Spatial Analysis of PMP Data: Applications and an Example

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May 11, 2010
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Applications of spatial analysis

- Identify geographic patterns of prescriptions for individual drugs or drug categories
  - Rates of over-/under-prescribing relative to standard clinical practice
  - Prescription patterns suggestive of diversion or abuse
  - Geographic clustering of patterns or rates
  - Geographic ‘isolates’ – areas of high or low rates surrounded by the opposite
Rates per 100,000, by Town

Rates per 100,000 population (quintiles)

- 0
- 0.01 - 18.01
- 18.02 - 41.63
- 41.64 - 62.73
- 62.74 - 225.51
Applications of spatial analysis

- Identify geographic patterns of prescriptions for individual drugs or drug categories
  - Each of these applications has substantive interest for public health and regulatory/law enforcement agencies
    - Targeted prescriber education
    - Contextual factors associated with doctor shopping
    - Targeting of clusters
    - Positive or negative factors contributing to an isolate
Applications of spatial analysis

- Dynamic geographic patterns
  - Spatial diffusion – how does behavior such as doctor shopping associated with a new drug spread?
  - Prediction of (changes in) outcomes of interest (e.g., deaths, hospitalizations, ER visits associated with prescription drug abuse)
    - Longitudinal models
    - Need to control for spatial association
An example from Massachusetts

• Are prescribing rates different in heavily minority communities (i.e., is there evidence of racial/ethnic disparities)?
• Do patterns suggestive of diversion and abuse (doctor shopping) predict rates of health outcomes such as fatal and non-fatal opioid overdoses?
2005 Schedule II Prescriptions per Prescriber by Zip Code
2005 Schedule II Prescriptions Associated with Questionable Activity 
(Rate per 100,000 Prescriptions) 
per Prescriber by Zip Code

Questionable activity rate quintiles:
- 0
- 0 - 3.62
- 3.62 - 5.39
- 5.39 - 7.96
- 7.96 - 47.75
Analyses of Schedule II Prescription and Questionable Activity Rates

• We asked: Are the rates of Schedule II prescriptions and questionable activity associated with socio-demographic measures that characterize Zip Code areas? (For example, rates of opioid-related hospitalization and death are associated with population density, poverty, and ethnic diversity)

• Approach: Spatial regression analyses exploring associations with Census-based measures and measures created for other geographic analyses
Summary of Findings

• Prescription rates tend to be associated with rates of adjacent Zip Codes, with stable populations, and with a range of nonprofit organization sizes, which is thought to reflect community infrastructure.

• In addition, prescription rates per pharmacy are associated with more densely populated areas, while rates per prescriber are associated with areas with a higher concentration of people 65 and over.

• In contrast, questionable activity rates are found not to be associated with rates of adjacent Zip Codes.

• Questionable activity rates are associated with a lower poverty rate and a higher concentration of people 65 and over.

• In addition, questionable activity rates per pharmacy are associated with stable populations, more densely populated areas, and with a range of nonprofit organizations.
Summary Continued

• Higher rates of questionable Schedule II prescription activity, then, appear to be associated with relatively more affluent, yet densely populated, areas, with a relatively developed community infrastructure and with a higher concentration of older adults.

• This finding contrasts with other types of drug-related problems, such as rates of hospitalizations and deaths associated with alcohol and other drug use. High rates of these problems are associated with poorer, densely populated, ethnically diverse areas with a more limited range of nonprofit organizations reflecting a less developed community infrastructure.

• These findings need to be interpreted with caution because of the limitations inherent in the current Prescription Monitoring Program data, including a lack of individual identifying information.
(Rates per 100,000 Prescriptions) by Pharmacy Town

Questionable activity rates

- 0
- 1 - 1095
- 1096 - 1897
- 1898 - 2882
- 2883 - 14184
Analyses of Opioid Overdose Rates and Questionable Activity Rates

• We asked: Are rates of opioid overdose cases predicted by rates of questionable activity, controlling for socio-demographic factors and spatial association?
• Approach: Spatial regression analyses exploring associations with Census-based measures and measures created for other geographic analyses
Summary of Findings

• Rates of opioid overdose cases, by questionable activity pharmacy town, were associated with:
  • Population density ($p < .001$)
  • Poverty rate ($p < .001$)
  • Questionable activity rate ($p < .01$)
  • Rate of opioid overdose cases of adjacent towns ($p < .001$)

• No association with questionable activity rate when aggregated by prescriber town
A Final Observation

- Rates of opioid overdose cases, at the town and Zip Code levels, are associated with high poverty rates.
- Yet rates of questionable activity are associated with low poverty rates.
- Association between the two may help localize Schedule II prescription drug abuse and diversion vs. abuse of street heroin and other street drugs.