Income and Health Inequalities and their Relationship to Population Health Delivery Systems

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Losing ground in population health

1. Or latest year available.
Source: OECD Health Data 2010.
Losing ground in population health

Mortality rates, 45 to 54 age group, per 100,000 people

Mortality by cause for white non-Hispanics, 45 to 54 age group, per 100,000 people

Drugs/alcohol overdoses
Lung cancer
Suicides
Chronic liver diseases
Diabetes

Case A, Deaton A. Proceedings of the National Academy of Sciences 2015
Income disparities in population health

Chetty et al. JAMA 2016
How do we support effective population health improvement strategies?

- Designed to achieve large-scale health improvement: neighborhood, city/county, region

- Target fundamental and often multiple determinants of health

- Mobilize the collective actions of multiple stakeholders in government & private sector
  - Infrastructure
  - Information
  - Incentives

**Challenge:** overcoming collective action problems across systems & sectors

- 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

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Motivation  Approach  Results  Discussion
Catalytic functions to support multi-sector actions in health

Foundational Capabilities for Population Health

Engage stakeholders
Assess needs & risks
Prioritize & recommend actions
Develop plans & policies
Mobilize multi-sector implementation
Monitor, evaluate, feed back

Guided by Culture of Health Action Framework

Action Area 1
Making Health a Shared Value

Action Area 2
Fostering Cross-Sector Collaboration to Improve Well-Being

Action Area 3
Creating Healthier, More Equitable Communities

Action Area 4
Strengthening Integration of Health Services and Systems

Questions of interest

- How strong are the delivery systems that support foundational population 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
Mapping who contributes to population health

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

Mays GP et al. Understanding the organization of public health delivery systems: an empirical typology.
Classifying multi-sector delivery systems for population health 1998-2014

Motivation

Approach

Results

Discussion

Scope
High High High Mod Mod Low Low

Centrality
Mod Low High High Low High Low

Density
High High Mod Mod Mod Low Mod

Comprehensive
(High System Capital)

Conventional

Limited
Comprehensive Systems
One of RWJF’s Culture of Health National Metrics

- **Broad scope** of population health activities
- **Dense network** of multi-sector relationships
- **Central actors** to coordinate actions

**Access to public health**

Overall, 47.2 percent of the population is covered by a comprehensive public health system. Individuals are more likely to have access if they are non-White (51.5 percent vs. 45.5 percent White) or live in a metropolitan area (48.7 percent vs. 34.1 percent in nonmetropolitan areas).

47.2% of population served by a comprehensive public health system

Data linkages expand analytic possibilities

- **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
- **Equality of Opportunity Project (Chetty)**: local estimates of life expectancy by income
- **National Health Interview Survey**: individual-level health
- **HCUP**: area-level hospital and ED use, readmissions
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
Estimating how population health delivery systems relate to life expectancy by income

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

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

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

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. **N=1019 community-years**
## 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%     |
## Organizational contributions to population health activities, 1998-2014

<table>
<thead>
<tr>
<th>Type of Organization</th>
<th>1998</th>
<th>2014</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local public health agencies</td>
<td>60.7%</td>
<td>67.5%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Other local government agencies</td>
<td>31.8%</td>
<td>33.2%</td>
<td>4.4%</td>
</tr>
<tr>
<td>State public health agencies</td>
<td>46.0%</td>
<td>34.3%</td>
<td>-25.4%</td>
</tr>
<tr>
<td>Other state government agencies</td>
<td>17.2%</td>
<td>12.3%</td>
<td>-28.8%</td>
</tr>
<tr>
<td>Federal government agencies</td>
<td>7.0%</td>
<td>7.2%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Hospitals</td>
<td>37.3%</td>
<td>46.6%</td>
<td>24.7%</td>
</tr>
<tr>
<td>Physician practices</td>
<td>20.2%</td>
<td>18.0%</td>
<td>-10.6%</td>
</tr>
<tr>
<td>Community health centers</td>
<td>12.4%</td>
<td>29.0%</td>
<td>134.6%</td>
</tr>
<tr>
<td>Health insurers</td>
<td>8.6%</td>
<td>10.6%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Employers/businesses</td>
<td>16.9%</td>
<td>15.3%</td>
<td>-9.6%</td>
</tr>
<tr>
<td>Schools</td>
<td>30.7%</td>
<td>25.2%</td>
<td>-17.9%</td>
</tr>
<tr>
<td>Universities/colleges</td>
<td>15.6%</td>
<td>22.6%</td>
<td>44.7%</td>
</tr>
<tr>
<td>Faith-based organizations</td>
<td>19.2%</td>
<td>17.5%</td>
<td>-9.1%</td>
</tr>
<tr>
<td>Other nonprofit organizations</td>
<td>31.9%</td>
<td>32.5%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Other</td>
<td>8.5%</td>
<td>5.2%</td>
<td>-38.4%</td>
</tr>
</tbody>
</table>
# Changes in system prevalence and coverage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comprehensive systems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of communities</td>
<td>24.2%</td>
<td>36.9%</td>
<td>31.1%</td>
<td>39.5%</td>
</tr>
<tr>
<td>% of population</td>
<td>25.0%</td>
<td>50.8%</td>
<td>47.7%</td>
<td>47.2%</td>
</tr>
<tr>
<td><strong>Conventional systems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of communities</td>
<td>50.1%</td>
<td>33.9%</td>
<td>49.0%</td>
<td>40.2%</td>
</tr>
<tr>
<td>% of population</td>
<td>46.9%</td>
<td>25.8%</td>
<td>36.3%</td>
<td>32.5%</td>
</tr>
<tr>
<td><strong>Limited systems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of communities</td>
<td>25.6%</td>
<td>29.2%</td>
<td>19.9%</td>
<td>20.3%</td>
</tr>
<tr>
<td>% of population</td>
<td>28.1%</td>
<td>23.4%</td>
<td>16.0%</td>
<td>19.6%</td>
</tr>
</tbody>
</table>

Predictors of Comprehensive System Capital

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

**IVs**

N=1019 community-years
### Effects of Comprehensive System Capital on Life Expectancy

<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
Some preliminary conclusions

- Post-recession progress in strengthening population health delivery systems
- Large potential reductions in preventable mortality over time (forthcoming)
- Multi-sector work in population health may also help to reduce disparities in life expectancy
- Inequities in population health activities are nontrivial
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

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References


