Prioritizing Cooling Tower Testing Using Routes Walked by Legionellosis Patients

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Controlling Legionellosis across NYC

Challenge: environmental source of infection unknown

- home address of patients reported
- destinations or walking routes not reported

Potential solution: Disease Detectives & GIS

- disease surveillance captures destination of patients
- Network Analyst can estimate walking routes
Symptoms & Bacterial Microbe

Legionnaires’ Disease: pneumonia
Symptoms: incubation up to ~2 weeks
• cough
• fever
• chest pain

*Legionella pneumophila*
• transmission: aerosolized
• >16 serogroups
Clinical & Environmental Testing

• culture: gold standard
  – identifies range of serogroups
  – resource intensive

• urine antigen
  – highly specific for *L. pneumophila* serogroup 1
Potential Sources of Infection

indoor water features
• hot tubs
• hot water tanks

outdoor water features
• decorative fountains
• cooling tower
Potential Sources of Infection

cooling tower
Cooling Towers
Often Implicated in Outbreaks

• aerosolizes bacteria
• contaminated mist can drift very far
• effective treatment:
  – biocide
  – filtration systems
Legionellosis, New York City
May 2015 Rates per 100,000

- 9
- 2 - 3
- 1
- 0

Neighborhood in Queens County
Legionella Outbreak, Queens County New York City—May 2015

15 patients identified with:

• automated analyses
  — detects multiple cases residing within a building
  — cluster detection algorithm (SaTScan)

• supplemental questionnaire
  — places visited 2 weeks prior to feeling sick
Finding the Source of Infection
Queens County—May 2015

disease detectives discovered...

• median age: 67 years
• 4 of 15 patients visited same commercial building
• 3 of 15 patients lived in same building complex
• 12 cooling towers in the area
Environmental sampling is resource intensive. How can we prioritize sampling?
Prioritizing Cooling Tower Testing

• calculating routes between patient homes and destinations
  – Network Analyst extension

• high density routes could be prioritized
  – Line Density tool
    (Spatial Analyst extension)
Network Analyst & Line Density

Prioritizing Cooling Tower Testing

• Network Analyst
  —calculates shortest routes along line data layer e.g., streams, roads
  —able to respect directionality and set weights e.g., barrier, preferred route

• Line Density
Network Analyst in Previous Studies

• Google Scholar query: “network analyst health”
• briefly reviewed first 20 abstracts
  5: estimate access to fresh produce (pertaining to obesity)
  2: estimate access to health care
  0: for infectious/communicable diseases
Network Analyst Limitations

- we did not collect data regarding the timing of travels...

Assumptions

- patients travelled along one line between their home and destination
- only 1 destination visited per trip
Patients Linked to Outbreak
Residences and Destinations
Legionellosis Outbreak—May 2015
Queens County, New York City

- Patient Residence
- Patient Destination
- Cooling Tower
Patients Linked to Outbreak
Residences and Destinations
Legionellosis Outbreak–May 2015
Queens County, New York City

- Patient Residence
- Patient Destination
- Cooling Tower
Walking Routes of Patients
Calculated with Network Analyst
Legionellosis Outbreak–May 2015
Queens County, New York City

- Patient Residence
- Patient Destination
- Cooling Tower
- Potential Walking Routes
Short-Term Public Health Action

both positive cooling towers disinfected

1. apartment complex installed copper-silver disinfection system on cooling tower
2. commercial building owners working closely with the NYC Department of Health and Mental Hygiene to develop a sanitation plan
Long-Term Public Health Action

• at the time of this outbreak NYC didn’t have a cooling tower registry
• August 18\textsuperscript{TH} 2015: legislation passed to regulate registration, testing, and inspection of cooling towers in NYC
• now better able to assess clustering of disease around foci of cooling towers
Applications for Public Health

• diseases with an environmental source of infection
  
  e.g., bioterrorism events
thank you for listening
questions?

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