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Geographic Variation in the Delivery of Public Health Services: Understanding Causes and Consequences

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Geographic Variation in the Delivery of Public Health Services: Understanding Causes and Consequences

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Washington University Dissemination & Implementation Seminar Series | April 1 2015
Many evidence-based public health strategies fail to reach large segments of U.S. populations at risk:

- Smoking cessation
- Influenza vaccination
- Hypertension control
- Nutrition & physical activity programs
- HIV prevention
- Family planning
- Substance abuse prevention
- Interpersonal violence prevention
- Maternal and infant home visiting for high-risk populations
- HPV vaccinations & cancer screening
Economics & public health implementation

>75% of US health spending is attributable to conditions that are largely preventable
  – Cardiovascular disease
  – Diabetes
  – Lung diseases
  – Cancer
  – Injuries
  – Vaccine-preventable diseases and sexually transmitted infections

<5% of US health spending is allocated to prevention and public health

CDC 2008 and CMS 2013
Complexity in public health delivery systems

Other Health & Social Organizations
- Needs
- Preferences
- Risks
- Threats
- Resources
- Perceptions

Population & Environment
- Nature & intensity of relationships
- Distribution of effort
- Compatibility of missions
- Scope of activity
- Division of responsibility
- Participation incentives

Public Health Agencies
- Leadership
- Intergovernmental relationships
- Staffing levels & mix
- Scope of services
- Funding levels & mix
- Legal authority
- Governing structure

Coordination mechanisms
- Nature & intensity of relationships
- Scope of activity
- Distribution of effort
- Participation incentives

Strategic Interactions
- Scale of operations
- Needs
- Preferences
- Risks
- Threats
- Resources
- Perceptions

Outputs and Outcomes
- Reach
- Effectiveness
- Timeliness
- Adherence to EBPs
- Efficiency
- Equity

Decision Support
- Accreditation
- Performance measures
- Practice guidelines
- Quality improvement

Mays et al 2009
What’s the role of public health infrastructure?

Foundational Public Health Capabilities

- Epidemiologic surveillance & investigation
- Community health assessment & planning
- Public education and communication
- Community engagement & deliberation
- Environmental health monitoring & assessment
- Policy development and analysis
- Policy compliance monitoring & enforcement
- Convening and planning for school-based, worksite-based, and community-based health programming
- Workforce development & training
- Fundraising & entrepreneurship
- Financial analysis & resource allocation

Strategies to promote health and prevent disease & injury on a population-wide basis: programs, policies, administrative practices

Mays, Halverson, and Scutchfield. 2003
Fundamental questions

- **How much variation across the U.S.?**
  - High-value programs & services
  - Cross-cutting infrastructure and capabilities

- **Drivers of variation?**
  - Need
  - Preferences & values
  - Resource availability
  - Delivery system attributes

- **Consequences of variation?**
  - Health impact
  - Cost & efficiency
  - Equity
Ongoing studies of implementation variation in public health

Macro

- National Longitudinal Survey of Public Health Systems
- Multi-network Practice and Outcome Variation Study (MPROVE)
- Public Health Delivery and Cost Studies (DACS)
- Costing Foundational Public Health Capabilities

Micro

PUBLIC HEALTH SERVICES & SYSTEMS RESEARCH PRACTICE-BASED RESEARCH NETWORKS
National Coordinating Center
Prior work: mortality reductions attributable to investments in public health delivery, 1993-2008

Hierarchical regression estimates with instrumental variables to correct for selection and unmeasured confounding

Mays et al. 2011
Prior work: medical cost offsets attributable to investments in public health delivery, 1993-2008

For every $10 of public health spending, ≈$9 are recovered in lower medical care spending over 15 years
1 - National Longitudinal Survey of Public Health Systems

- Cohort of 360 communities with at least 100,000 residents
- Measured from local public health official’s perspective:
  - **Scope**: availability of 20 recommended public health activities
  - **Network**: types of organizations contributing to each activity
  - **Effort**: contributed by designated local public health agency
  - **Quality**: perceived effectiveness of each activity
- Linked with organizational and financial data from NACCHO’s National Profile of Local Health Departments, Area Resource File, U.S. Census data
## Delivery of recommended public health activities in U.S. communities

<table>
<thead>
<tr>
<th>Public Health Activity</th>
<th>1998</th>
<th>2006</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Community health needs assessment</td>
<td>71.5</td>
<td>77.5</td>
<td>72.6</td>
</tr>
<tr>
<td>2. Behavioral risk factor surveillance</td>
<td>45.8</td>
<td>70.2</td>
<td>73.9</td>
</tr>
<tr>
<td>3. Adverse health events investigation</td>
<td>98.6</td>
<td>97.9</td>
<td>99.6</td>
</tr>
<tr>
<td>4. Public health laboratory testing services</td>
<td>96.3</td>
<td>97.0</td>
<td>99.2</td>
</tr>
<tr>
<td>5. Analysis of health status &amp; health determinants</td>
<td>61.3</td>
<td>73.2</td>
<td>63.5</td>
</tr>
<tr>
<td>6. Analysis of preventive services utilization</td>
<td>28.4</td>
<td>26.1</td>
<td>33.2</td>
</tr>
<tr>
<td>7. Health information provision to elected officials</td>
<td>80.9</td>
<td>90.1</td>
<td>87.1</td>
</tr>
<tr>
<td>8. Health information provision to the public</td>
<td>75.4</td>
<td>88.8</td>
<td>80.9</td>
</tr>
<tr>
<td>9. Health information provision to the media</td>
<td>75.2</td>
<td>88.4</td>
<td>87.1</td>
</tr>
<tr>
<td>10. Prioritization of community health needs</td>
<td>66.1</td>
<td>71.7</td>
<td>66.8</td>
</tr>
<tr>
<td>11. Community participation in health planning</td>
<td>41.5</td>
<td>50.6</td>
<td>49.8</td>
</tr>
<tr>
<td>12. Development of community health improvement plan</td>
<td>81.9</td>
<td>86.7</td>
<td>69.7</td>
</tr>
<tr>
<td>13. Resource development &amp; allocation to implement health plan</td>
<td>26.2</td>
<td>37.3</td>
<td>27.8</td>
</tr>
<tr>
<td>14. Policy development to implement health plan</td>
<td>48.6</td>
<td>51.9</td>
<td>49.0</td>
</tr>
<tr>
<td>15. Communication with health-related organizations</td>
<td>78.8</td>
<td>87.2</td>
<td>89.6</td>
</tr>
<tr>
<td>16. Implementation of strategies to enhance access to services</td>
<td>75.6</td>
<td>68.7</td>
<td>60.6</td>
</tr>
<tr>
<td>17. Implementation of legally mandated PH activities</td>
<td>91.4</td>
<td>92.3</td>
<td>89.2</td>
</tr>
<tr>
<td>18. Evaluation of public health programs and services</td>
<td>34.7</td>
<td>37.5</td>
<td>33.2</td>
</tr>
<tr>
<td>19. Evaluation of local public health agency performance</td>
<td>56.3</td>
<td>56.2</td>
<td>55.2</td>
</tr>
<tr>
<td>20. Implementation of quality improvement processes</td>
<td>47.3</td>
<td>50.4</td>
<td>42.7</td>
</tr>
</tbody>
</table>
Delivery of recommended public health activities in U.S. communities

Mays et al. AJPH 2015
Variation in Scope of Public Health Delivery

Delivery of recommended public health activities, 2012

Variation and Change in Delivery
Delivery of recommended public health activities, 2006-12

Mays et al. AJPH 2015
Patterns of interaction in implementing recommended activities
<table>
<thead>
<tr>
<th>Organization</th>
<th>% Change 2006-2012</th>
<th>Scope of Production 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local health agency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other local government</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State health agency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other state government</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community health centers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health insurers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employers/business</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBOs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bridging capital in public health delivery systems
Trends in betweenness centrality

* Change from prior years is statistically significant at p<0.05
Seven types of public health delivery systems

Scope

Centrality

Density

- Comprehensive
- Conventional
- Limited

Source: Mays et al. 2010; 2012
Integrated systems do more with less

Expenditures per capita

% of recommended activities performed

Source: Mays et al. 2010; 2012
Integrated systems achieve better health outcomes

Fixed-effects models control for population size, density, age composition, poverty status, racial composition, and physician supply.

Percent Changes in Preventable Mortality Rates Attributable to Delivery System Type

- Cancer deaths/100,000 population
- Heart Disease Deaths/100,000
- Influenza Deaths/100,000
- Infectious Disease Deaths/100,000

Charts show the percent changes in preventable mortality rates attributable to different delivery system types, including comprehensive, conventional, limited, and very limited. The graphs compare clusters of data across different delivery systems, illustrating the impact on mortality rates for cancer, heart disease, influenza, and infectious diseases.
Integrated systems generate larger health & economic gains in low-resource communities

Impact in Low-Income vs. High Income Communities

Log IV regression estimates controlling for community-level and state-level characteristics

Mays et al. forthcoming 2015
Estimated crowd-out in hospital contributions to public health activities

Note: GLLAMM estimates, holding all other variables constant in the model
Identify implementation measures high-value services:
- Chronic disease prevention
- Communicable disease control
- Environmental health protection

Create registry of measures: consistent across communities

Profile geographic variation in the delivery of selected public health services across local communities

Decompose variation into attributable components:
- Need-sensitive or preference-sensitive factors
- Supply-sensitive factors

Examine associations between service delivery & outcomes
**MPROVE measurement dimensions**

- **Availability/Scope:** specific activities produced
- **Volume/Intensity:** Frequency of producing activity over period of time
- **Capacity:** Labor and capital inputs assigned to an activity
- **Reach:** Proportion of target population reached by activity
- **Quality:** timeliness of activity, guideline concordance
- **Efficiency:** resources required to produce given volume of activity
Overall Patterns of Variation in Local Public Health Implementation

Estimates from random effects regression models
Correlates of Variation in Local Public Health Implementation

% of Total Variance

Estimates from state fixed-effects regression models

*p<0.05
3 - Public Health Delivery and Cost Studies (DACS)

11 states → 250 community settings

- Adapt & apply established cost measurement/estimation methodologies to public health settings
- Identify the costs of implementing selected high-value public health services
- Assess how costs vary across institutional and community settings
- Examine the determinants and consequences of variation in the costs of implementation
  - Economies of scale and scope
  - Efficiency & productivity
  - Equity
DACS cost estimation methods

- Retrospective “cost accounting” methods
  - Modeling and decomposition using administrative records
  - Surveys with staff and/or administrators

- Concurrent “actual cost” methods (micro-costing)
  - Time studies with staff
  - Activity logs with staff
  - Direct observation

- Prospective “expected cost” methods
  - Vignettes
  - Surveys with staff and/or administrators
  - Delphi group processes
DACS Example: Returns to Scale in Implementing Disease Investigation in Colorado

Atherly et al. University of Colorado and Colorado Public Health PBRN. http://www.ucdenver.edu/academics/colleges/PublicHealth/research/centers/RMPRC/projects/Pages/COPHPBRN.aspx
4 – Costing Foundational Capabilities

2012 Institute of Medicine Recommendations

- Identify the components and **costs of a minimum package** of public health services
  - Foundational capabilities
  - Basic programs
- Examine variation in costs across community and institutional settings
- Identify population and delivery system attributes that influence costs

Costing Methodology Targets

- Foundational Capabilities (FCs) Costs
  - Health Assessment
  - Emergency Preparedness
  - Communications
  - Policy Development and Support
  - Community Partnership Development
  - Organizational Competencies

- Foundational Program Areas (FA) Costs
  - Communicable Disease Control
  - Chronic Disease & Injury Prevention
  - Environmental Health
  - Maternal and Child Health
  - Access and Linkage to Clinical Care

Total costs = ΣFC + ΣFA
Estimation of “projected” costs from current implementation ratings

A. Cost at current implementation level
B. Projected cost of full implementation

Pilot Estimates: Current and Projected Costs of Foundational Capabilities

Current

Projected

Mean = 65.036
5% = 52.750
95% = 78.323

Mean = 101.82
5% = 76.75
95% = 127.46

Pilot Estimates: Current and Projected Costs of Foundational Capabilities
Sampling for national cost estimates

- National stratified, nested sample of state and local jurisdictions
- Selection of 9 states stratified by administrative structure:
  - Centralized: AR, SC
  - Shared: FL, GA, (KY)
  - Decentralized: NY, CA, OH, (WA)
- Selection of 3 local jurisdictions in each state, stratified by population: <50k | 50-299k | >=300k
- Supplement data already collected from KY, WA
- Web-based survey administration with telephone support
Learning from variation: Dissemination & Translation

- Customized reporting of results

- Collaborative interpretation of patterns & determinants
  - Disentangling demand (need) from supply
  - System structure
  - Geospatial
  - Within and across domains of activity: composite measures

- Follow-on studies: qualitative & quantitative

- Many dissemination channels
  - Rapid-cycle journal: www.FrontiersinPHSSR.org
  - Research archive: works.bepress.com/glen_mays
  - Blog: PublicHealthEconomics.org
  - Web: publichealthsystems.org
  - RE-ACT podcast series
  - Annual Keeneland Conference
Public Health PBRNs: mechanisms for research production & translation

>1900 public health agencies
56 universities
>60 CBOs

First cohort (December 2008 start-up)
Second cohort (January 2010 start-up)
Affiliate/Emerging PBRNs (2011-14)
# PBRNs and Research Translation

## Local Health Departments Engaged in Research Implementation & Translation Activities During Past 12 months

<table>
<thead>
<tr>
<th>Activity</th>
<th>PBRN Agencies Percent/Mean</th>
<th>National Sample Percent/Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying research topics</td>
<td>94.1%</td>
<td>27.5%</td>
</tr>
<tr>
<td>Planning/designing studies</td>
<td>81.6%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Recruitment, data collection &amp; analysis</td>
<td>79.6%</td>
<td>50.3%</td>
</tr>
<tr>
<td>Disseminating study results</td>
<td>84.5%</td>
<td>36.6%</td>
</tr>
<tr>
<td>Applying findings in own organization</td>
<td>87.4%</td>
<td>32.1%</td>
</tr>
<tr>
<td>Helping others apply findings</td>
<td>76.5%</td>
<td>18.0%</td>
</tr>
<tr>
<td>Research implementation composite</td>
<td>84.04 (27.38)</td>
<td>30.20 (31.38)</td>
</tr>
<tr>
<td>N</td>
<td>209</td>
<td>505</td>
</tr>
</tbody>
</table>

Toward a “rapid-learning system” in population health

In a learning health care system, research influences practice and practice influences research

Evaluate
Collect data and analyze results to show what does and does not work

Adjust
Use evidence to influence continual improvement

Implement
Apply the plan in pilot and control settings

Design
Design care and evaluation based on evidence generated here and elsewhere

Disseminate
Share results to improve care for everyone

Internal and External Scan
Identify problems and potentially innovative solutions

More Information

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