The Science of Public Health Delivery: Evidence, Uncertainties & Research Needs

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The Science of Public Health Delivery: Evidence, Uncertainties & Research Needs

Glen P. Mays
University of Kentucky College of Public Health
Public Health Practice-Based Research Networks Program

Case Western Reserve University Public Health Research and Innovation Symposium • Cleveland, OH
14 November 2011
Overview

Why is research on the public health delivery system important and urgent?

What are we learning from this research so far?

What are important things to learn in the future from this avenue of inquiry?
Preventable mortality in the U.S.

Preventable Deaths per 100,000 population

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.

Source: Commonwealth Fund 2008
Geographic variation in preventable mortality

Source: Commonwealth Fund 2008
Missed opportunities in public health delivery

Large segments of the populations at risk are not covered by evidence-based public health practices:

- Smoking cessation
- Influenza vaccination
- Hypertension control
- Nutrition and physical activity programming
- HIV prevention
- Family planning
- Substance abuse prevention
- Interpersonal violence prevention
- Maternal and infant home visiting for high-risk populations
The disconnect between discovery research and delivery research

For every $100 in federal health research spending, <$1 is devoted to delivery system research.

Woolf SH, Johnson RE. 2005. The break-even point: when medical advances are less important than improving the fidelity with which they are delivered. Ann Fam Med. 2005;3(6):545-52.
Why study public health delivery?

“The Committee had hoped to provide specific guidance elaborating on the types and levels of workforce, infrastructure, related resources, and financial investments necessary to ensure the availability of essential public health services to all of the nation’s communities. However, such evidence is limited, and there is no agenda or support for this type of research, despite the critical need for such data to promote and protect the nation’s health.”

—Institute of Medicine, 2003
What is Public Health Services & Systems Research?

A field of inquiry examining the organization, financing, and delivery of public health services at local, state and national levels, and the impact of these activities on population health.

Mays, Halverson, and Scutchfield. 2003
Subtitle D—Support for Prevention and Public Health Innovation

SEC. 4301. RESEARCH ON OPTIMIZING THE DELIVERY OF PUBLIC HEALTH SERVICES.

(a) IN GENERAL.—The Secretary of Health and Human Services (referred to in this section as the “Secretary”), acting through the Director of the Centers for Disease Control and Prevention, shall provide funding for research in the area of public health services and systems.

(b) REQUIREMENTS OF RESEARCH.—Research supported under this section shall include—

(1) examining evidence-based practices relating to prevention, with a particular focus on high priority areas as identified by the Secretary in the National Prevention Strategy or Healthy People 2020, and including comparing community-based public health interventions in terms of effectiveness and cost;

(2) analyzing the translation of interventions from academic settings to real world settings; and

(3) identifying effective strategies for organizing, financing, or delivering public health services in real world community settings, including comparing State and local health department structures and systems in terms of effectiveness and cost.
PHSSR’s place in the continuum

**Intervention Research**

- What works – proof of efficacy
- Controlled trials
- *Guide to Community Preventive Services*

**Services/Systems Research**

- How to organize, implement and sustain in the real-world
  - Reach
  - Quality/Effectiveness
  - Cost/Efficiency
  - Equity/Disparities
- Impact on population health

- Comparative effectiveness & efficiency
The public health delivery system

Public Health System
- Resources & expertise
- Participation incentives
- Needs
- Preferences
- Risks
- Threats
- Population & Environment
- Resources
- Perceptions

Strategic Decisions
- Scope of activity
- Division of responsibility
- Distribution of effort
- Nature & intensity of relationships
- Strategic Decisions
- Leadership
- Intergovernmental relationships
- Funding levels & mix
- Governing structure
- Decision Support
  - Surveillance & IT
  - Performance measures
  - Practice guidelines
  - Accreditation

Public Health Agency
- Legal authority
- Staffing levels & mix
- Funding levels & mix
- Governing structure
- Leadership

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

Mays et al. 2009
Developmental path for PHSSR

- Measuring practice & performance
- Detecting variation in practice
- Examining determinants of variation
  - Organization
  - Financing
  - Workforce
- Determining consequences of variation
  - Health outcomes
  - Economic outcomes
- Testing strategies to reduce harmful, wasteful, & inequitable variation in practice and outcomes
**Example: Practice Variation**

Local Variation In Public Health Preparedness: Lessons From California

Even in California—one of the best-prepared states—much work remains to ensure preparedness for a public health emergency.

by Nicole Lurie, Jeffrey Wasserman, Michael Stoto, Sarah Myers, Poki Narkung, Jonathan Fielding, and Robert Burciaga Valdez

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**EXHIBIT 1**
Characteristics Of Local Public Health Agencies (LPHAs) Participating In Test Of Response To Case Reports, 2004

<table>
<thead>
<tr>
<th>LPHA</th>
<th>Region</th>
<th>Population served</th>
<th>Urban/rural</th>
<th>Mean time until calls returned (minutes)</th>
<th>Longest period before calls returned (minutes)</th>
<th>Number of calls not returned</th>
<th>Percent “warm transfers”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Midwest</td>
<td>Small</td>
<td>Rural</td>
<td>93</td>
<td>630</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>2</td>
<td>Midwest</td>
<td>Medium</td>
<td>Rural</td>
<td>51</td>
<td>350</td>
<td>1</td>
<td>57</td>
</tr>
<tr>
<td>3</td>
<td>Midwest</td>
<td>Medium</td>
<td>Urban</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td>4</td>
<td>Midwest</td>
<td>Large</td>
<td>Urban</td>
<td>14</td>
<td>30</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>Midwest</td>
<td>Large</td>
<td>Urban</td>
<td>10</td>
<td>23</td>
<td>0</td>
<td>38</td>
</tr>
</tbody>
</table>

Lurie et al. 2004
Missed Opportunities
Local Health Departments as Providers of Obesity Prevention Programs for Adolescents
Sandy J. Slater, PhD, Lisa M. Powell, PhD, Frank J. Chaloupka, PhD

Percent of local health departments offering evidence-based obesity programs

Slater et al. 2007
Mixed Results In Tracking Food Scares

Minnesota health officials investigate all reports of food-borne illness, but officials in many states do not. From 1990 to 2006, Minnesota reported 548 outbreaks, while Kentucky reported 18.

Reported outbreaks of food-related illness
Per 100,000 people, 1990 to 2006

Source: Centers for Disease Control and Prevention
Estimated Effects of Smoke-free Policies on AMI admissions

<table>
<thead>
<tr>
<th>Study</th>
<th>ES (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helena Montana</td>
<td>0.60 (0.21, 0.99)</td>
<td>1.76</td>
</tr>
<tr>
<td>Pueblo Colorado</td>
<td>0.73 (0.63, 0.85)</td>
<td>10.13</td>
</tr>
<tr>
<td>Piedmont Italy</td>
<td>0.89 (0.81, 0.98)</td>
<td>12.14</td>
</tr>
<tr>
<td>Bowling Green Ohio</td>
<td>0.61 (0.55, 0.67)</td>
<td>14.24</td>
</tr>
<tr>
<td>New York State</td>
<td>0.80 (0.80, 0.80)</td>
<td>17.20</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.89 (0.81, 0.97)</td>
<td>12.56</td>
</tr>
<tr>
<td>Saskatoon Canada</td>
<td>0.87 (0.84, 0.90)</td>
<td>16.35</td>
</tr>
<tr>
<td>Rome Italy</td>
<td>0.89 (0.85, 0.93)</td>
<td>15.61</td>
</tr>
<tr>
<td>Overall</td>
<td>0.81 (0.76, 0.86)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

NOTE: Weights are from random effects analysis

Glantz 2008
Estimating the Value of Public Health Strategies: Two Examples

- Macro-level study: geographic variation and change in public health spending
- Micro-level study: effects of a specific public health delivery strategy

Value as defined by:
- Health effects
- Cost-effectiveness
- Cost offsets
- Technical efficiency
Allocation of U.S. health spending

Public health and preventive services
3%

Medical care, treatment, rehab, and LTC
97%

Batelle 1993, CMS 2005, NASBO 2005
What we know about geographic variation in medical care spending

- Medical spending varies by a factor of more than 2 across local areas
- Medicare enrollees in high-spending regions receive more care but do not experience lower mortality
- What can we say about public health spending?

Fisher et al. Annals 2003
Variation in Local Public Health Spending

Gini = 0.472

“Local spending varies by a factor of 13 between the top 20% and bottom 20% of communities, even after adjusting for differences in demographics, SES, and service mix.”

Mays et al. 2009
Changes in Local Public Health Spending
1993-2008

- 62% growth
- 38% decline
Drivers of geographic variation in public health spending

- Delivery system size & structure
- Service mix
- Population needs and risks
- Efficiency & uncertainty

Mays et al. 2009
Analyzing consequences of spending

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
## Determinants of Local Public Health Spending Levels

<table>
<thead>
<tr>
<th>Governance/Decision Authority</th>
<th>Coefficient</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local board of health exists</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>State approves local PH budget†</td>
<td>-0.388***</td>
<td>(-0.576, -0.200)</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>
</tbody>
</table>

Semi-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.

Mays et al. 2011
Hierarchical logistic regression estimates with instrumental variables to correct for selection and unmeasured confounding

Mays et al. Health Affairs 2011
Cross-sectional association between PH spending and Medical spending

Quintiles of public health spending/capita

Mays et al. 2009
**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>

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

*p<0.10   **p<0.05   ***p<0.01

Mays et al. forthcoming
Projected effects of ACA public health spending

- $15B in **new** public health spending over 10 years:
  - Deaths averted: 255,000 – 437,000
  - Medical cost offset: $2.2B – $6.9B
  - Cost/life-year gained $9,800 – $22,400

Mays et al. forthcoming
Micro Example: Evaluating Community Connectors

- 3 year demonstration serving three rural counties in Arkansas’ Mississippi Delta region
- Rural, predominantly African American, low SES population
- Targets Medicaid eligible elders and adults with physical disabilities
- Uses lay health workers to identify persons with unmet LTC needs and link them to HCBS

Source: RWJF University of Wisconsin County Health Rankings 2010
Defining Comparison Group Using Propensity Score Matching

Comparison Group: statistically matched on age, gender, race, eligibility category, enrollment duration, waiver enrollment, comorbidities, prior-year spending, distance to services

Felix, Mays et al. Health Affairs 2011
### Comparison groups and years

<table>
<thead>
<tr>
<th>Group</th>
<th>FY2005</th>
<th>FY2006</th>
<th>FY2007</th>
<th>FY2008</th>
<th>FY2009*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCP Cohort 1</td>
<td>Pre</td>
<td>Post 1</td>
<td>Post 2</td>
<td>Post 3</td>
<td>Post 4</td>
</tr>
<tr>
<td>Comparison Group 1</td>
<td>Pre</td>
<td>Post 1</td>
<td>Post 2</td>
<td>Post 3</td>
<td>Post 4</td>
</tr>
<tr>
<td>CCP Cohort 2</td>
<td>--</td>
<td>Pre</td>
<td>Post 1</td>
<td>Post 2</td>
<td>Post 3</td>
</tr>
<tr>
<td>Comparison Group 2</td>
<td>--</td>
<td>Pre</td>
<td>Post 1</td>
<td>Post 2</td>
<td>Post 3</td>
</tr>
<tr>
<td>CCP Cohort 3</td>
<td>--</td>
<td>--</td>
<td>Pre</td>
<td>Post 1</td>
<td>Post 2</td>
</tr>
<tr>
<td>Comparison Group 3</td>
<td>--</td>
<td>--</td>
<td>Pre</td>
<td>Post 1</td>
<td>Post 2</td>
</tr>
<tr>
<td>CCP Cohort 4</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Pre</td>
<td>Post 1</td>
</tr>
<tr>
<td>Comparison Group 4</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Pre</td>
<td>Post 1</td>
</tr>
</tbody>
</table>

*First 6 months only

Pre = one year period prior to CCP participation
Post = periods following CCP participation

Felix, Mays et al. Health Affairs 2011
# Estimates of Program Impact

Regression-Adjusted, Difference-in-Difference Estimates

<table>
<thead>
<tr>
<th>Time Period*</th>
<th>Spending Change from Baseline</th>
<th>95% Conf. Int.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>-6.0%</td>
<td>(-14.2, 2.3)</td>
</tr>
<tr>
<td>Year 2</td>
<td>-21.4%</td>
<td>(-32.8, -10.0)**</td>
</tr>
<tr>
<td>Year 3</td>
<td>-22.3%</td>
<td>(-35.4, -9.2)**</td>
</tr>
</tbody>
</table>

After adjusting for baseline and time-varying differences between groups

*Reference year is one year prior to CCP participation

**p<0.05

Felix, Mays et al. Health Affairs 2011
Cost Neutrality Estimates

Three Year Aggregate Estimates, FY2006-08

- Combined Medicaid spending reductions: $3.515 M
- Program operational expenses: $0.896 M
- Net savings: $2.629 M
- ROI: $2.92
Moving the field forward

We need research that penetrates and elucidates the “black box” of public health agencies and systems.

Policy & legal authority
Funding
Human capital
Population needs & risks

Agencies & Systems

Service delivery
Health & economic outcomes
The Logic of Public Health PBRNs

Identify Common questions of interest

Translation & application

Data exchange

Analysis & interpretation

Engaged practice settings

Research partner

Apply Rigorous research methods
The Robert Wood Johnson Foundation’s Public Health PBRN Program

First cohort (December 2008 start-up)
Second cohort (January 2010 start-up)
Affiliate/Emerging PBRNs

Map of the United States showing different states highlighted in green, yellow, or blue to indicate which cohort they belong to, or if they are an affiliate/emerging PBRN.

National Coordinating Center

Legend:
- Green: First cohort (December 2008 start-up)
- Yellow: Second cohort (January 2010 start-up)
- Blue: Affiliate/Emerging PBRNs
Examples: Economic Shocks and Decisions

- **Washington**: Variation in LHD budget reductions during the 2009-10 economic downturn, and how the reductions have affected service delivery and use of evidence-based practices.

- **North Carolina**: LHD responses to Medicaid maternity case management funding cut, and impact on service delivery.

- **Connecticut**: Responses to elimination of state subsidies to small LHDs.

- **Ohio**: LHD enforcement of smoke-free workplace act (magnitude & frequency) in response to economic downturn.

- **Wisconsin & Florida**: Changes in LHD spending, funding sources and resource allocation during economic recession.
Examples: Regionalized Service Delivery

- **Massachusetts:** Local variation in decision-making and implementation regarding regional delivery models

- **Nebraska:** How do organizational design and workforce issues affect implementation of regional health department models

- **Connecticut:** How do state-mandated services and funding reductions influence decision-making regarding regional models

- **Colorado:** Impact of state public health law reform on regional approaches to service delivery; variation in local legal instruments and approaches to regionalization
Examples: Comparative Effectiveness

- **New York**: Comparative effectiveness of integrated delivery model for STI and HIV services vs. traditional model

- **Arkansas**: Comparative effectiveness of prenatal care delivery through public health clinics with telemedicine support vs. physician office-based delivery
Conclusions: getting inside the box

- Routine, structured collaboration between researchers and practitioners
- Attention to addressing salient policy questions
- Improvements in methods, measures & data
- Feedback loops for system partners
- Expanded evidence
- Improved decisions
- Greater value for investments
For More Information

PUBLIC HEALTH
Practice-Based Research Networks
National Coordinating Center

Supported by The Robert Wood Johnson Foundation

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