Spatial Analysis of Lyme Disease in Howard County, Maryland

Methods and Public Health Significance

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May 14, 2010

Lyme Disease

- Bacteria *Borrelia burgdorferi* causes Lyme disease
- Transmitted to humans through infected ticks during bloodfeeding
- *Ixodes scapularis* (deer tick)

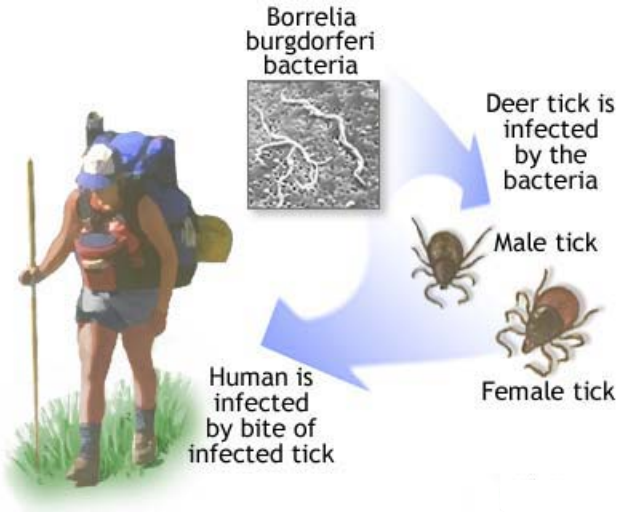


Image by Dr. Jantin M. Vyas (2009)

Lyme Disease: Transmission Cycle

- Juvenile ticks (nymphs) most common vector
  - Difficult to see and remove
  - Bacteria transmitted 36 hours after attachment

Photograph by John VanDyk, Iowa State University Department of Entomology (1996)

Lyme Disease: Clinical Manifestations

- Characteristic bulls-eye rash (erythema migrans, EM)
  - Only 70 – 80% patients manifest EM
- Flu-like symptoms
- Muscle involvement
- Severe headaches, neck stiffness
- Cardiac involvement
- Joint pain

CDC (2007)

Lyme Disease: Public Health Impact

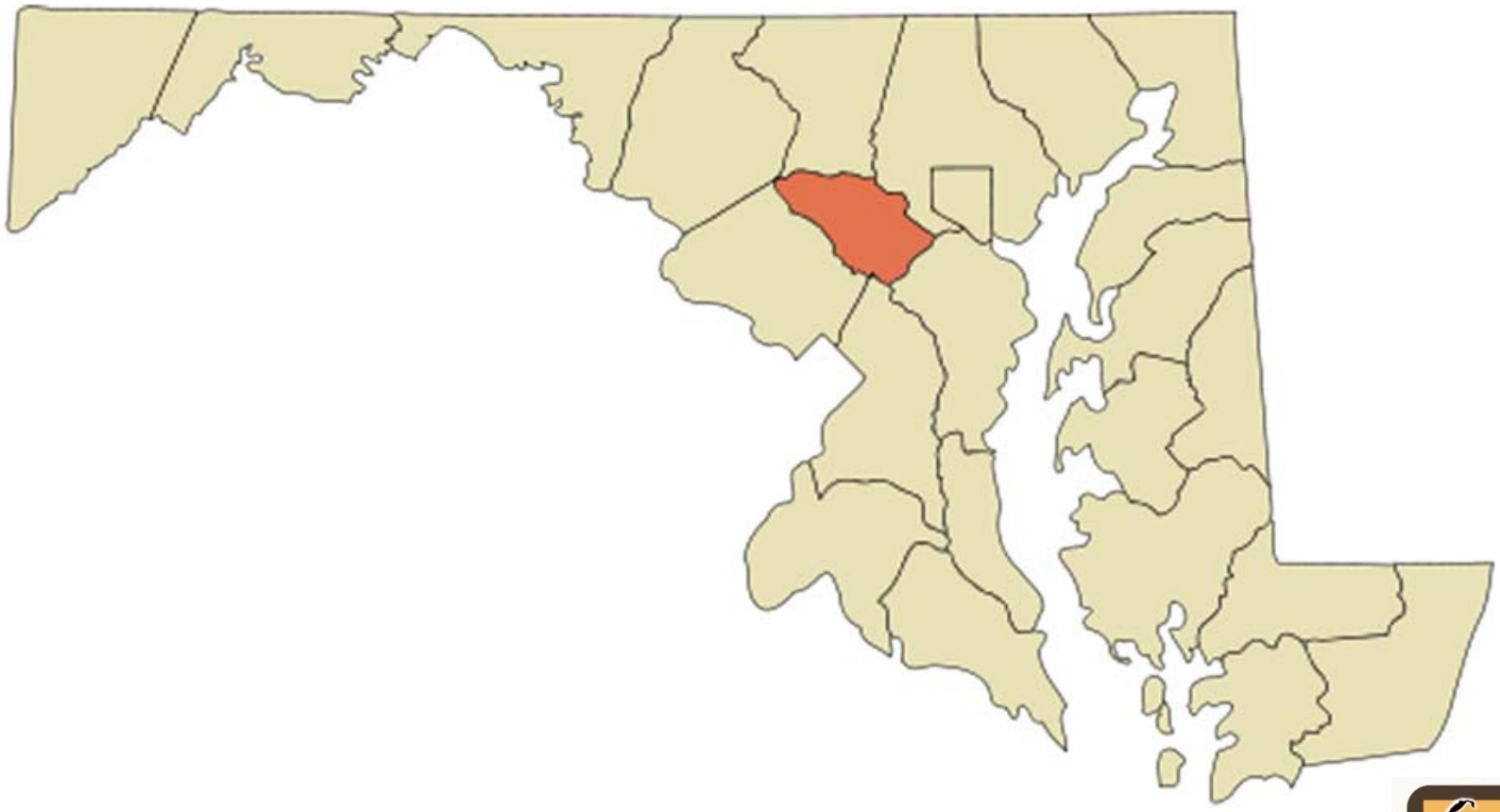
- Most common arthropod-borne disease in the United States
- Maryland: 9th highest incidence rate in United States, 2008
- Howard County: Highest number cases and 3rd highest incidence rate in Maryland, 2008

	2008 Case Count*	2008 Incidence per 100,000
United States	35195	9.4
Maryland	2216	31
Howard County	369	133.8

*Confirmed and probable case diagnoses per CDC guidelines

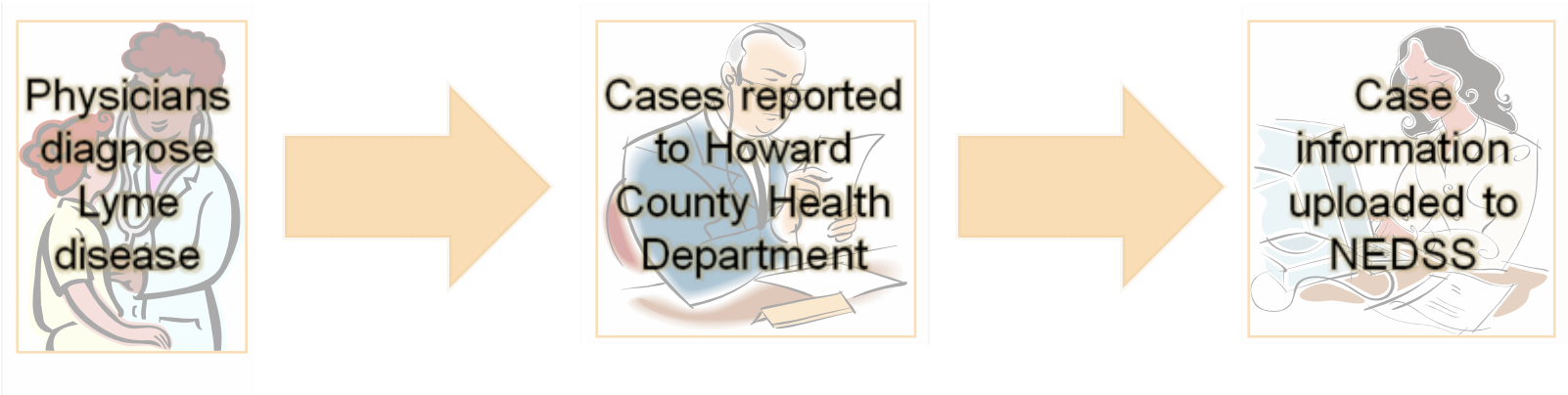
CDC (2009)
Maryland Department of Health and Mental Hygiene (2009)

Study Site: Howard County, MD



Study Methods

- Lyme disease reportable under Code of Maryland Regulations 10.06.01.03



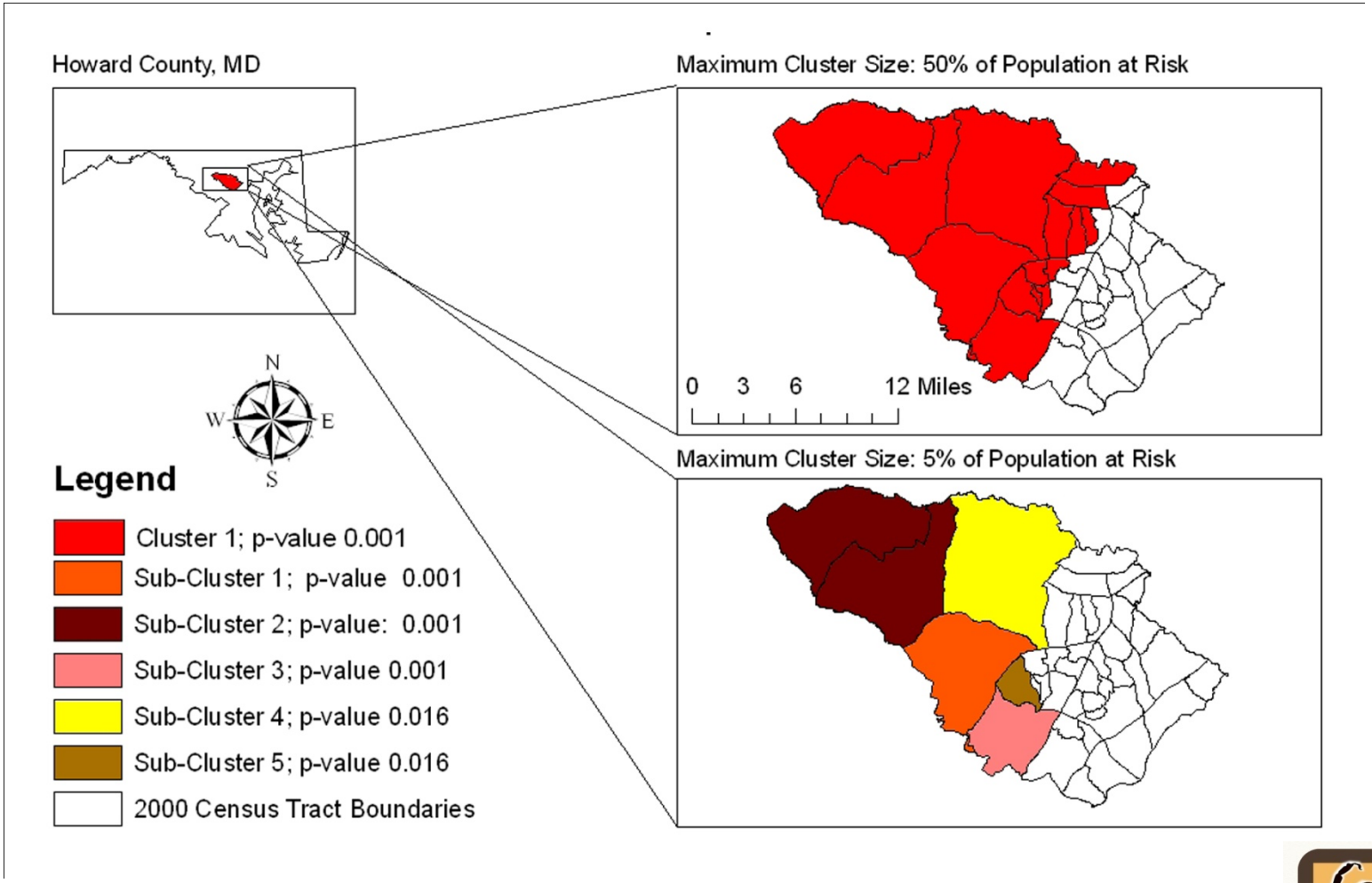
- Cases extracted from the National Electronic Disease Surveillance System (NEDSS)
  - Deidentified to census block and census tract by geocoding in ArcGIS

Analysis: Cluster Detection

- To determine if certain areas show higher than expected case counts (clusters) while accounting for variations in population density
- Kulldorff's spatial scan statistic
  - Adjusts for uneven population distribution across study area
  - Identifies the existence of disease clusters and their approximate locations
  - Provides single p-value to test null hypothesis of no clusters

Kulldorff et al. (1997)

Cluster Analysis: 2005 - 2007



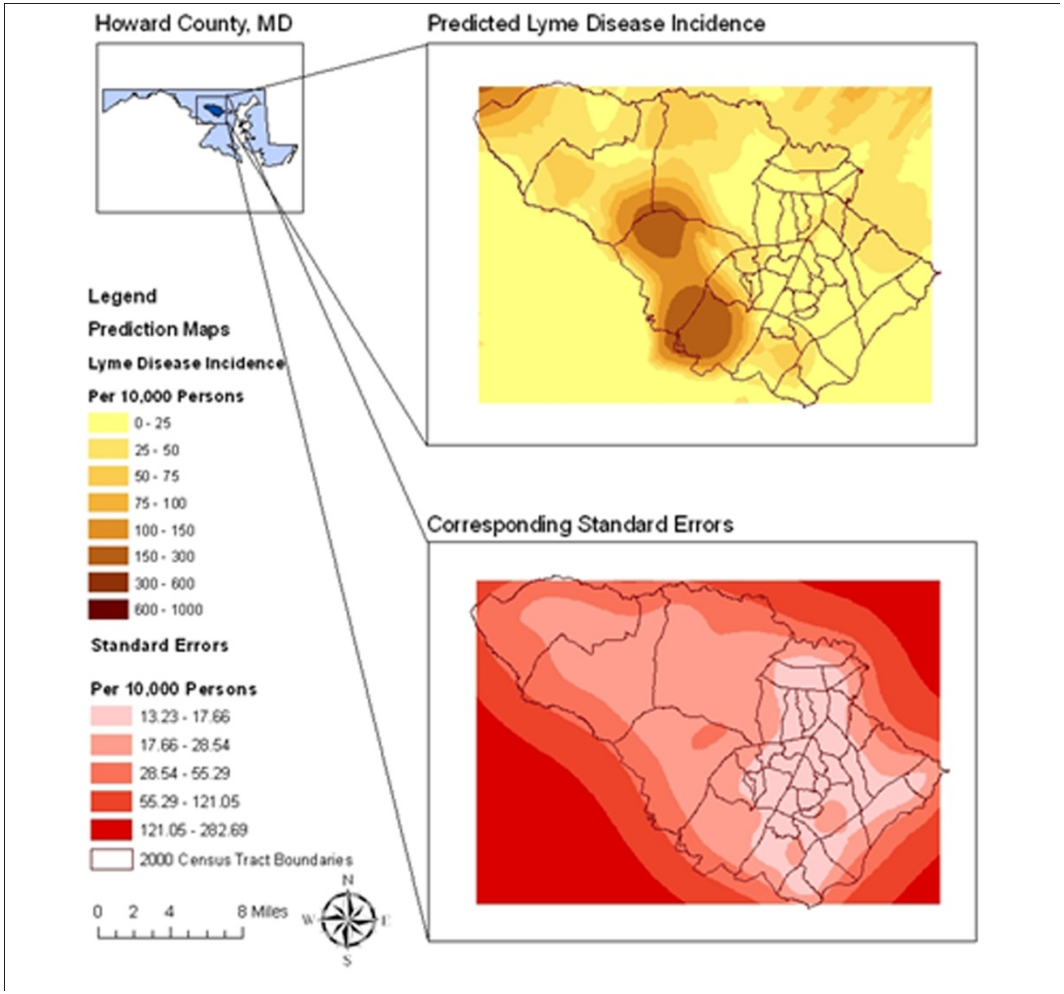
Doll (2008)

Analysis: Assessing Risk

- Relative Risk
  - Number of cases observed divided by expected number of cases for a given area
- Choropleth map to show changes in relative risk across Howard County
- Differs from 2007 risk analysis
  - 2007 used ordinary kriging to approximate risk
  - Relative risk method expected to produce similar risk maps

Dr. Frank Curriero, personal communication, May 6, 2010

Risk Assessment: 2005 - 2007



Doll (2008)

Utilizing the Maps

- Result: Multiple maps to help characterize geographic distribution of Lyme disease in Howard County
- Guide governmental agencies in Lyme prevention activities
  - Education campaigns
  - Pesticide application
  - Environment modification

Geographic Information Systems (GIS) in Public Health

- Computer-based procedures that allow users to input, manipulate, analyze, and output data to investigate spatial patterns and trends
  - Output often in map format
- Spatial component of infectious disease transmission
  - Tick vector distribution for Lyme disease
  - Place of residence as approximation for place of exposure

Glass et al. (1995)

Geographic Information Systems (GIS) in Public Health

- To identify potential risk factors for disease
  - Overlay maps of disease risk with maps of environment to visualize correlations
  - Potential environmental covariates for Lyme disease study:
    - Proximity to forest
    - Soil type
    - Urbanicity
    - Landuse

Glass et al. (1995)

Acknowledgements

- Howard County Health Department
  - *Elizabeth Bohle and Andrea Raid*
- Johns Hopkins Bloomberg School of Public Health
  - *Dr. Greg Glass and Dr. Frank Curriero*
- PHASE Directors and Staff
  - *Dr. Frangiscos Sifakis, Dipti Shah, James Kucik, and Beth Resnick*

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