Measuring Progress to Comprehensive Public Health Systems, National Preparedness, and a Culture of Health

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Measuring Progress to Comprehensive Public Health Systems, National Preparedness, and a Culture of Health

Glen Mays, PhD, MPH
Scutchfield Professor of Health Services & Systems Research
University of Kentucky

America’s Health Rankings Scientific Advisory Committee Meeting • Chapel Hill, NC • 22 April 2016
Updates on 2 RWJF National Measurement Initiatives

- National Health Security Preparedness Index
- National Longitudinal Survey of Public Health Systems
Why a Preparedness Index?

Increase awareness & understanding of preparedness as a shared responsibility of multiple sectors in government and society

- Identify strengths and vulnerabilities
- Track progress
- Encourage coordination & collaboration
- Facilitate planning & policy development
- Support benchmarking & quality improvement
- Drive research & development
A Brief History

2012
- **Collaborative Development**: Partnership led by CDC, ASTHO and >25 collaborating organizations

12/2013
- **1st Release**: Initial model structure and results
  - 5 domains and 14 subdomains
  - 128 measures

12/2014
- **2nd Release**: Revised model and results
  - 6 domains and 18 active subdomains
  - 119 retained + 75 new = 194 measures
  - 75% of retained measures have updated data

1/2015
- **Transition to Robert Wood Johnson Foundation**
  - Validation studies and revision to methodology & measures

4/2016
- **3rd Release**: Revised model and results
  - 6 domains & 19 subdomains
  - 65% measures retained, 12% respecified, 8 new additions =134
  - 90% of retained measures have updated data from 2nd release
# Current Index Structure

<table>
<thead>
<tr>
<th>Overall Index Score</th>
<th>Health Security Surveillance</th>
<th>Community Planning &amp; Engagement</th>
<th>Incident &amp; Information Management</th>
<th>Healthcare Delivery</th>
<th>Countermeasure Management</th>
<th>Environmental &amp; Occupational Health</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Health Surveillance &amp; Epidemilological Investigation</td>
<td>Cross-Sector / Community Collaboration</td>
<td>Incident Management &amp; Multi-Agency Coordination</td>
<td>Prehospital Care</td>
<td>Medical Materiel Management, Distribution, &amp; Dispensing</td>
<td>Food &amp; Water Security</td>
</tr>
<tr>
<td></td>
<td>Biological Monitoring &amp; Laboratory Testing</td>
<td>Children &amp; Other At-Risk Populations</td>
<td>Emergency Public Information &amp; Warning</td>
<td>Inpatient Care</td>
<td>Countermeasure Utilization &amp; Effectiveness</td>
<td>Environmental Monitoring</td>
</tr>
<tr>
<td></td>
<td>Management of Volunteers during Emergencies</td>
<td>Legal &amp; Administrative</td>
<td>Long-Term Care</td>
<td>Non-Pharmaceutical Intervention</td>
<td>Mental &amp; Behavioral Healthcare</td>
<td>Home Care</td>
</tr>
<tr>
<td></td>
<td>Social Capital &amp; Cohesion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2016 Methodological Enhancements

- **Consolidation**: reduce correlated, redundant & noisy measures
- **Composition**: expand social, environmental economic indicators of preparedness & resiliency
- **Grouping & weighting**: use empirical methods for internal consistency, discriminant power
- **Scaling**: reflect distributional properties
- **Comparisons**: address accuracy and uncertainty
- **Trending**: apply new methods/measures retrospectively
## 2016 Changes in Measure Set

- 42 measures eliminated due to data periodicity >3 years
- 29 measures eliminated due to poor construct validity
- 22 measures respecified to improve construct validity
- 8 newly added measures

<table>
<thead>
<tr>
<th>Domain</th>
<th>2014 Alpha</th>
<th>2016 Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health security surveillance</td>
<td>0.377</td>
<td>0.712</td>
</tr>
<tr>
<td>Community planning &amp; engagement</td>
<td>0.382</td>
<td>0.631</td>
</tr>
<tr>
<td>Incident &amp; information management</td>
<td>0.455</td>
<td>0.734</td>
</tr>
<tr>
<td>Healthcare delivery</td>
<td>0.354</td>
<td>0.596</td>
</tr>
<tr>
<td>Countermeasure management</td>
<td>0.231</td>
<td>0.654</td>
</tr>
<tr>
<td>Environmental/occupational health</td>
<td>0.546</td>
<td>0.749</td>
</tr>
</tbody>
</table>

Construct Validity

Current Index Structure and Methodology

- 134 individual measures
  - Weighted average
- 19 subdomains
  - Weighted average
- 6 domains
  - Weighted average
- State overall values
  - Unweighted average
- National overall values

- Normalized to 0-10 scale using min-max scaling to preserve distributions
- Imputations based on multivariate longitudinal models
- Empirical weights based on Delphi expert panels
- Bayesian credible intervals reflect sampling and measurement error
- Annual estimates for 2013, 2014 and 2015
1. National preparedness trended upward in most functional areas during 2013-15, except in environmental health and healthcare delivery.
2. Preparedness improved in most states during 2013-15, but significant geographic differences remain.
3. Preparedness levels improved by an average of 3.6% between 2013 and 2015. Individual state trends ranged from a 9.1% improvement to a 3.5% decline.
4. Improvements in preparedness occurred across the U.S. in both above-average and below-average states. However, some below-average states continued to lose ground.
5. Gaps in preparedness between the highest and lowest states are large and persistent, and they have increased in environmental health and in healthcare delivery.
Caveats and cautions

- Imperfect measures & latent constructs
- Missing capabilities
- Timing and accuracy of underlying data sources
Next Steps

- Now: state preview period
- 2016 Public Release on April 26
  [www.nhspi.org](http://www.nhspi.org)
- National convening to showcase uses: Fall 2016
- Continued work to incorporate advances in measurement: ASPR, CDC, NIH, AHRQ, HP2020
- Additional analysis to understand causes and consequences of change
National Advisory Committee Members | 2015-16

1. Tom Inglesby, (Chair) UPMC Center for Health Security
2. Robert Burhans, Emergency Management Consultant
3. Anita Chandra, RAND
4. Ana-Marie Jones, Collaborating Agencies Responding to Disasters
5. Eric Klinenberg, New York University
6. Jeff Levi/Dara Lieberman, Trust for America’s Health
7. Nicole Lurie, Assistant Secretary for Preparedness and Response
8. Stephanie Lynch, Caddo Parish (LA) Commissioner
9. Suzet McKinney, Chicago Department of Public Health
10. Stephen Redd, CDC Office of Public Health Preparedness & Response
11. Richard Reed, American Red Cross (through 2/2016)
12. Martin Jose Sepulveda, IBM Corporation
13. Claudia Thompson, NIH National Institute of Environmental Health Sci.
14. John Wiesman, Washington State Secretary of Health
For More Information

National Program Office

Supported by The Robert Wood Johnson Foundation

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Blog:       publichealtheconomics.org

Systems for Action

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

What foundational services are needed to support collective actions in health?

Public health agency as chief health strategist for the system:

- Articulate population health needs & priorities
- Engage community stakeholders
- Plan with clear roles & responsibilities
- Recruit & leverage resources
- Develop and enforce policies
- Ensure coordination across sectors
- Promote equity and target disparities
- Support evidence-based practices
- Monitor and feed back results
- Ensure transparency & accountability: resources, results, ROI
What do we call a system that delivers a broad scope of foundational public health services through a dense network of multi-sector relationships?

COMPREHENSIVE
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

What do we know about the benefits of Comprehensive Public Health Systems?

- Greater concordance with national recommendations
  - IOM Core Functions
  - Essential Public Health Services
  - PHAB national accreditation standards
  - Foundational Public Health Services
- Fewer governmental resources per capita: more for less
- Over time, larger gains in population health
Prevalence of Public Health System Configurations 1998-2014

Scope
- High
- Mod
- Low

Centrality
- High
- Mod
- Low

Density
- High
- Mod
- Low

Comprehensive (High System Capital)

Conventional

Limited
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 public health activities
  - **Network density**: types of organizations contributing to each activity
  - **Centrality of effort**: contributed by designated local public health agency
  - **Quality**: perceived effectiveness of each activity

** Expanded sample of 500 communities<100,000 added in 2014 wave
Cluster and network analysis to identify “system capital”

Cluster analysis is used to classify communities into one of 7 categories of **public health system capital** based on:

- Scope of activities contributed by each type of organization
- **Density of connections** among organizations jointly producing public health activities
- **Degree centrality** of the local public health agency

Average public health system structure in 2014

Node size = degree centrality
Line size = % activities jointly contributed (tie strength)
Changes in system prevalence and coverage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive systems</td>
<td></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>32.7%</td>
<td>25.7%</td>
</tr>
<tr>
<td>% of population</td>
<td>25.0%</td>
<td>50.8%</td>
<td>47.7%</td>
<td>47.2%</td>
<td>36.6%</td>
</tr>
<tr>
<td>Conventional systems</td>
<td></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>40.1%</td>
<td>57.6%</td>
</tr>
<tr>
<td>% of population</td>
<td>46.9%</td>
<td>25.8%</td>
<td>36.3%</td>
<td>32.5%</td>
<td>47.3%</td>
</tr>
<tr>
<td>Limited systems</td>
<td></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>20.6%</td>
<td>16.7%</td>
</tr>
<tr>
<td>% of population</td>
<td>28.1%</td>
<td>23.4%</td>
<td>16.0%</td>
<td>19.6%</td>
<td>16.1%</td>
</tr>
</tbody>
</table>
Delivery of recommended public health activities 1998-2014

% of recommended activities performed

- Assessment (+5.6%)
- Policy/Planning (+15.8%)
- Total (+1.1%)
- Assurance (-18.4%)

# Delivery of recommended public health activities 1998-2014

<table>
<thead>
<tr>
<th>Public Health Activity</th>
<th>1998</th>
<th>2014</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Community health needs assessment</td>
<td>71.5%</td>
<td>86.0%</td>
<td>20.2%**</td>
</tr>
<tr>
<td>2  Behavioral risk factor surveillance</td>
<td>45.8%</td>
<td>70.2%</td>
<td>53.2%**</td>
</tr>
<tr>
<td>3  Adverse health events investigation</td>
<td>98.6%</td>
<td>100.0%</td>
<td>1.4%</td>
</tr>
<tr>
<td>4  Public health laboratory testing services</td>
<td>96.3%</td>
<td>96.5%</td>
<td>0.2%</td>
</tr>
<tr>
<td>5  Analysis of health status and health determinants</td>
<td>61.3%</td>
<td>72.8%</td>
<td>18.7%**</td>
</tr>
<tr>
<td>6  Analysis of preventive services utilization</td>
<td>28.4%</td>
<td>39.4%</td>
<td>38.8%**</td>
</tr>
<tr>
<td>7  Health information provision to elected officials</td>
<td>80.9%</td>
<td>84.8%</td>
<td>4.8%</td>
</tr>
<tr>
<td>8  Health information provision to the public</td>
<td>75.4%</td>
<td>83.8%</td>
<td>11.1%*</td>
</tr>
<tr>
<td>9  Health information provision to the media</td>
<td>75.2%</td>
<td>87.5%</td>
<td>16.3%**</td>
</tr>
<tr>
<td>10 Prioritization of community health needs</td>
<td>66.1%</td>
<td>82.3%</td>
<td>24.6%**</td>
</tr>
<tr>
<td>11 Community participation in health improvement planning</td>
<td>41.5%</td>
<td>67.7%</td>
<td>63.0%**</td>
</tr>
<tr>
<td>12 Development of community health improvement plan</td>
<td>81.9%</td>
<td>86.2%</td>
<td>5.2%</td>
</tr>
<tr>
<td>13 Resource allocation to implement community health plan</td>
<td>26.2%</td>
<td>43.2%</td>
<td>64.9%**</td>
</tr>
<tr>
<td>14 Policy development to implement community health plan</td>
<td>48.6%</td>
<td>57.5%</td>
<td>18.4%*</td>
</tr>
<tr>
<td>15 Communication network of health-related organizations</td>
<td>78.8%</td>
<td>84.8%</td>
<td>7.6%</td>
</tr>
<tr>
<td>16 Strategies to enhance access to needed health services</td>
<td>75.6%</td>
<td>50.2%</td>
<td>-33.6%**</td>
</tr>
<tr>
<td>17 Implementation of legally mandated public health activities</td>
<td>91.4%</td>
<td>92.4%</td>
<td>1.0%</td>
</tr>
<tr>
<td>18 Evaluation of public health programs and services</td>
<td>34.7%</td>
<td>38.4%</td>
<td>10.8%**</td>
</tr>
<tr>
<td>19 Evaluation of local public health agency capacity/performance</td>
<td>56.3%</td>
<td>55.0%</td>
<td>-2.4%</td>
</tr>
<tr>
<td>20 Implementation of quality improvement processes</td>
<td>47.3%</td>
<td>49.6%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Composite availability of assessment activities (1-6)</td>
<td>66.7%</td>
<td>77.6%</td>
<td>16.4%**</td>
</tr>
<tr>
<td>Composite availability of policy development activities (7-15)</td>
<td>60.2%</td>
<td>72.5%</td>
<td>20.4%</td>
</tr>
<tr>
<td>Composite availability of assurance activities (16-20)</td>
<td>64.4%</td>
<td>52.8%</td>
<td>-18.0%*</td>
</tr>
<tr>
<td>Composite availability of all activities (1-20)</td>
<td>63.8%</td>
<td>67.6%</td>
<td>6.0%*</td>
</tr>
</tbody>
</table>
Variation in public health service delivery

National Longitudinal Survey of Public Health Systems

Percent of activities performed

Percent of U.S. communities
Equity in Delivery
Delivery of recommended public health activities, 2006-14

Quintiles of communities

% of recommended activities performed

Q1 Q2 Q3 Q4 Q5

-40% -20% 0% 20% 40% 60% 80% 100%

2014

△ 2006-14

2014

△ 2006-14

2014

△ 2006-14

2014

△ 2006-14

2014

△ 2006-14

2014

△ 2006-14

2014

△ 2006-14
## Organizational contributions to recommended public health activities, 1998-2014

<table>
<thead>
<tr>
<th>Type of Organization</th>
<th>1998</th>
<th>2006</th>
<th>2012</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local public health agency</td>
<td>60.7%</td>
<td>66.5%</td>
<td>62.0%</td>
<td>67.4%</td>
</tr>
<tr>
<td>Other local govt agencies</td>
<td>31.8%</td>
<td>50.8%</td>
<td>26.3%</td>
<td>32.7%</td>
</tr>
<tr>
<td>State public health agency</td>
<td>46.0%</td>
<td>45.3%</td>
<td>36.4%</td>
<td>34.0%</td>
</tr>
<tr>
<td>Other state govt agencies</td>
<td>17.2%</td>
<td>16.4%</td>
<td>13.0%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Federal agencies</td>
<td>7.0%</td>
<td>12.0%</td>
<td>8.7%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Hospitals</td>
<td>37.3%</td>
<td>41.1%</td>
<td>39.3%</td>
<td>47.2%</td>
</tr>
<tr>
<td>Physician practices</td>
<td>20.2%</td>
<td>24.1%</td>
<td>19.5%</td>
<td>18.0%</td>
</tr>
<tr>
<td>Community health centers</td>
<td>12.4%</td>
<td>28.6%</td>
<td>26.9%</td>
<td>28.3%</td>
</tr>
<tr>
<td>Health insurers</td>
<td>8.6%</td>
<td>10.0%</td>
<td>9.8%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Employers/business</td>
<td>25.5%</td>
<td>16.9%</td>
<td>13.4%</td>
<td>15.0%</td>
</tr>
<tr>
<td>Schools</td>
<td>30.7%</td>
<td>27.6%</td>
<td>24.9%</td>
<td>24.7%</td>
</tr>
<tr>
<td>Universities/colleges</td>
<td>15.6%</td>
<td>21.6%</td>
<td>21.2%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Faith-based organizations</td>
<td>24.0%</td>
<td>19.2%</td>
<td>15.7%</td>
<td>16.8%</td>
</tr>
<tr>
<td>Other nonprofits</td>
<td>31.9%</td>
<td>34.2%</td>
<td>31.6%</td>
<td>33.6%</td>
</tr>
<tr>
<td>Other organizations</td>
<td>8.5%</td>
<td>8.8%</td>
<td>5.4%</td>
<td>5.4%</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
Health and economic impact of comprehensive systems

Fixed Effects and IV Estimates: Effects of Comprehensive System Capital on Mortality and Spending

Models also control for racial composition, unemployment, health insurance coverage, educational attainment, age composition, and state and year fixed effects.

N=779 community-years  **p<0.05   *p<0.10
Making the case for equity: larger gains in low-resource communities

Effects of Comprehensive Public Health Systems in Low-Income vs. High-Income Communities

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

- Mortality
- Medical costs
- 95% CI
Comprehensive systems do more with less

![Bar chart showing expenditures per capita and % of recommended activities performed for different types of delivery systems: Comprehensive, Conventional, Limited, and Very limited.](chart.png)
Assessing public health system change under PHNCl

- Pre and Post surveys with the National Longitudinal Survey of Public Health Systems
- Comparative feedback reports of results
- Comparison of PHNCl sites with non-participating communities
- Qualitative interviews to explore more granular measures of system innovation and change
For more information

• Survey instrument
  http://works.bepress.com/glen_mays/38/

• Defining Comprehensive Public Health Delivery Systems
  https://works.bepress.com/glen_mays/198/

• Original methodology: Milbank Quarterly 2010
  http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2888010/

• Most recent analysis of health/economic benefits of comprehensive systems: AJPH 2015

• Example customized report
  http://works.bepress.com/glen_mays/67/
Systems for Action
National Coordinating Center
Systems and Services Research to Build a Culture of Health

Supported by The Robert Wood Johnson Foundation

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Journal: www.FrontiersinPHSSR.org
Archive: works.bepress.com/glen_mays
Blog: publichealtheconomics.org
## Appendix: specifications

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specific Measures</th>
<th>Threshold Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of recommended activities</td>
<td>Activities that are performed in the community</td>
<td>&gt;75%</td>
</tr>
<tr>
<td>Organizational contributions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government agency sector</td>
<td>Activities with state agency contributions</td>
<td>&gt;50%</td>
</tr>
<tr>
<td></td>
<td>Activities with local agency contributions (other than public health agency)</td>
<td>&gt;46%</td>
</tr>
<tr>
<td></td>
<td>Activities with federal agency contributions</td>
<td>&gt;11%</td>
</tr>
<tr>
<td>Organizational contributions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health care provider sector</td>
<td>Activities with hospital contributions</td>
<td>&gt;50%</td>
</tr>
<tr>
<td></td>
<td>Activities with physician organization contributions</td>
<td>&gt;31%</td>
</tr>
<tr>
<td></td>
<td>Activities with FQHC/CHC contributions</td>
<td>&gt;15%</td>
</tr>
<tr>
<td>Organizational contributions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community institution sector</td>
<td>Activities with school contributions</td>
<td>&gt;21%</td>
</tr>
<tr>
<td></td>
<td>Activities with university contributions</td>
<td>&gt;26%</td>
</tr>
<tr>
<td></td>
<td>Activities with other nonprofit contributions</td>
<td>&gt;46%</td>
</tr>
<tr>
<td>Organizational contributions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private sector</td>
<td>Activities with health insurer contributions</td>
<td>&gt;11%</td>
</tr>
<tr>
<td></td>
<td>Activities with employer contributions</td>
<td>&gt;15%</td>
</tr>
<tr>
<td>Local public health agency effort</td>
<td>Activities in which the local public health agency contributes most or all of the effort</td>
<td>&gt;50%</td>
</tr>
</tbody>
</table>

*Proportion of the 20 recommended activities for which the attribute is reported.
Appendix: specifications

Table 2: Definitions for Comprehensive Public Health System Configurations

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated Comprehensive</td>
<td>Exceeds availability threshold AND exceeds organizational contribution thresholds in at least two different organizational sectors AND exceeds local agency effort threshold</td>
</tr>
<tr>
<td>Distributed Comprehensive</td>
<td>Exceeds availability threshold AND exceeds organizational contribution thresholds in at least two different organizational sectors BUT does not exceed local agency effort threshold</td>
</tr>
<tr>
<td>Independent Comprehensive</td>
<td>Exceeds availability threshold AND exceeds local agency effort threshold BUT does not exceed organizational contribution thresholds in at least two organizational sectors</td>
</tr>
</tbody>
</table>