The Utilization of Administrative Surveillance Data to Assess Herd Immunity Against Influenza

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Background

- Common strategy to control influenza in seniors is to vaccinate vulnerable elderly
  - Vaccine efficacy is 12-68% in seniors[1-4] and 65-93% in children.[5-7]
  - Inconsistent morbidity and mortality benefit from vaccinating seniors[8]
- *Potential for a link between children and the elderly?*
  - Children as main spreaders of disease in households[9-11]
  - Vaccinating children may reduce pneumonia and influenza (**P&I**) in seniors through herd immunity.[12]

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Research Question

Does vaccination of children against influenza reduce P&I burden in seniors through herd immunity?

- If so, are those associations dependent upon income and rurality?

Exposure Data

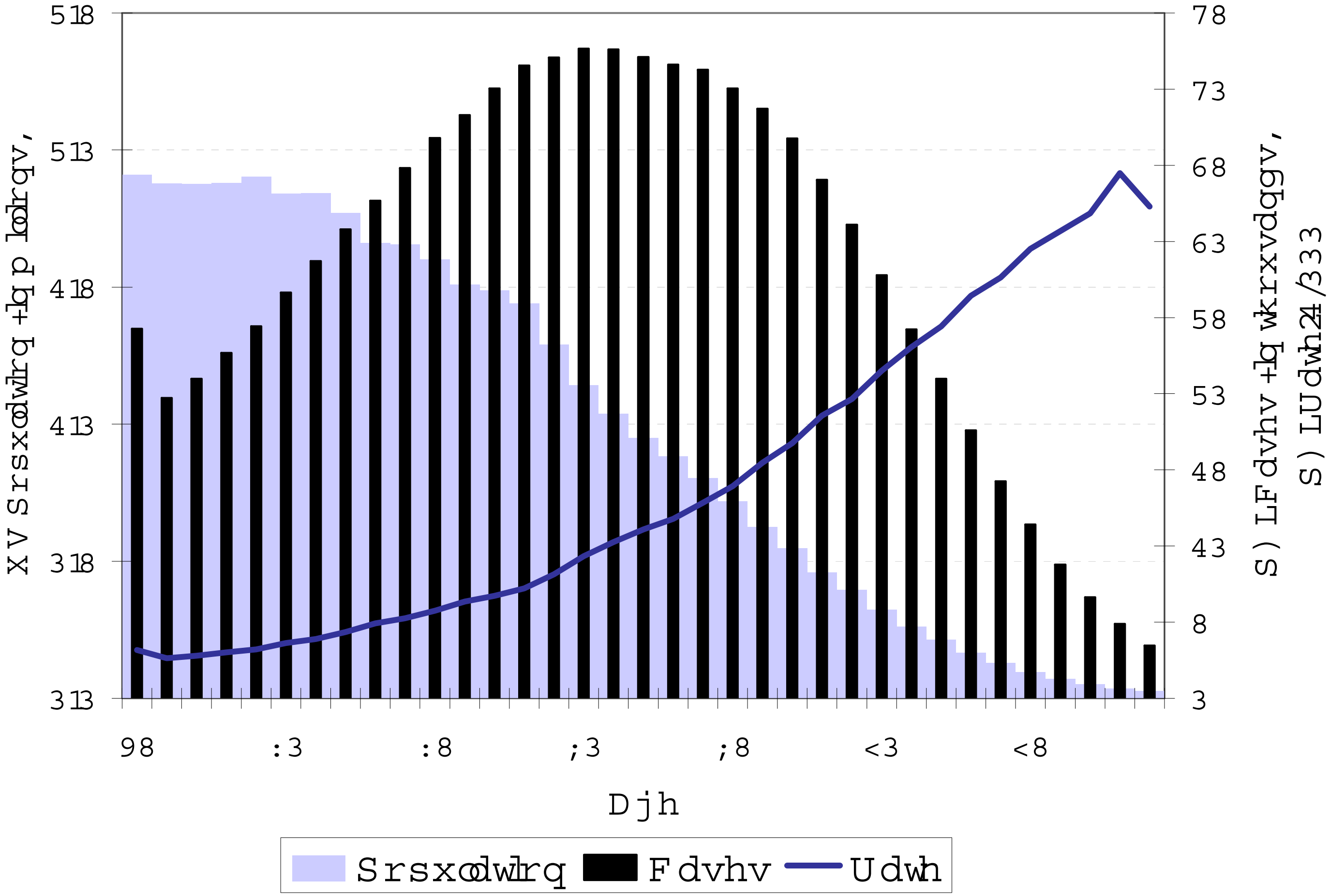
- Derived from two surveillance system surveys
  - Behavioral Risk Factor Surveillance System
    - Vaccination (flu and pneumonia) coverage in 65+
  - National Immunization Survey (NIH)
    - Influenza vaccination coverage in children

Outcome Data

Data source: Centers for Medicare and Medicaid Services hospitalization (MedPar)

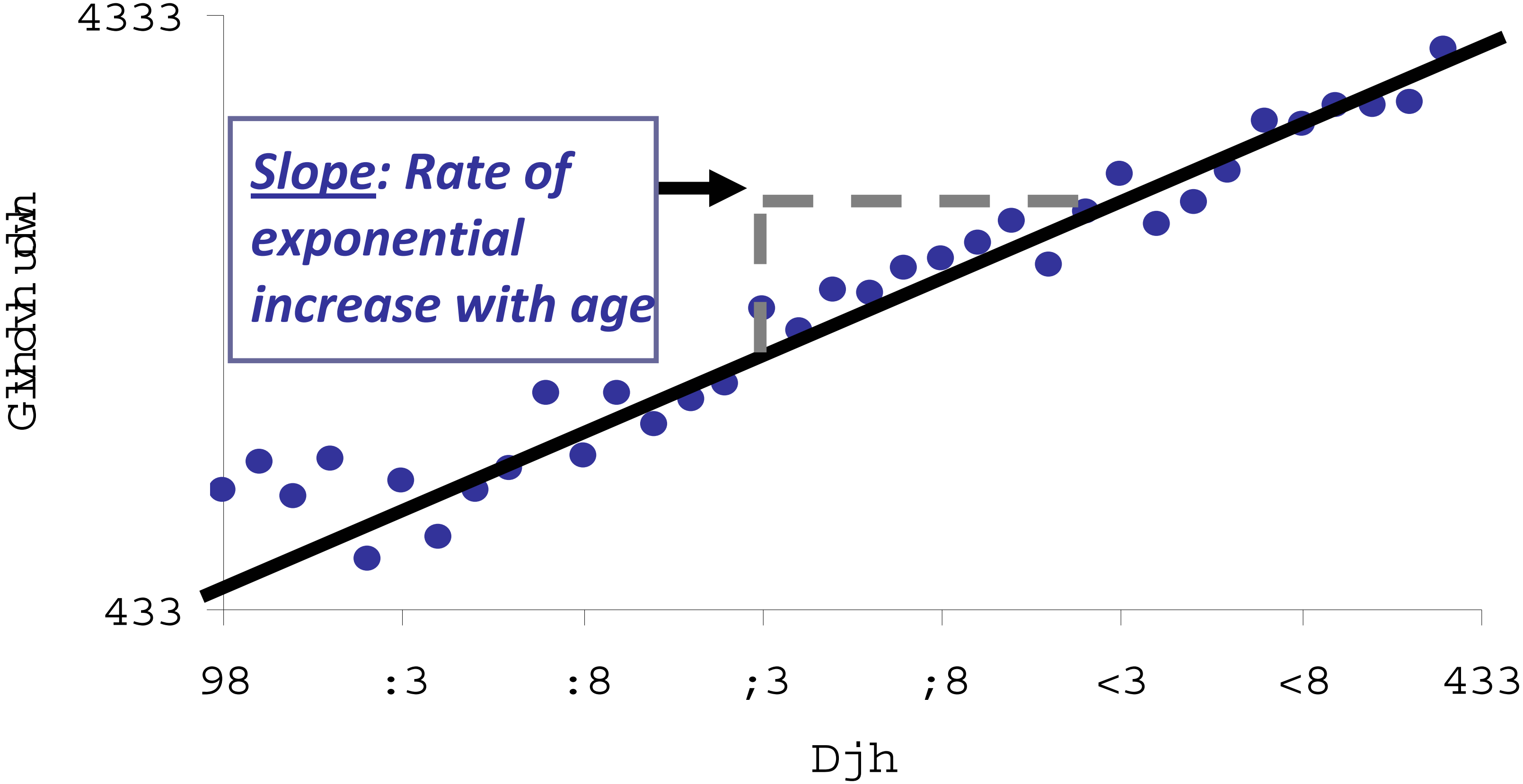
- Age-adjusted P&I rates in 65+
- Age-specific P&I rates (65-74, 75-84, 85+)
- Age acceleration of P&I rates in 65+

Outcome: Age Distribution



Outcome: Age Acceleration

Uses slope (β_1) and intercept (β_0) parameters from SLR model[13,14]



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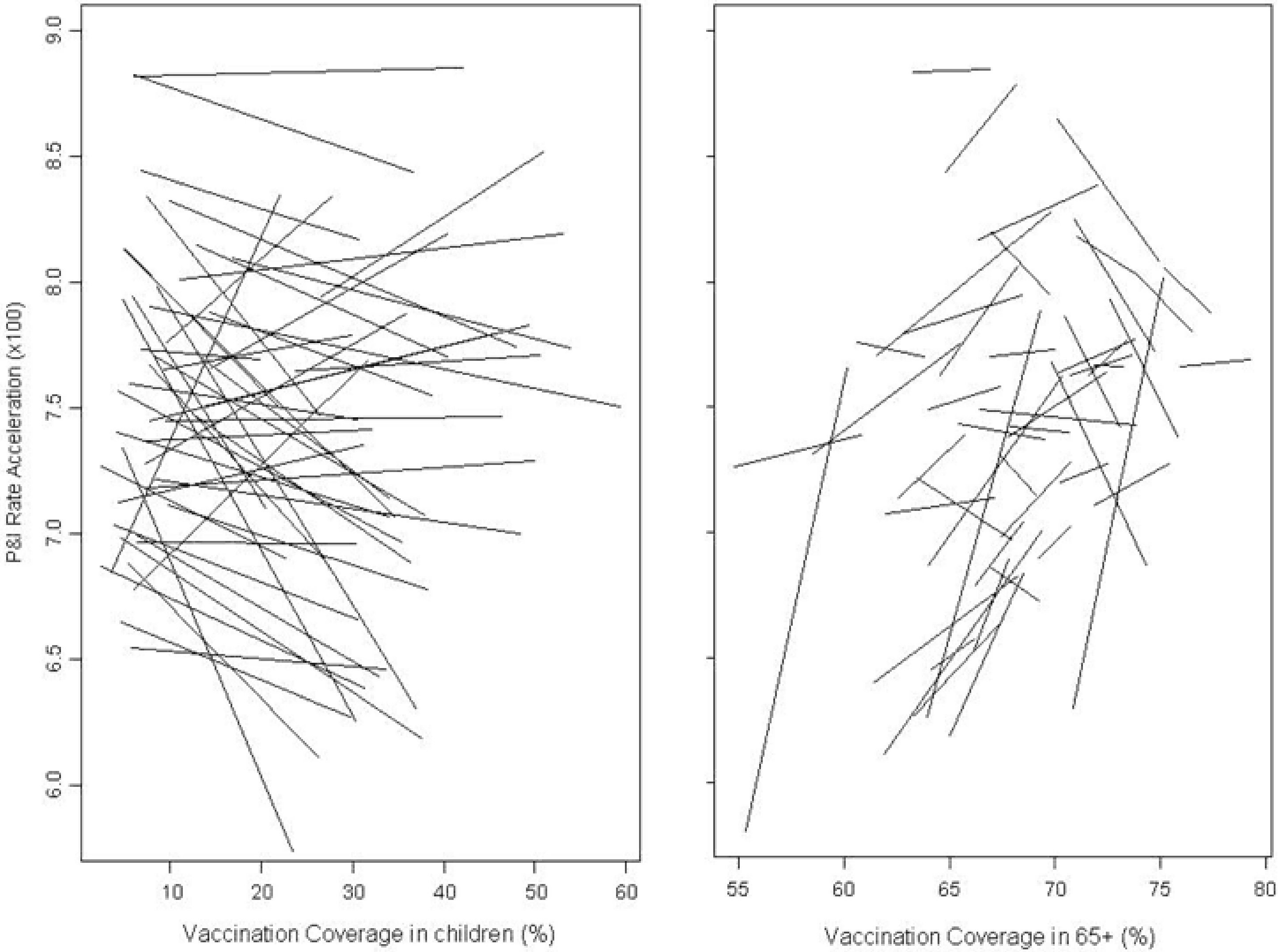
Methods: Statistical Analysis

- Unit of analysis is state
- Single-year (July-June) models
- Single-state models
- Two types of longitudinal models
  - Marginal models (GEE)
  - Mixed effects with random intercept
  - Both had AR1 covariance structure
- SAS 9.1 used for all analyses
- S-Plus used to make graphs

Results: Vaccination and P&I



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Results: Mixed & Marginal Models

Parameter estimates (with standard errors) representing the effects of vaccination coverage on age acceleration coefficient

	Influenza vaccine coverage in:	Marginal Models *Unadjusted*	Marginal Models *Adjusted†*	Mixed Effects Models *Unadjusted*	Mixed Effects Models *Adjusted†*
Influenza					
Model 1	*Older adults*	0.039 (0.032)	0.024 (0.041)	0.057 (0.028)*	0.044 (0.032)
Model 2	*Children*	-0.002 (0.006)	-0.005 (0.006)	-0.006 (0.006)	-0.007 (0.006)
Model 3	*Older adults*	0.004 (0.032)	0.023 (0.041)	0.053 (0.030)	0.035 (0.034)
	Children	-0.001 (0.006)	-0.005 (0.006)	-0.003 (0.007)	-0.005 (0.007)
Pneumonia and Influenza					
Model 1	*Older adults*	0.025 (0.012)*	0.019 (0.013)	0.024 (0.012)*	0.017 (0.013)
Model 2	*Children*	-0.005 (0.003)	-0.006 (0.003)*	-0.005 (0.003)	-0.006 (0.003)*
Model 3	*Older adults*	0.020 (0.012)	0.010 (0.014)	0.019 (0.012)	0.008 (0.013)
	Children	-0.004 (0.003)	-0.006 (0.003)*	-0.004 (0.003)	-0.006 (0.003)*

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Results: Effect Modification

Parameter estimates (with standard errors) representing the effects of vaccination coverage on age acceleration coefficient in P&I

		Model 1	Model 2	Model 3	
Vaccination coverage:		In seniors	In children	In seniors	In children
	Overall	0.017 (0.013)	-0.006 (0.003)*	0.008 (0.013)	-0.006 (0.003)*
Income	*Low*	0.031 (0.024)	-0.014 (0.005)**	0.017 (0.024)	-0.013 (0.005)*
	Medium	0.008 (0.020)	-0.003 (0.004)	0.002 (0.022)	-0.003 (0.004)
	High	0.029 (0.024)	-0.006 (0.004)	0.013 (0.027)	-0.005 (0.004)
Urbanicity	*Low*	0.037 (0.025)	-0.012 (0.006)*	0.038 (0.024)	-0.012 (0.006)*
	Medium	0.018 (0.019)	-0.007 (0.004)	0.000 (0.022)	-0.007 (0.004)
	High	-0.025 (0.020)	-0.005 (0.003)	-0.042 (0.022)	-0.006 (0.004)

* $p < 0.05$

** $p < 0.01$

Note: Mixed effects modeling was used with random intercept for state; outcome variable is age-acceleration coefficient for pneumonia and influenza rates, and adjusted for log of population density, income, and percent of institutionalized population age 65+

Summary of Findings

- **Vaccination coverage and P&I in seniors**
  - Weak to moderate, but consistent negative associations for vaccination coverage in children
    - Strongest in low income and rural states
  - Little to no associations for vaccination coverage in seniors
    - Significantly positive associations for combined pneumonia and influenza
  - Potential use of Medicare data to assess herd immunity in seniors

Policy and Research Implications

- Potential to reduce P&I in seniors by:
  - Vaccinating children against influenza
  - Targeting especially vulnerable populations of seniors based on socioeconomics and demographics
- More detailed research is needed
    - Improved data quality
      - A detailed surveillance system for vaccination coverage on multiple geographic levels (e.g. county)
    - Social network analyses for validation
    - Matching vaccine strain to prevailing influenza strains
- Timeliness
  - H1N1 and seasonal flu vaccine supply limited

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Data Source

- Centers for Medicare and Medicaid Services (CMS)

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For Additional Information…

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Thank you!