Practice-Based Learning: Opportunities and Implications for STEM Education

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Overview

- What is practice-based learning and research?
- Why do we use it in public health?
- PBR roles in knowledge acquisition & dissemination
- Implications & opportunities for STEM education
What is Practice-Based Research?

- Designed to address uncertainties and information needs of real-world decision-makers
- Engages practitioners in the scientific process: conceptualization → translation
- Tests effectiveness & impact of interventions in real-world practice settings
- Evaluates the implementation and impact of innovations in practice
- Uses observations generated through routine practice to produce knowledge
PBR and “rapid-learning systems”

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.

Key targets of PBR

- Diffusion and implementation of evidence-based practices
  - Under-use
  - Over-use
  - Mis-use

- Fidelity vs. adaptation

- Targeting & tailoring
Failures in public health practice

Figure 1. There are large differences in life expectancy and health care spending across OECD countries 2008.

1. Or latest year available.
Source: OECD Health Data 2010.
Failures in public health practice

Premature Deaths per 100,000 Residents

Commonwealth Fund 2012
Failures in public health practice

Less than 50% of the U.S. population at risk is reached 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
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

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

Mays, Halverson, and Scutchfield. 2003
A Key PHSSR Goal: Optimization

How to optimally deploy a diverse collection of responsibilities, resources, actors & expectations?

- Epidemiologic **surveillance & investigation**
- Community health **assessment & planning**
- Communicable disease control
- Chronic disease and injury prevention
- Health education and communication
- 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 roles in **assuring access** to medical care
Standardization vs. Customization in public health delivery systems

**Standardization**
- Harmful variation
- Wasteful variation
- Inequitable variation
- Race to the bottom
- Network externalities: interoperability/coordination

**Customization**
- Target resources to greatest needs/risks
- Tailor approaches to values & preferences of stakeholders
- Deploy unique resources & skills to their best purposes

Effectiveness  
Efficiency  
Equity
Developmental path for PBR: learning from variation

- Measuring practice & performance
- Detecting variation in practice
- Examining determinants of variation
  - Organization  – Law & policy
  - Financing    – Information
  - Workforce   – Preference
- Determining consequences of variation
  - Health outcomes   – Medical care use
  - Economic outcomes – Disparities
- Testing strategies to reduce harmful, wasteful, & inequitable variation in practice and outcomes
The Logic of Practice Based Research Networks

Identify
Common questions of interest

Engaged practice settings

Research partner

Apply Rigorous research methods

Data exchange

Analysis & interpretation

Translation & application
Diffusion of Public Health PBRNs

- First cohort (December 2008 start-up)
- Second cohort (January 2010 start-up)
- Affiliate/Emerging PBRNs (2011-14)
PBRNs as Research Engines

- 31 networks
- 1593 local public health agencies
- 35 state agencies
- 52 academic research units
- 58 professional & community organizations
- 60 competitively awarded research projects
- 82 articles in peer-reviewed journals
- 221 presentations and conferences & meetings
- 51 reports & tools in the grey literature
- >15,000 downloads of Frontiers in PHSSR articles
- >8,000 downloads from Research Archive
- >2,000 page views on PublicHealthEconomics blog
## 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>

Mays et al. 2013
Examples of PBR Learning & Research in Public Health

- Observational, comparative studies
- Natural experiments
- Modeling and simulation
- Pragmatic prospective trials
Delivery of recommended public health activities

Variation in Scope of Public Health Delivery

Delivery of recommended public health activities, 2012

Percent of U.S. communities

Percent of activities performed

A typology of public health delivery systems

Source: Mays et al. 2010; 2012
Changes in health associated with delivery system

Percent Changes in Preventable Mortality Rates by System Typology (cluster)

- Infant Deaths/1000 Births
  - Clusters 1-3: -0.1
  - Clusters 4-5: 0.0
  - Cluster 6: 0.1
  - Cluster 7: 0.2

- Cancer deaths/100,000 population
  - Clusters 1-3: 3.0
  - Clusters 4-5: 6.0
  - Cluster 6: 2.0
  - Cluster 7: 4.0

- Heart Disease Deaths/100,000
  - Clusters 1-3: 2.0
  - Clusters 4-5: 8.0
  - Cluster 6: 6.0
  - Cluster 7: 4.0

- Influenza Deaths/100,000
  - Clusters 1-3: 1.0
  - Clusters 4-5: 2.0
  - Cluster 6: 0.0
  - Cluster 7: -0.2

- Infectious Disease Deaths/100,000
  - Clusters 1-3: 0.0
  - Clusters 4-5: 4.0
  - Cluster 6: 2.0
  - Cluster 7: 3.0

Fixed-effects models control for population size, density, age composition, poverty status, racial composition, and physician supply
Variation in Local Public Health Spending

Gini = 0.485
Changes in Local Public Health Spending 1993-2010

62% growth

38% decline
Mortality reductions attributable to local public health spending, 1993-2008

Infant mortality  Heart disease  Diabetes  Cancer  Influenza  All-cause  Alzheimers

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

Mays et al. 2011
Variation in Public Health Response Capability

Scope and Timing of H1N1 Response Activities in NC by Agency Accreditation Status

- **Served by accredited agencies**
- **Served by non-accredited agencies**
Economies of scale and scope in public health delivery

Mays et al. 2013
Gains from regionalizing public health delivery

Mays et al. 2013
Examples: Practice Standards in Ohio

Analyzing Concordance between Position Descriptions and Practice Standards for Public Health Nurses

- **Question of interest:** Are positions consistent with national competency standards and scope of practice policies?
- **Practice settings:** 125 local health departments in Ohio
- **Factors examined:**
  - Geographic variation in concordance
  - Organizational, economic, and community characteristics associated with concordance
- **Study design:** observational practice variation study, mixed-method
Improve Cultural Competency of Public Health Workers

**Question of interest:** Can a health professions cultural competency training program be adapted to improve skills among local public health workers?

**Practice settings:** 56 local agencies

**Factors examined:**
- Knowledge and skills related to CLAS standards
- RE-AIM measures of success

**Study design:** random-assignment delayed intervention trial
Evaluation of a QI Process to Improve Workforce Diversity

**Question of interest:** Can a QI process be implemented to improve recruitment and retention of public health workers from under-represented racial/ethnic backgrounds?

**Practice settings:** Seattle-King County

**Factors examined:**
- Recruitment
- Hiring process
- Retention

**Study design:** pre-post study with comparison group
Examples: Studying Public Health Production
Multi-Network Practice and Outcome Variation (MPROVE) Study, 2012-14

Measures Collected Consistently Across 6 PBRNs

- **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**: effectiveness, timeliness, equity of activity
- **Efficiency**: resources required to produce given volume of activity
## Table 2: Local Health Department Performance of Tobacco Prevention, Control, and Cessation Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Agency</th>
<th>State-specific Averages</th>
<th>Six-State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CO</td>
<td>FL</td>
</tr>
<tr>
<td>1 Educational materials</td>
<td>Yes</td>
<td>88.7%</td>
<td>89.4%</td>
</tr>
<tr>
<td>2 Educational media</td>
<td>No</td>
<td>54.7%</td>
<td>66.0%</td>
</tr>
<tr>
<td>3 Cultural/linguistic specific materials</td>
<td>No</td>
<td>58.5%</td>
<td>61.7%</td>
</tr>
<tr>
<td>4 Cultural/linguistic specific programs</td>
<td>No</td>
<td>41.5%</td>
<td>44.7%</td>
</tr>
<tr>
<td>5 Educational/training programs</td>
<td>Yes</td>
<td>58.5%</td>
<td>80.9%</td>
</tr>
<tr>
<td>6 Community development</td>
<td>No</td>
<td>35.8%</td>
<td>80.9%</td>
</tr>
<tr>
<td>7 Policy development</td>
<td>No</td>
<td>43.4%</td>
<td>78.7%</td>
</tr>
<tr>
<td>8 Tobacco cessation programs</td>
<td>Yes</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>9 Adult tobacco use surveillance</td>
<td>No</td>
<td>0.0%</td>
<td>31.9%</td>
</tr>
<tr>
<td>10 Youth tobacco use surveillance</td>
<td>Yes</td>
<td>0.0%</td>
<td>57.4%</td>
</tr>
<tr>
<td>Any activity</td>
<td>Yes</td>
<td>64.5%</td>
<td>67.2%</td>
</tr>
<tr>
<td>All activities</td>
<td>No</td>
<td>0.0%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Average number of activities</td>
<td>4.0</td>
<td>3.0</td>
<td>4.4</td>
</tr>
<tr>
<td>Responded (n)</td>
<td>Yes</td>
<td>53.0</td>
<td>47.0</td>
</tr>
<tr>
<td>Missing</td>
<td></td>
<td>23.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Not Applicable</td>
<td></td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### MPROVE Benchmarking and peer comparisons
Examples: Cost and Staffing Studies

Costing and Staffing a Minimum Package of Services

- **Question of interest:** What financial and human resources are required to deliver a core package of services for a defined population?

- **Practice settings:** Selected agencies from multiple PBRNs

- **Factors examined:**
  - Labor costs and FTEs
  - Volume and intensity of service delivery
  - Direct and indirect costs

- **Study design:** observational, cross-sectional
Practice-Based Learning: Implications for STEM Education

- Relevant practice settings for STEM education
  - K12 Schools
  - Higher ed
  - Research institutions
  - Place-based settings (e.g. museums, parks)

- Evidence-based practices to study
  - Diffusion and Reach
  - Fidelity in implementation
  - Adaptation
  - Cost and value

- Innovations to evaluate
A PBRN for STEM Education?

- Translation & application
- Identify common questions of interest
- Engaged practice settings
- Research partner
- Apply rigorous research methods
- Analysis & interpretation
- Data exchange
Conclusions: getting inside the box

- Engagement of practice and research partners
- Sensitive and specific measures
- Research designs in real-world settings
- What works best in which settings and why
- Informed practice decisions
- Smarter investments and greater value
Toward a “rapid-learning system” in STEM education?

For More Information

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