Geographic Information Systems (GIS) use in Public Health

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Why use GIS?

• To visualize, understand, question and interpret data
• To reveal spatial and temporal relationships, patterns and trends
• Facilitates the integration and analysis of data from different sources for better decision-making
• Tobler’s First Law of Geography
  "Everything is related to everything else, but near things are more related than distant things"
  - Waldo Tobler
Why use GIS in Public Health?

**Epidemiology**

- The basic science of public health
- *Epi* – means “upon”
- *Demos* – means “people” as in “democracy”
- *Logos* – “the study of”
- “the study of what is upon the people”

- Definition (Last, JM)
  - The study of the **distribution** and **determinants** of health-related states or events in specified populations and the **application of control** of health problems
Why use GIS in Public Health?

- To reveal relationships, patterns and trends about the interaction between host, agent, vector and the environment
- Epidemiology Triad
- Demographic and Geographic characteristics of host and pathogenic communities encourage and inhibit disease
GIS in Public Health: Dengue

Transmission of dengue virus (DENV)
- Prior DENV infection/exposure
- Increased risk for DHF/DSS

Human Host
- Competitive strain displacement
- Genotype
- Virulence

Aedes vector
- Wolbachia co-infection
- SiRNA silencing

Environment
- Climate temperature
- Breeding grounds; standing water
- Urban sanitation

Agent
- Vector-host immune response
- Breeding grounds; standing water

Environment
- Global warming

Host
- Genetic susceptibility, income, resilience

Vector
- Manufacturers, distributors, vendors

Agent
- Filtration cigarettes, Safe cigarettes
Medical Mapping Examples
Arrieta: Bubonic Plague (Bari, 1694)
Seaman: Yellow Fever (New York, 1798)
John Snow and Spot Maps (1854)

• “Father” of Modern Epidemiology
• Cholera
• London Broad Street Pump
• Chlorine in Water
GIS use in Los Angeles County Department of Public Health
• 8 Service Planning Areas (SPA)
• 4 Area Health Officers
  – One per 2 SPAs
• 26 Health Districts (HD) with the 8 SPAs
  – Built upon Census Tracts
• 14 Public Health Centers (PHC)
• Results consistent with Study that showed three LA restaurant hubs
• Who is more likely to complain?
• First time these data were “spatially enabled”
• Eliminating downtown LA as a candidate
  – Pasadena location a good alternative?
Census Tract Proximity to Public Health Centers and Hot Spot of Median Income

- Public Health Centers
- Census Tract Centroid (2010)
- Health Districts (2012)
- Routes

**HotSpot: Median Income**

**Gi_Bin**
- Cold Spot - 99% Confidence
- Cold Spot - 95% Confidence
- Cold Spot - 90% Confidence
- Not Significant
- Hot Spot - 90% Confidence
- Hot Spot - 95% Confidence
- Hot Spot - 99% Confidence

**Median Income Statistics**
- Count: 2,314
- Minimum: $8,647
- Maximum: $242,935
- Mean: $60,342.82
- Standard Deviation: $29,715.08

**Significance Level (p-value)**
- Critical Value (z-score)
  - 0.01: -2.58
  - 0.05: -1.65
  - 0.10: 1.65
  - Not Significant

**Z-scores vs. p-values**

- Random
- Significant
Attachment IVa: Stool and Urine samples within 600 feet of a Public Restroom

Public Restrooms
- Open (n=1)
- Out of Service* (n=3)
- Feces (n=25)
- Urine (n=20)
- Feces and Urine (n=2)
- Homeless Shelters (n=6)

Minor Streets
Major Streets
Skid Row Focus Area

*Public Restroom was out of service or closed for maintenance at time of study, conducted on 05/02/2013.

Note: GPS locations were corrected. Placement of observations (feces, urine, trash cans and public restrooms) by EHS Specialists were identified and confirmed by Aerial and Oblique imagery.

Created by: Office of Health Assessment and Epidemiology, Epidemiology Unit
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WNV + Animal Distribution

Legend

WNV+ Birds
Year
- 2008
- 2009
- 2010
- 2011
- 2012

Mean Center
Median Center
Standard Devational Ellipse
Web GIS Application
LA County Health Viewer

- Added functionality
- New/Updated data
- Latitude Geographics
  - Geocortex Essentials
  - Geocortex Viewer for Silverlight
Think Spatially!

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