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Glen P. Mays
University of Kentucky, glen.mays@uky.edu

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Estimating Medical Cost Offsets Attributable to Public Health Spending

Glen Mays, PhD, MPH
University of Kentucky

glen.mays@uky.edu

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Preventable mortality in the U.S.

Preventable Deaths per 100,000 population

Source: Commonwealth Fund 2008

Countries’ age-standardized death rates before age 75; including ischemic heart disease, diabetes, stroke, and bacterial infections. See report Appendix B for list of all conditions considered amenable to health care in the analysis.
Geographic variation in preventable mortality

Source: Commonwealth Fund 2008
Preventable disease burden and national health spending

>75% of national health spending is attributable to chronic diseases that are largely preventable
  – 80% of cardiovascular disease
  – 80% of diabetes
  – 60% of lung diseases
  – 40% of cancers
  (not counting injuries, vaccine-preventable diseases)

<3% of national health spending is allocated to public health and prevention

CDC 2011
Public health activities

Organized programs, policies, and laws to prevent disease and injury and promote health on a population-wide basis

- Epidemiologic surveillance & investigation
- Community health assessment & planning
- Communicable disease control
- Chronic disease prevention
- Health education
- Environmental health monitoring and assessment
- Enforcement of health laws and regulations
- Inspection and licensing
- Inform, advise, and assist school-based, worksite-based, and community-based health programming

...and legacy of assuring access to medical care
Public health’s share of national health spending

USDHHS National Health Expenditure Accounts

% of total health spending
Factors driving growth in medical spending

Health spending growth rate 1996-2006

Growth rate due to cost per case

Growth rate due to prevalence

Roehrig et al. Health Affairs 2011
$15 billion in new federal public health spending over 10 years (cut by $5B last week)

Public Health and Prevention Trust Fund

Incentives for hospitals, health insurers to invest in public health and prevention
Some research questions of interest…

- How does *public health* spending vary across communities and change over time?
- What are the health effects attributable to changes in public health spending?
- What are the medical cost effects attributable to changes in public health spending?
The problem with public health spending

- Federal & state funding sources often targeted to communities based in part on disease burden, risk, need

- Local funding sources often dependent on local economic conditions that may also influence health

- Public health spending may be correlated with other resources that influence health

Sources of Local Public Health Agency Revenue, 2005

- Medicaid 9%
- Medicare 2%
- Medicaid 9%
- Federal direct 7%
- Federal pass-thru 13%
- Other 12%
- State direct 23%
- Local 28%

NACCHO 2005
Example: cross-sectional association between PH spending and mortality

- Public health spending/capita
- Heart disease mortality

Quintile of public health spending/capita

Deaths per 100,000

Quintile 1  Quintile 2  Quintile 3  Quintile 4  Quintile 5
Example: cross-sectional association between PH spending and Medical spending

Quintile 1
Quintile 2
Quintile 3
Quintile 4
Quintile 5

Public health spending/capita

Medicare spending per recipient

Quintiles of public health spending/capita

Mays et al. 2009
Analyzing spending effects

**Approaches**

1. Cross-sectional regression: control for **observable** confounders
2. Fixed effects: also control for **time-invariant, unmeasured** differences between communities
3. IV: use exogenous sources of variation in spending
4. Discriminate between causes of death amenable vs. non-amendable to PH intervention
Data used in empirical work


- Residual state and federal spending estimates from US Census of Governments and Consolidated Federal Funding Report

- Community characteristics obtained from Census and Area Resource File (ARF)

- Community mortality data obtained from CDC’s Compressed Mortality File

- **HSA-level** medical care spending data from CMS and Dartmouth Atlas (Medicare claims data)
Analytical approach

- Dependent variables
  - Age-adjusted mortality rates, conditions sensitive to public health interventions
  - Medical care spending per recipient (Medicare as proxy)

- Independent variables of interest
  - Local PH spending per capita, all sources
  - Residual state spending per capita (funds not passed thru to local agencies)
  - Residual federal spending per capita

- Analytic strategy for panel data: 1993-2008
  - Fixed effects estimation
  - Random effects with instrumental variables (IV)
Analytical approach: IV estimation

- Identify exogenous sources of variation in spending that are unrelated to outcomes
  - Governance structures: local boards of health
  - Decision-making authority: agency, board, local, state

- Controls for unmeasured factors that jointly influence spending and outcomes
Analytical approach

- Semi-logarithmic multivariate regression models used to test associations between spending, service delivery, and outcomes while controlling for other factors

$$\ln(\text{PH}$_{ijt}$) = \beta\text{Agency}$_{ijt}$ + \delta\text{Community}$_{ijt}$ + \lambda\text{State}$_{jt}$ + \mu_j + \phi_t + \epsilon_{ijt}$$

$$\ln(\text{Mortality}$_{ijt}$) = \alpha\ln(\text{PH}$_{ijt}$) + \beta\text{Agency}$_{ijt}$ + \delta\text{Community}$_{ijt}$ + \lambda\text{State}$_{jt}$ + \mu_j + \phi_t + \epsilon_{ijt}$$

$$\ln(\text{Medical}$_{ijt}$) = \alpha\ln(\text{PH}$_{ijt}$) + \beta\text{Agency}$_{ijt}$ + \delta\text{Community}$_{ijt}$ + \lambda\text{State}$_{jt}$ + \mu_j + \phi_t + \epsilon_{ijt}$$

Sensitivity analyses using 1, 3, and 5 year lag structures
Other Variables Used in the Models

- **Agency characteristics**: type of government jurisdiction, scope of services offered, *local governance and decision-making structures*

- **Community characteristics**: population size, rural-urban, poverty, income per capita, education attainment, unemployment, age distributions, physicians per capita, CHC funding per low income, health insurance coverage, local health care wage index

- **State characteristics**: Private insurance coverage, Medicaid coverage, state fixed effects
Variation in Local Public Health Spending

Gini = 0.485
Changes in Local Public Health Spending 1993-2008

- 62% growth
- 38% decline
## Determinants of Local Public Health Spending Levels: IVs

<table>
<thead>
<tr>
<th>Governance/Decision Authority</th>
<th>Coefficient</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governed by local board of health</td>
<td>0.131**</td>
<td>(0.061, 0.201)</td>
</tr>
<tr>
<td>State hires local PH agency head†</td>
<td>-0.151*</td>
<td>(-0.318, 0.018)</td>
</tr>
<tr>
<td>Local govt approves local PH budget†</td>
<td>-0.388***</td>
<td>(-0.576, -0.200)</td>
</tr>
<tr>
<td>State approves local PH budget†</td>
<td>-0.308**</td>
<td>(-0.162, -0.454)</td>
</tr>
<tr>
<td>Local govt sets local PH fees</td>
<td>0.217**</td>
<td>(0.101, 0.334)</td>
</tr>
<tr>
<td>Local govt imposes local PH taxes</td>
<td>0.190**</td>
<td>(0.044, 0.337)</td>
</tr>
<tr>
<td>Local board can request local PH levy</td>
<td>0.120**</td>
<td>(0.246, 0.007)</td>
</tr>
</tbody>
</table>

Elasticity

\[ F = 13.4 \quad p < 0.001 \]

Log regression estimates controlling for community-level and state-level characteristics.  
* \( p < 0.10 \)  
** \( p < 0.05 \)  
*** \( p < 0.01 \)

† As compared to the local board of health having the authority.
## Multivariate estimates of public health spending effects on mortality 1993-2008

### Cross-sectional model

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Elasticity</th>
<th>St. Err.</th>
<th>Elasticity</th>
<th>St. Err.</th>
<th>Elasticity</th>
<th>St. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant mortality</td>
<td>0.0516</td>
<td>0.0181 **</td>
<td>0.0234</td>
<td>0.0192</td>
<td>-0.1437</td>
<td>0.0589 ***</td>
</tr>
<tr>
<td>Heart disease</td>
<td>-0.0003</td>
<td>0.0051</td>
<td>-0.0103</td>
<td>0.0040 **</td>
<td>-0.1881</td>
<td>0.0292 **</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.0323</td>
<td>0.0187</td>
<td>-0.0487</td>
<td>0.0174 ***</td>
<td>-0.3015</td>
<td>0.0633 **</td>
</tr>
<tr>
<td>Cancer</td>
<td>0.0048</td>
<td>0.0029 *</td>
<td>-0.0075</td>
<td>0.0240</td>
<td>-0.0532</td>
<td>0.0166 **</td>
</tr>
<tr>
<td>Influenza</td>
<td>-0.0400</td>
<td>0.0200 **</td>
<td>-0.0275</td>
<td>0.0107 **</td>
<td>-0.4320</td>
<td>0.0624 **</td>
</tr>
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</table>

### Fixed-effects model

<table>
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### IV model

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log regression estimates controlling for community-level and state-level characteristics

*p<0.10  **p<0.05  ***p<0.01
## Effects of public health spending on medical care spending 1993-2008

Change in Medical Care Spending Per Capita Attributable to 1% Increase in Public Health Spending Per Capita

<table>
<thead>
<tr>
<th>Model</th>
<th>Elasticity</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed effects</td>
<td>-0.010</td>
<td>0.002</td>
</tr>
<tr>
<td>Instrumental variables</td>
<td>-0.088</td>
<td>0.013</td>
</tr>
</tbody>
</table>

log regression estimates controlling for community-level and state-level characteristics

*p<0.10  **p<0.05  ***p<0.01
Projected effects of ACA public health spending

- 10% increase in public health spending in average community:

  - Public health cost: $594,291
  - Medical cost offset: -$515,114 (Medicare only)
  - Deaths averted: 14.8
  - LY gained: 148
  - Net cost/LY: $534
Conclusions

- Local public health spending varies widely across communities
- Communities with higher spending experience lower mortality from leading preventable causes of death
- Growth in local public health spending appears to offset growth in medical care spending
Implications for Policy and Practice

- Mortality reductions achievable through increases in public health spending may equal or exceed the reductions produced by similar expansions in local medical care resources.
- Increased federal investments may help to reduce geographic disparities in population health and bend the medical cost curve.
- Gains from federal investments may be offset by reductions in state and local spending.
Limitations and next steps

- Aggregate spending measures
  - Average effects
  - Role of allocation decisions?

- Mortality – distal measures with long incubation periods

- Medical care spending relies on Medicare as a proxy measure (20% of total medical $)

- Ongoing exploration of lag structures