Income, Life Expectancy & the Strength of Public Health Activities in American Communities

Glen P. Mays, University of Kentucky

Available at: https://works.bepress.com/glen_mays/314/
Income, Life Expectancy & the Strength of Public Health Activities in American Communities

Glen Mays, PhD, MPH
University of Kentucky

glen.mays@uky.edu
systemsforaction.org
Losing ground in population health

U.S. LIFE EXPECTANCY FALLS

<table>
<thead>
<tr>
<th></th>
<th>Both sexes</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>78.8</td>
<td>76.3</td>
<td>81.2</td>
</tr>
<tr>
<td>2014</td>
<td>78.9</td>
<td>76.5</td>
<td>81.3</td>
</tr>
</tbody>
</table>

SOURCE CDC
Jim Sergent, USA TODAY

Published December 8, 2016
Income, geography and population health

Chetty et al. JAMA 2016
The U.S. public health sector

- Federation of 3000 local agencies, 50 states + federal agencies
- Broad scope of activity
- Decentralized authority
- Highly variable capacity

Community health assessment
Health surveillance
Epidemiologic investigation
Environmental health monitoring
Community health planning & priority-setting
Health regulation enforcement
Public education & risk communication
Policy development & assessment
Emergency preparedness & response
Implementation of prevention programs
Consultation for school & worksite health
Direct clinical service delivery

Percent of communities

Expenditures per capita

Gini = 0.485
Challenge: overcoming collective action problems in public health

- Incentive compatibility → public goods
- Concentrated costs & diffuse benefits
- Time lags: costs vs. improvements
- Uncertainties about what works
- Asymmetry in information
- Difficulties measuring progress
- Weak and variable institutions & infrastructure
- Imbalance: resources vs. needs
- Stability & sustainability of funding

Ostrom E. 1994
Widely recommended activities to support multi-sector initiatives in population health

Engage stakeholders

Assess needs & risks

Prioritize & recommend actions

Develop plans & policies

Mobilize multi-sector implementation

Monitor, evaluate, feed back

Foundational Capabilities

Prior work: health affects attributable to delivery systems supporting strong health activities

Impact of Comprehensive System Capital on Mortality, 1998-2014

Fixed-effects instrumental variables estimates controlling for racial composition, unemployment, health insurance coverage, educational attainment, age composition, and state and year fixed effects.  N=1019 community-years

Mays GP et al. Health Affairs 2016
Questions of interest

- How strong are the delivery systems that support public health activities?
- How do these delivery systems change over time? Recession | Recovery | ACA implementation
- How do these delivery systems relate to income disparities in population health?
A useful lens for studying multi-sector work

National Longitudinal Survey of Public Health Systems

- Cohort of 360 communities with at least 100,000 residents
- Local public health officials report:
  - **Scope**: availability of 20 recommended population health activities
  - **Network**: organizations contributing to each activity
  - **Centrality of effort**: contributed by governmental public health agency
  - **Quality**: perceived effectiveness of each activity

** Expanded sample of 500 communities<100,000 added in 2014 wave
Chetty’s data: life expectancy by income

- **Income data**: federal tax records for every filer for every year 1999-2014 (pre-tax household earnings): 1.4B person-years
- **Mortality data**: SSA death records: 6.8M deaths
- **Period life expectancy**: estimated conditional on income percentile at 40 years of age
- **Geography**: Life expectancy by income quartile estimated for counties (n>3000) and for commuting zones (n=741) by year
- **Time**: annual estimates for 2001-14
Other data linkages

- **Area Health Resource File**: health resources, demographics, socioeconomic status, insurance coverage
- **NACCHO Profile data**: public health agency institutional and financial characteristics
- **CMS Impact File & Cost Report**: hospital ownership, market share, uncompensated care
- **Dartmouth Atlas**: Area-level medical spending (Medicare)
- **CDC Compressed Mortality File**: Cause-specific death rates by county
Analytical approach: IV estimation

- Identify exogenous sources of variation in system strength 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 systems and outcomes
Analytical approach: IV estimation

- Panel regression estimation with fixed and random effects to account for repeated measures and clustering of public health jurisdictions within states.
- Two-stage IV model to estimate effect of system changes on life expectancy by income quartile (residual inclusion method).

\[
\text{Prob}(\text{System}_{ijt}=\text{Comprehensive}) = f(\text{Governance}, \text{Agency}, \text{Community})_{ijt} + \text{State}_j + \text{Year}_t
\]

\[
\mathbb{E}(\text{LE}_{ijt}) = f(\text{System+resid}, \text{Agency}, \text{Community})_{ijt} + \text{State}_j + \text{Year}_t + \epsilon_{ijt}
\]

All models control for type of jurisdiction, population size and density, metropolitan area designation, income per capita, unemployment, poverty rate, racial composition, age distribution, physician and hospital availability, insurance coverage, and state and year fixed effects. \textbf{N=1019 community-years}
Variation in implementing population health activities

National Longitudinal Survey of Public Health Systems 2014

Percent of U.S. communities

Percent of activities performed

Motivation  Approach  Results  Discussion
Implementation of population health activities, 1998-2014

<table>
<thead>
<tr>
<th>Activity</th>
<th>1998</th>
<th>2014</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conduct periodic assessment of community health status and needs</td>
<td>71.5%</td>
<td>87.1%</td>
<td>21.8%</td>
</tr>
<tr>
<td>2. Survey community for behavioral risk factors</td>
<td>45.8%</td>
<td>71.1%</td>
<td>55.2%</td>
</tr>
<tr>
<td>3. Investigate adverse health events, outbreaks and hazards</td>
<td>98.6%</td>
<td>100.0%</td>
<td>1.4%</td>
</tr>
<tr>
<td>4. Conduct laboratory testing to identify health hazards and risks</td>
<td>96.3%</td>
<td>96.1%</td>
<td>-0.2%</td>
</tr>
<tr>
<td>5. Analyze data on community health status and health determinants</td>
<td>61.3%</td>
<td>72.7%</td>
<td>18.6%</td>
</tr>
<tr>
<td>6. Analyze data on preventive services use</td>
<td>28.4%</td>
<td>39.0%</td>
<td>37.3%</td>
</tr>
<tr>
<td>7. Routinely provide community health information to elected officials</td>
<td>80.9%</td>
<td>84.0%</td>
<td>3.8%</td>
</tr>
<tr>
<td>8. Routinely provide community health information to the public</td>
<td>75.4%</td>
<td>82.3%</td>
<td>9.1%</td>
</tr>
<tr>
<td>9. Routinely provide community health information to the media</td>
<td>75.2%</td>
<td>89.0%</td>
<td>18.3%</td>
</tr>
<tr>
<td>10. Prioritize community health needs</td>
<td>66.1%</td>
<td>83.6%</td>
<td>26.5%</td>
</tr>
<tr>
<td>11. Engage community stakeholders in health improvement planning</td>
<td>41.5%</td>
<td>68.8%</td>
<td>65.7%</td>
</tr>
<tr>
<td>12. Develop a community-wide health improvement plan</td>
<td>81.9%</td>
<td>87.9%</td>
<td>7.3%</td>
</tr>
<tr>
<td>13. Identify and allocate resources based on community health plan</td>
<td>26.2%</td>
<td>41.9%</td>
<td>59.9%</td>
</tr>
<tr>
<td>14. Develop policies to address priorities in community health plan</td>
<td>48.6%</td>
<td>56.8%</td>
<td>16.9%</td>
</tr>
<tr>
<td>15. Maintain a communication network among health-related organizations</td>
<td>78.8%</td>
<td>85.3%</td>
<td>8.2%</td>
</tr>
<tr>
<td>16. Link people to needed health and social services</td>
<td>75.6%</td>
<td>50.0%</td>
<td>-33.8%</td>
</tr>
<tr>
<td>17. Implement legally mandated public health activities</td>
<td>91.4%</td>
<td>92.4%</td>
<td>1.1%</td>
</tr>
<tr>
<td>18. Evaluate health programs and services in the community</td>
<td>34.7%</td>
<td>37.9%</td>
<td>9.4%</td>
</tr>
<tr>
<td>19. Evaluate local public health agency capacity and performance</td>
<td>56.3%</td>
<td>56.1%</td>
<td>-0.3%</td>
</tr>
<tr>
<td>20. Monitor and improve implementation of health programs and policies</td>
<td>47.3%</td>
<td>46.4%</td>
<td>-1.9%</td>
</tr>
</tbody>
</table>

Mean performance of assessment activities (#1-6) | 67.0% | 77.7% | 15.9% |
Mean performance of policy and planning activities (#7-15) | 63.9% | 75.5% | 18.3% |
Mean performance of implementation and assurance activities (#16-20) | 61.1% | 56.6% | -7.3% |
Mean performance of all activities | 63.8% | 67.6% | 6.0% |
Mapping who contributes to population health

Node size = degree centrality
Line size = % activities jointly contributed (tie strength)

Composite measure of system strength

Comprehensive System Capital

Density of Contributing Organizations

Proportion of Activities Contributed

Mays GP et al. *Health Affairs* 2016
Variation and change in comprehensive system capital
## Predictors of Comprehensive System Capital

### First Stage Logit Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Marginal Effect</th>
<th>S.E.</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population size (10,000s)</td>
<td>0.033</td>
<td>0.009</td>
<td>***</td>
</tr>
<tr>
<td>Poverty rate (10%)</td>
<td>-0.033</td>
<td>0.016</td>
<td>**</td>
</tr>
<tr>
<td>Policy-making local BOH (0,1)</td>
<td>0.046</td>
<td>0.016</td>
<td>***</td>
</tr>
<tr>
<td>Centralized local health agency (0,1)</td>
<td>-0.087</td>
<td>0.036</td>
<td>**</td>
</tr>
<tr>
<td>Local control of health budget (0,1)</td>
<td>0.043</td>
<td>0.022</td>
<td>*</td>
</tr>
<tr>
<td>Local health tax/fee authority (0,1)</td>
<td>0.028</td>
<td>0.011</td>
<td>**</td>
</tr>
</tbody>
</table>

Models also control for racial composition, unemployment, health insurance coverage, educational attainment, age composition, and year fixed effects. N=1019 community-years
## Effects of Comprehensive System Capital on Life Expectancy by Income Quartile

### Second Stage Regression Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coeff.</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single-equation estimates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom income quartile</td>
<td>2.36</td>
<td>1.21</td>
</tr>
<tr>
<td>Top income quartile</td>
<td>-0.04</td>
<td>0.09</td>
</tr>
<tr>
<td>Difference</td>
<td>-2.21</td>
<td>1.09</td>
</tr>
<tr>
<td><strong>IV Estimates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom income quartile</td>
<td>4.11</td>
<td>1.86 **</td>
</tr>
<tr>
<td>Top income quartile</td>
<td>0.85</td>
<td>0.48</td>
</tr>
<tr>
<td>Difference</td>
<td>-3.02</td>
<td>1.44 **</td>
</tr>
</tbody>
</table>

Models also control for racial composition, unemployment, health insurance coverage, educational attainment, age composition, and year fixed effects.  N=1019 community-years
Conclusions and implications

- Large health gains in places with strong system capital
- Larger gains for low-income populations
- Comprehensive systems do more than just plan: prioritize, invest, evaluate, repeat (crowd-sourcing)
- Equity and opportunity: more than half of communities currently lack comprehensive system capital
- ACA incentives and resources may help:
  - Hospital community benefit
  - Value-based health care payments
  - Insurer and employer incentives
- Sustainability and resiliency are not automatic
Ongoing work

- Robustness to alternative specifications
- Lagged and cumulative effects
- Trajectories of system strength over time
- Proximal outcomes
- Value-added of specific combinations of activities and organizations
For More Information

Systems for Action
National Coordinating Center
Systems and Services Research to Build a Culture of Health

Supported by The Robert Wood Johnson Foundation

Glen P. Mays, Ph.D., M.P.H.
glen.mays@uky.edu
@GlenMays

Email: systemsforaction@uky.edu
Web: www.systemsforaction.org
     www.publichealthsystems.org
Archive: works.bepress.com/glen_mays
Blog: publichealtheconomics.org
References


