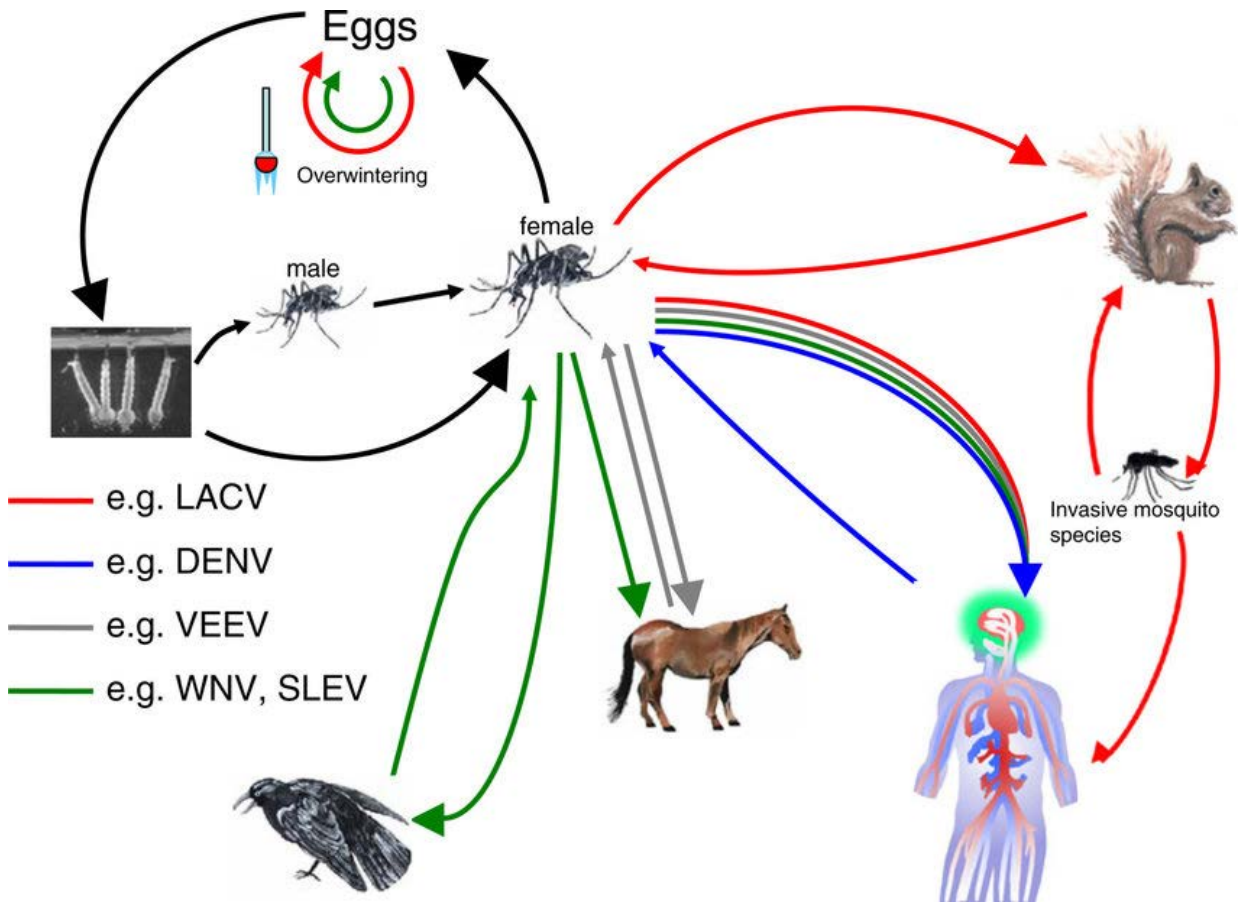
Disease Cycles



Social Cycles

"You have a 24-hour virus -- of course, you'll be dead by then."

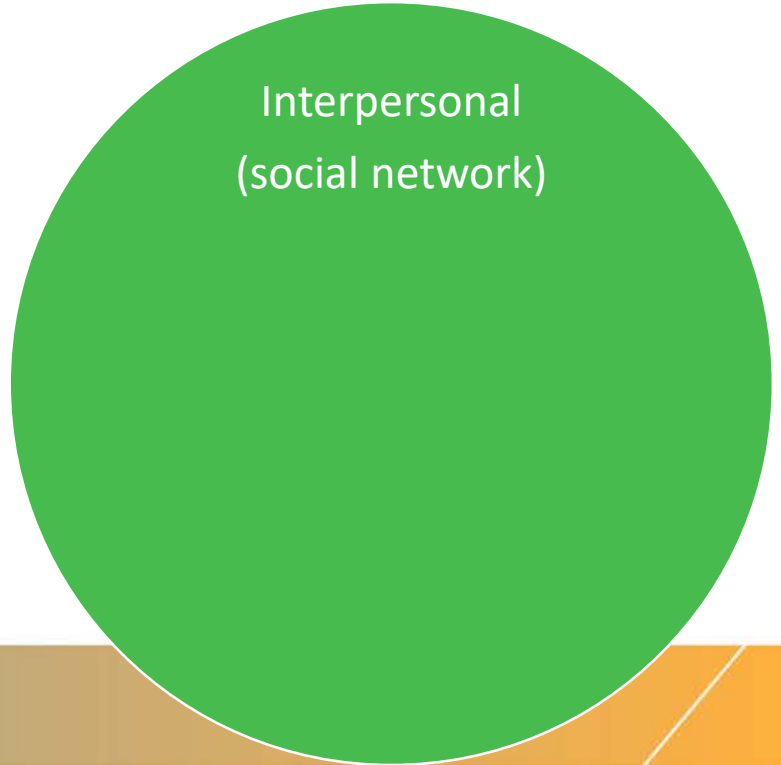
Social Cycles

Individual

- Occupation
- Income
- Education
- Age
- Sex
- Comorbidities
- Ethnicity
- Disease knowledge, attitude, and beliefs
- Self Efficacy
- Personal protective behaviors
- Immigration status
- Travel behavior

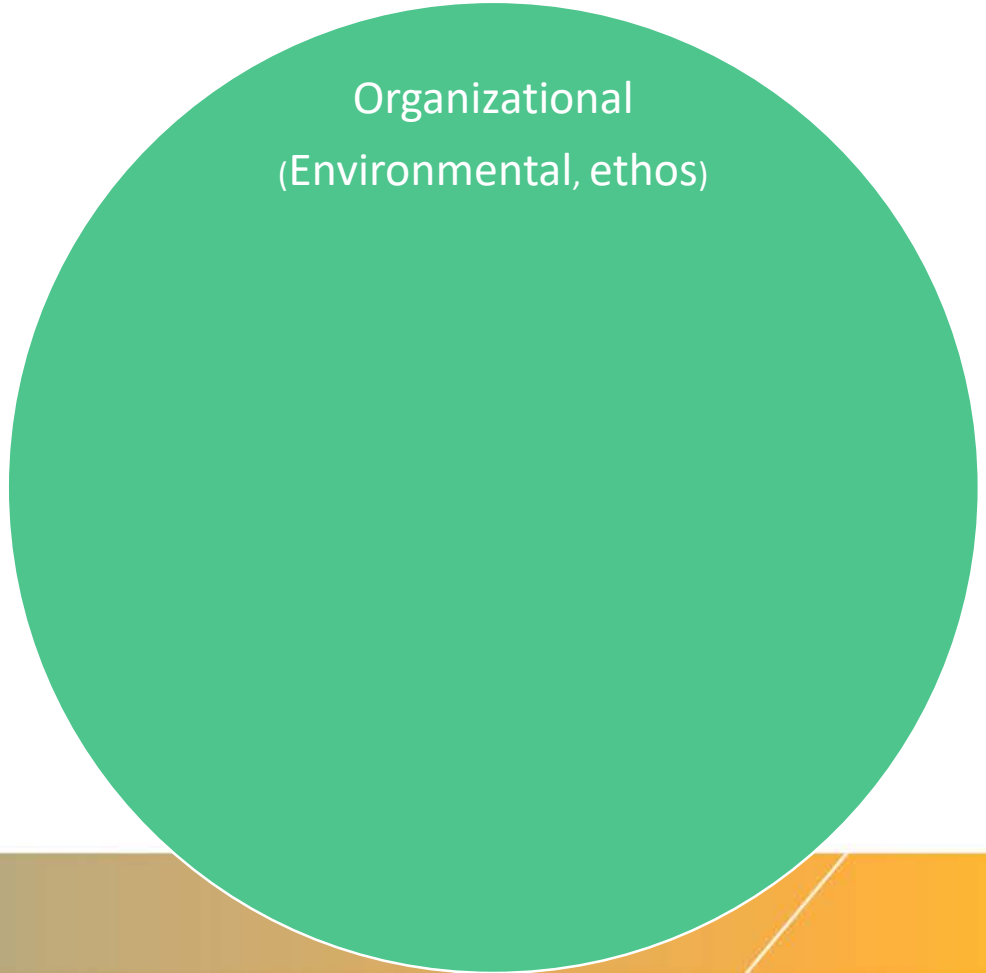
Interpersonal

- Social beliefs
- Religious beliefs
- Gender roles
- Poverty
- Conflict
- Care seeking behaviors
- Types of work
- Bed net usage
- Rising/sleeping hours



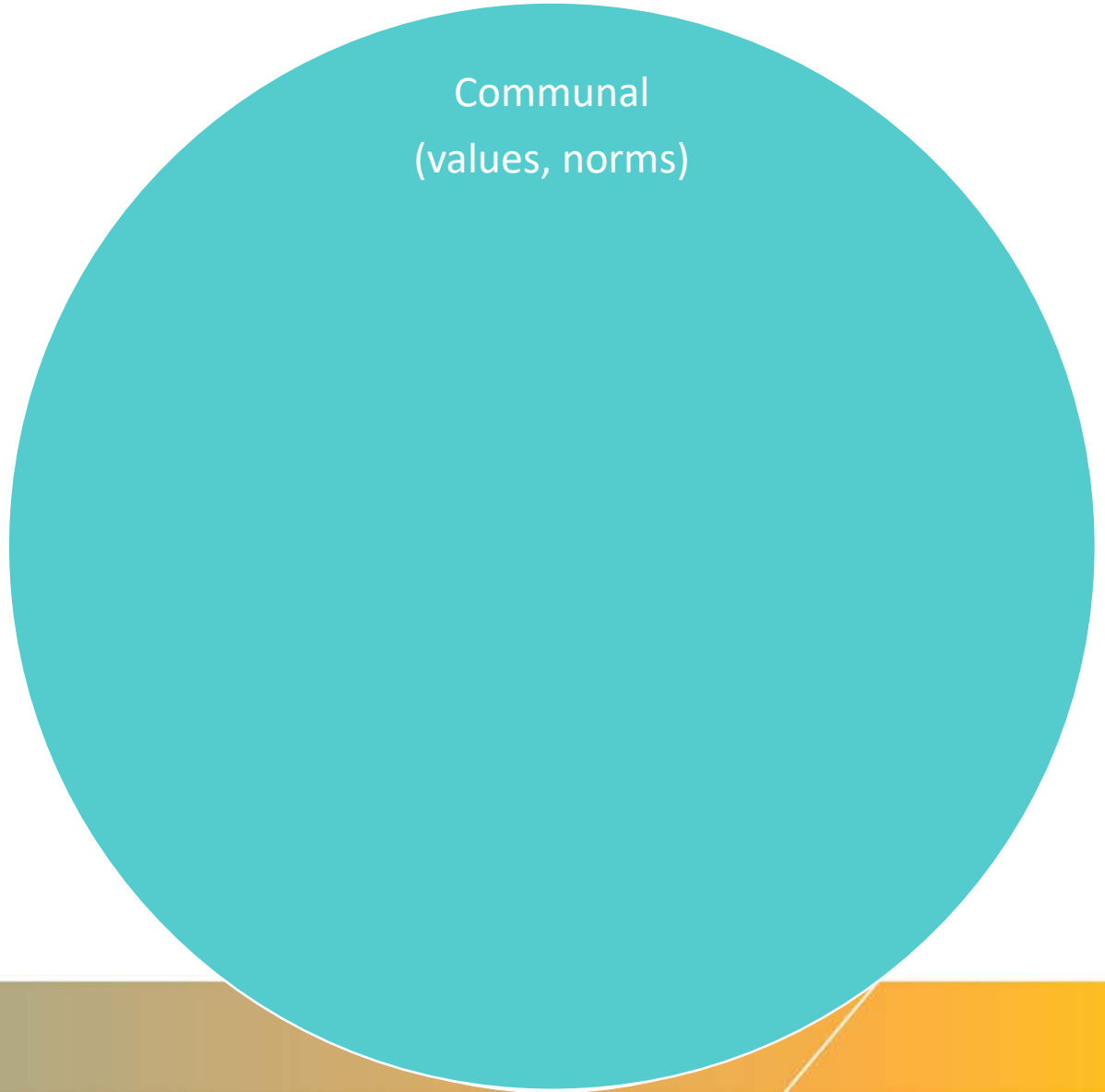
Organizational

- Healthcare access
- Coverage
- Quality
- Health staff knowledge
- Housing type and quality



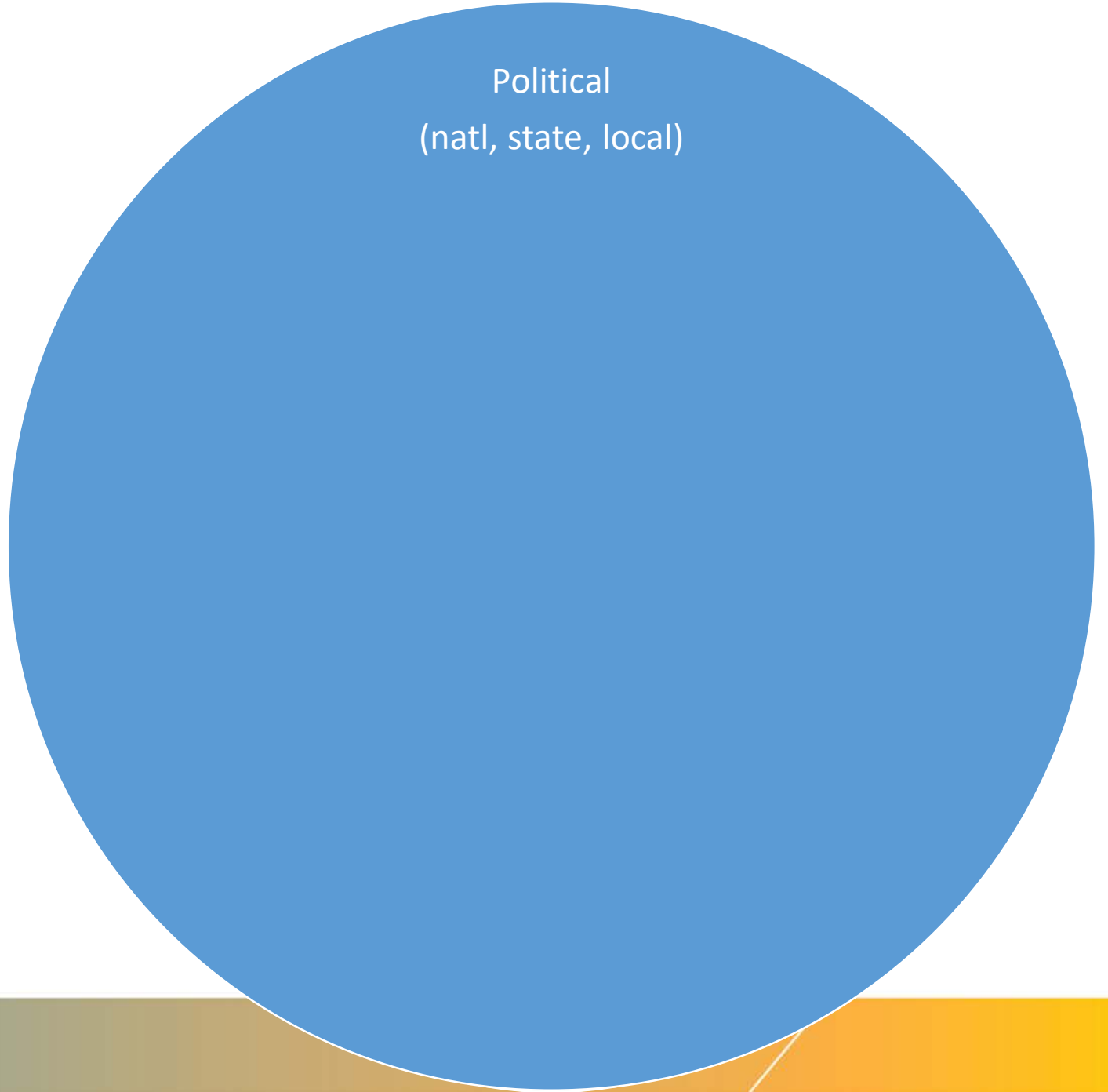
Communal

- Urbanization
- Cultural norms
- Group behaviors



Political

- Political context
- War or conflict
- Health promotion, disease prevention, environmental protection policies at national, regional, and local levels
- Sewage systems

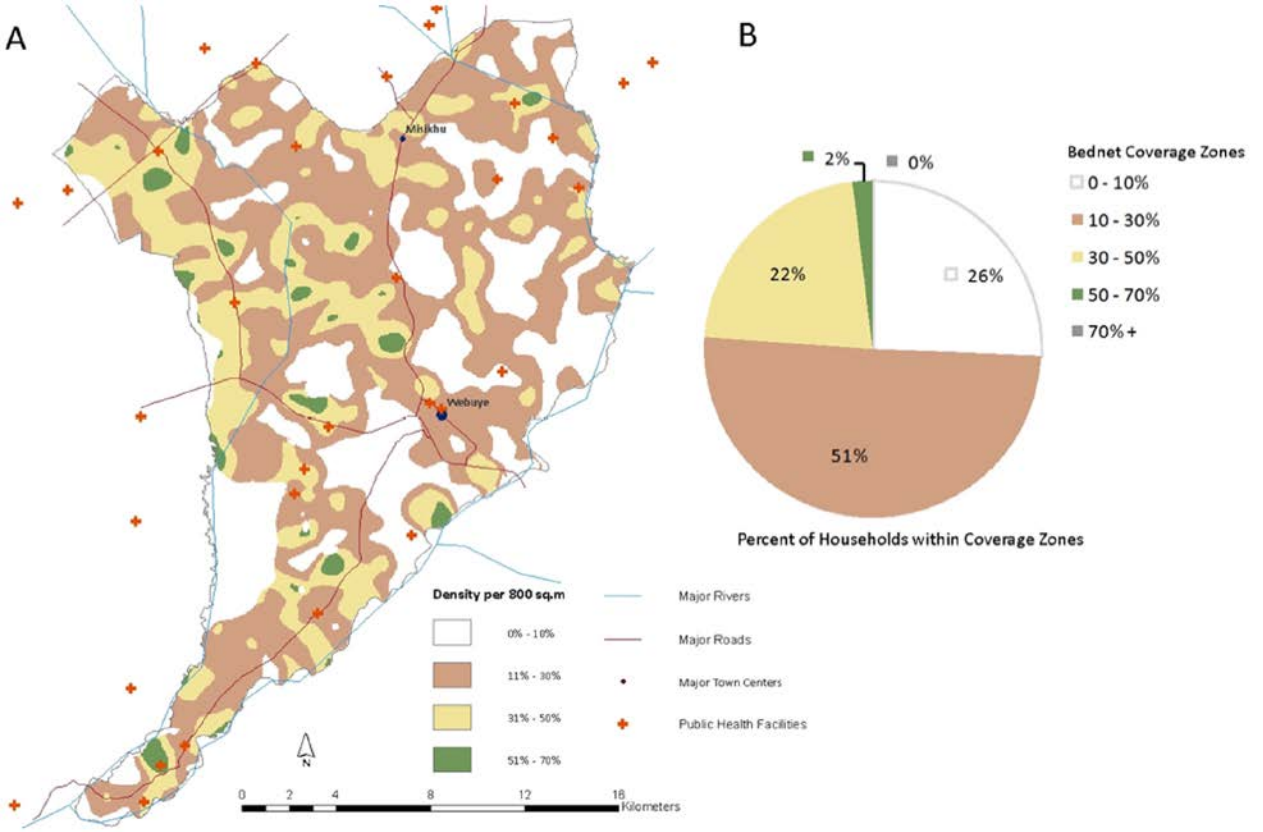


Statistically significant predictors of VBD

- Koyadun, Butraporn, Kittayapong. Ecologic and sociodemographic risk determinants for dengue transmission in urban areas in Thailand. *Int Pers on Inf Dis.* 2012.
- Carabali, Hernandez, Arauz, Villar, Ridde. Why are people with dengue dying? A scoping review of determinants for dengue mortality. *BMC Infec Dis*. 2014, 15:301.
- Akter, Naish, Hu, Tong. Socio-demographic, ecological factors and dengue infection trends in Australia. *Plos ONE*. 2017, 12:10.
- Teixeira, Morato, Barreto, Mendes, Barreto, Costa. Risk factors for the incidence of dengue virus infection in preschool children. *Trop Med Intl Health.* 2012, 17(11):1391-1395.
- …

Bednet Behavior

- K-function values show clustering of HH with nets
- Income predicted net usage in urban areas but not in rural areas
- Rural area net usage predicted by Euclidean distance to nearest road or nearest health centre



O'Meara, Smith, Ekal, Cole, Ndege. Spatial distribution of bednet coverage under routine distribution through the public health sector in a rural district in Kenya. PlosONE, 2011.

Treatment Seeking Behaviors

- Hot spot analysis of treatment seeking behavior from retail vendors
- Hot spot analysis of treatment seeking behavior from national control programme

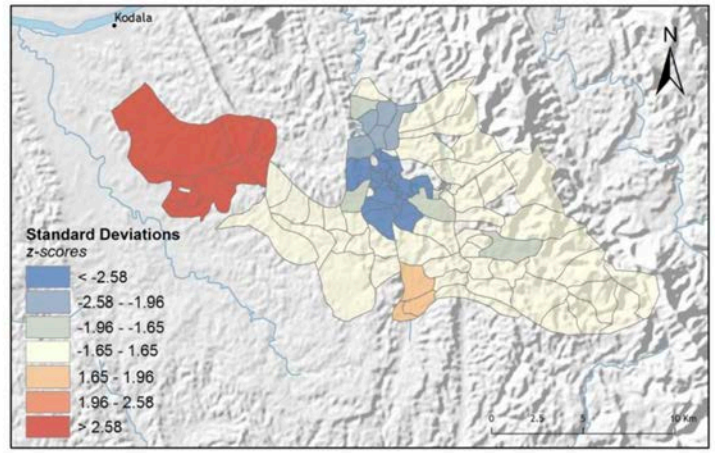


Figure 2
Hot-spot analysis for vendor usage rates.

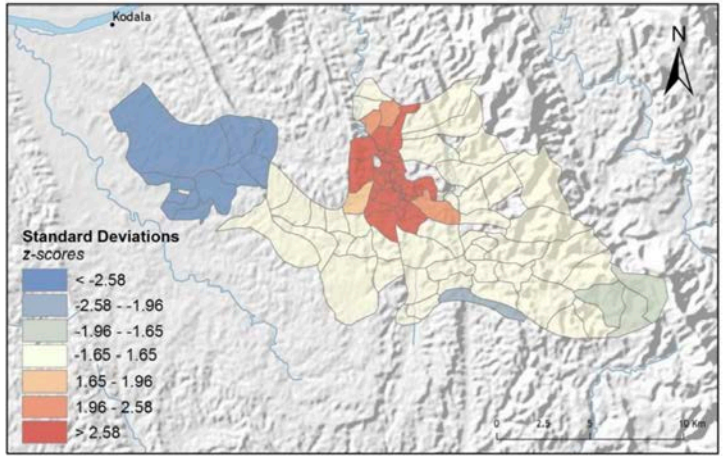


Figure 3
Hot-spot analysis for control programme usage rates.

Haque, Scott, Hashizume, Fisher, Haque, Yamamoto, Glass. Modelling malaria treatment practices in Bangladesh using spatial statistics. Malaria Journal 2012; 11:63

Treatment Seeking Behavior – Evaluating Control Program Effectiveness through its Determinants

- Evaluating National Control Programme effectiveness by assessing strength of relationship to determinants

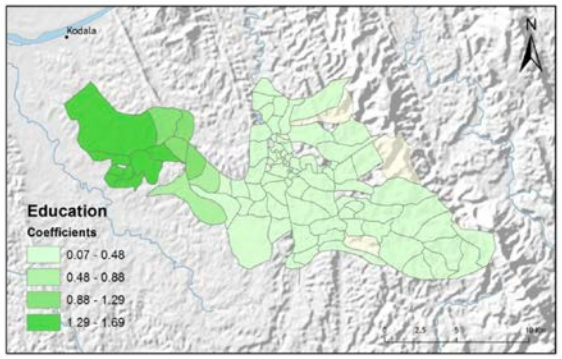


Figure 10
Education GWR coefficients for predicting vendor service preference.

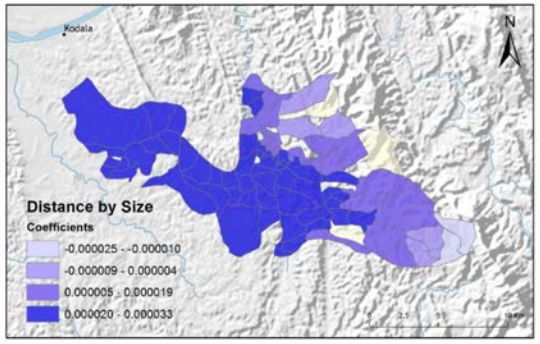


Figure 11
Distance to regional centre by size GWR coefficients for predicting vendor service preference.

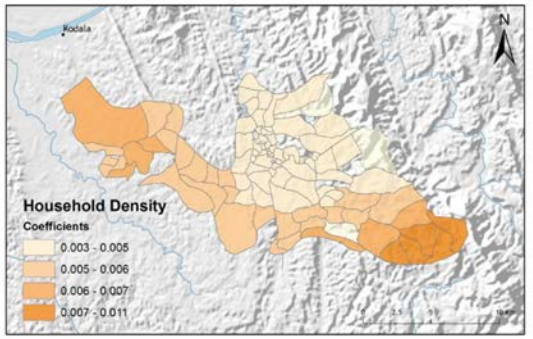


Figure 12
Household density GWR coefficients for predicting control programme preference.

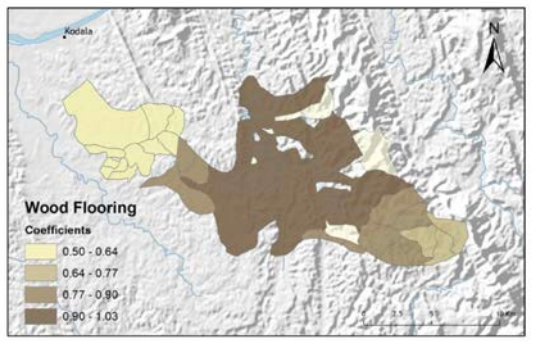


Figure 14
Wood floor GWR coefficients for predicting control programme preference.

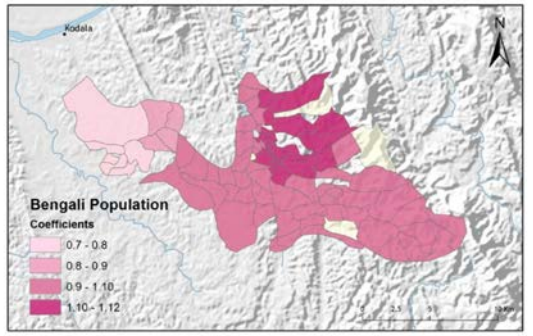


Figure 13
Bengali population GWR coefficients for predicting control programme preference.

Realizing TAPAS!

- The most important factor for success:

3. ID geographical areas most at risk for introduction and/or emergence

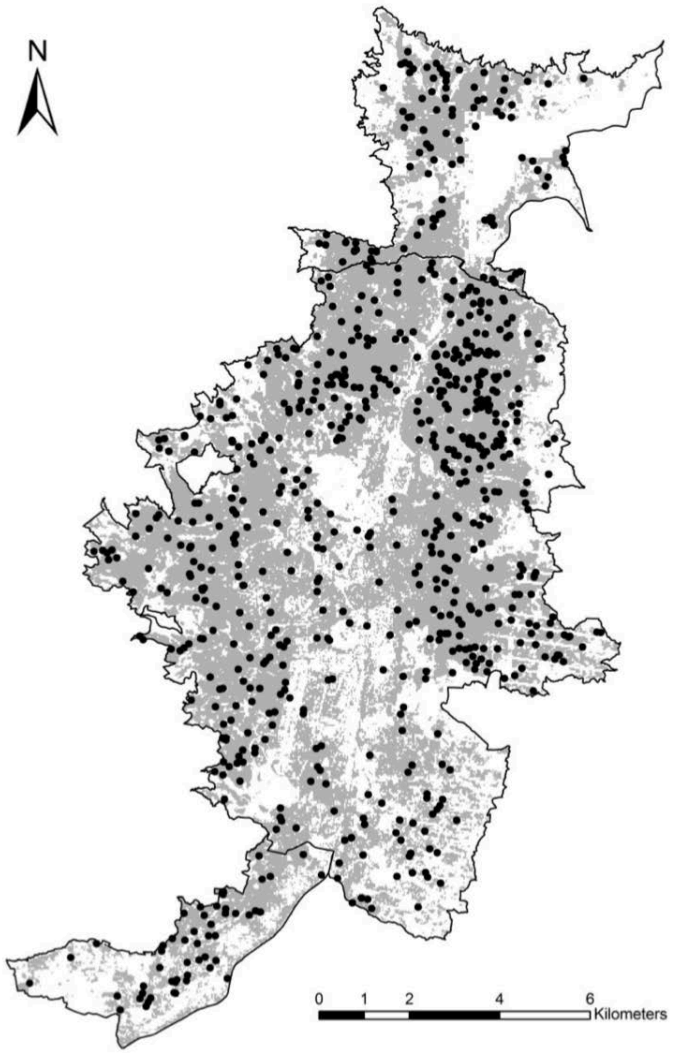
Risk=

- Anthropod Surveillance, vector breeding habits
- Land surface temperatures, rainfall, climate changes
- Provider practices
- Income, education, healthcare access, behavior…

Areas of Risk: Environment

- Bello, Medellín, and Itagüi Colombia
- Landsat data for topography, temp and vegetation using 7 Landsat bands of classification
- Used maxent algorithm for generating predictions from incomplete datasets
- Tested model fit in target municipalities by quadrant
- Final risk model with highest predictive fit using symptomatic cases

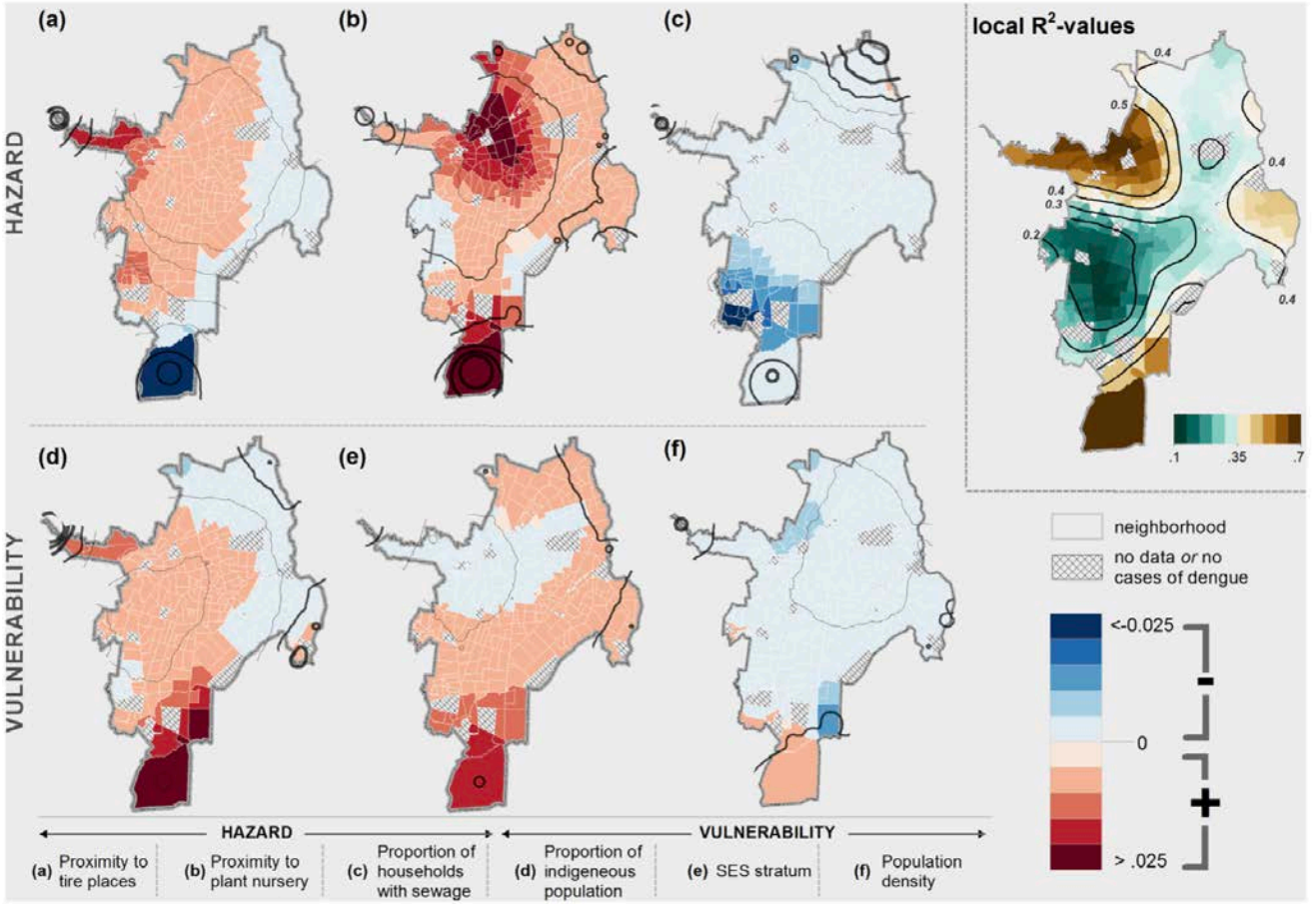
Figure 4. Final risk model for dengue fever case-occurrences in three municipalities of Aburrá Valley. Gray areas are areas predicted as suitable for DF cases; black points are the 2008 cases of dengue fever.



Arboleda, Jaramillo-O., Peterson. Mapping environmental dimensions of dengue fever transmission risk in the Aburra Valley, Colombia. 2009. Int J Environ Res Public Health, 6, 3040-3055.

Areas of Risk: Social

- Local variation of coefficients related to dengue rates
- Red = strength in association is positive, blue = strength in association is negative
- Confirmed the role of environmental factors, as well as population density and socioeconomic status in the spread of Dengue disease.
- Confirms the usefulness of spatial regression in predicting Dengue fever rates with limited data availability.
- Provided the foundation for sub-neighborhood level research investigating specific risk areas



Delmelle, Hagenlocher, et al. “A spatial model of socioeconomic and environmental determinants of dengue fever in Cali, Colombia.” Acta Tropica 164(2016) 169-176

Intervention Successes

- Progress toward community-based interventions for Dengue control:
  - Pesticide-free vector control
  - Behavior change intervention
  - Education materials
- Left panels are baseline data of larvae and pupae per resident comparing intervention areas (A) with control areas (B)

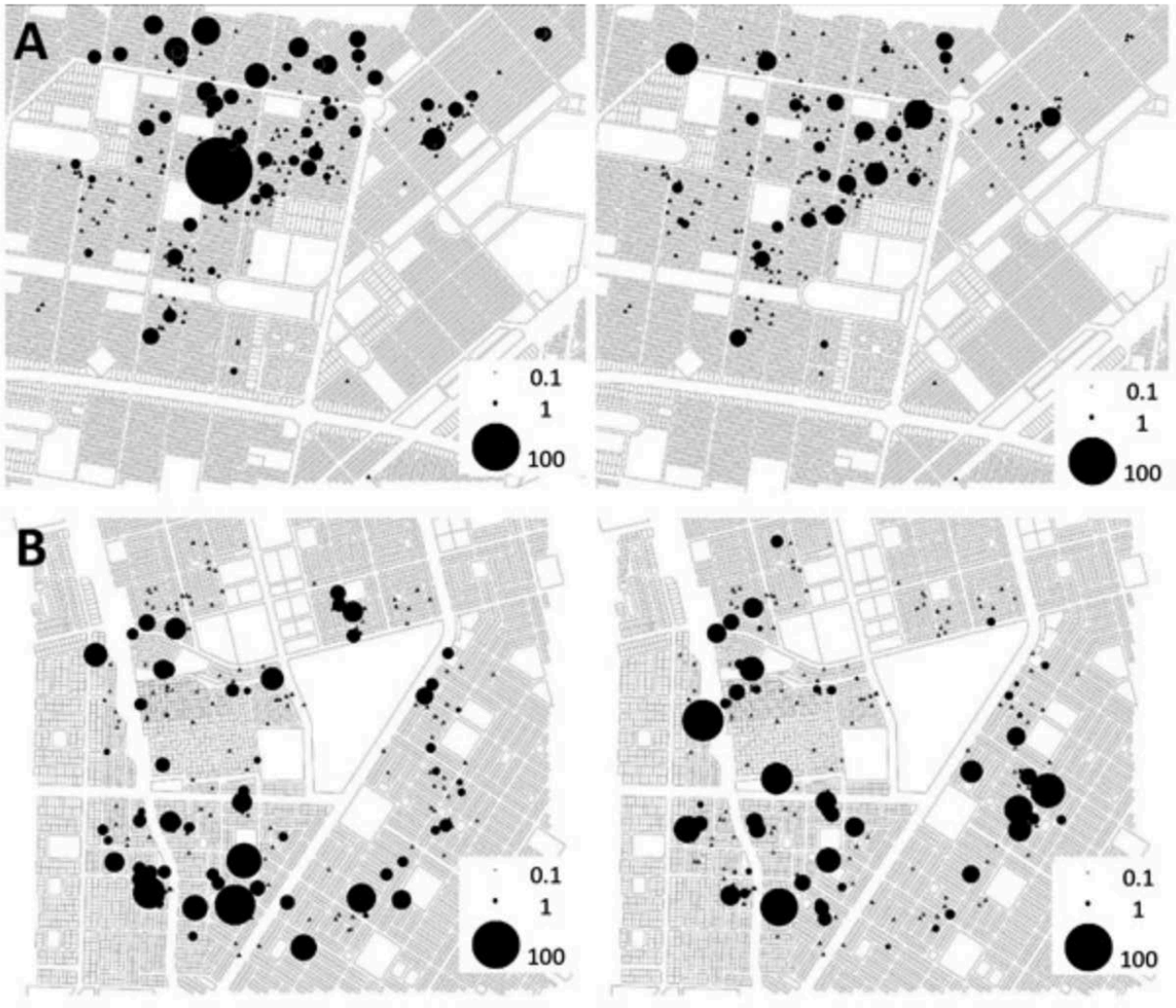
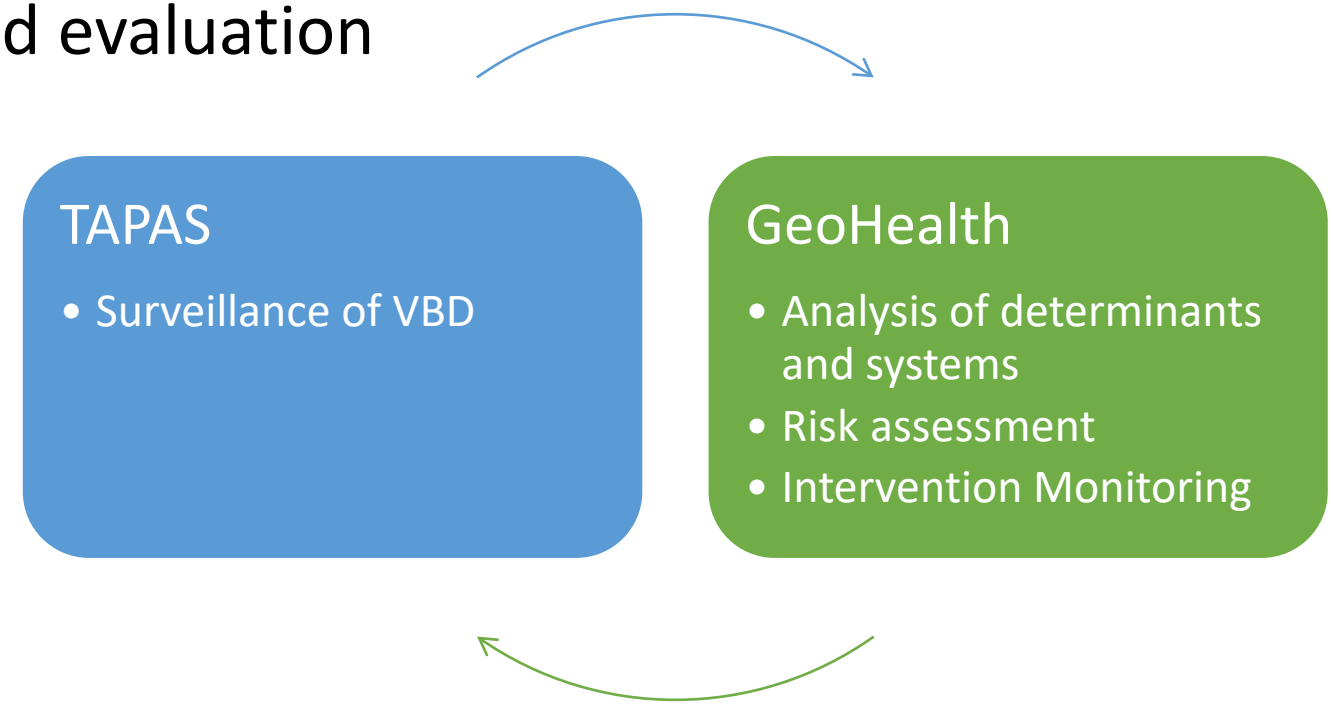


Figure 3. *Aedes aegypti* larvae and pupae per resident (black dots) in the compounds of (A) intervention neighborhood (Tampouy) and (B) control neighborhood (Juvenat) at baseline (left) and endline (right) of an evaluation of a community-based intervention for dengue vector control conducted in Ouagadougou, Burkina Faso, June–October 2016.

Ouedraogo, Benmarhina, Bonnet, Some, Barro, Kafando, Soma, Dabire, Sare, Fournet, Ridde. Evaluation of effectiveness of a community-based intervention for control of dengue virus vector, Ouagadougou, Burkina Faso. Emerging Infectious Diseases, 24:10.

To monitor and evaluate control efforts

- Including surveillance outputs in GeoHealth Framework applications
- Including feedback loop in Surveillance and Control Program monitoring and evaluation



WHO promulgation

- WHO is calling for geospatial analysis techniques to be used for vector born disease control and eradication
- “Geographical Information Systems should greatly assist targeting of interventions at the focal and household levels, leading to improved effectiveness and cost effectiveness of control.” WHO: Carter, Mendis, and Roberts: Bulletin of the World Health Organization, 2000

Acknowledgements

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