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Measuring Multi-Sector Contributions to Public Health Delivery Systems & Population Health

Glen P. Mays, *University of Kentucky*

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Center for Public Health Systems and Services Research

Systems for Action
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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

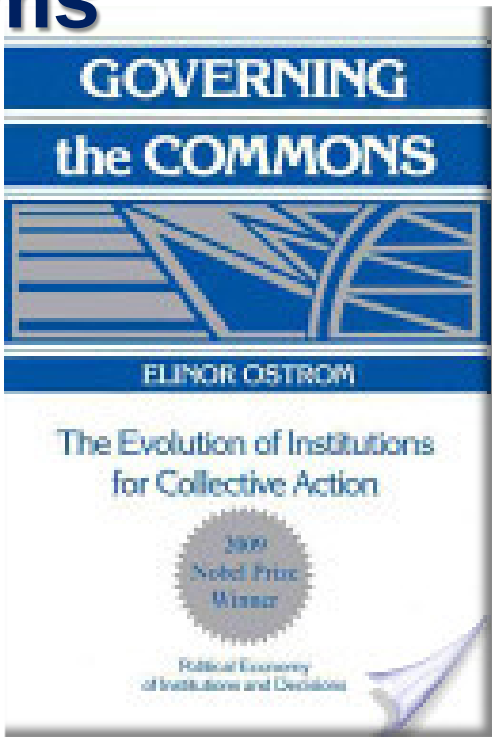
  - Resource commitments

  - Infrastructure requirements

Mays GP. Governmental public health and the economics of adaptation to population health strategies. ***National Academy of Medicine Discussion Paper.*** 2014. http://nam.edu/wp-content/uploads/2015/06/EconomicsOfAdaptation.pdf

Fundamental challenge: overcoming collective action problems

- Incentive compatibility → public goods
- Concentrated costs & diffuse benefits
- Time lags: costs vs. improvements
- Uncertainties about what works
- Asymmetries in information
- Difficulties measuring progress

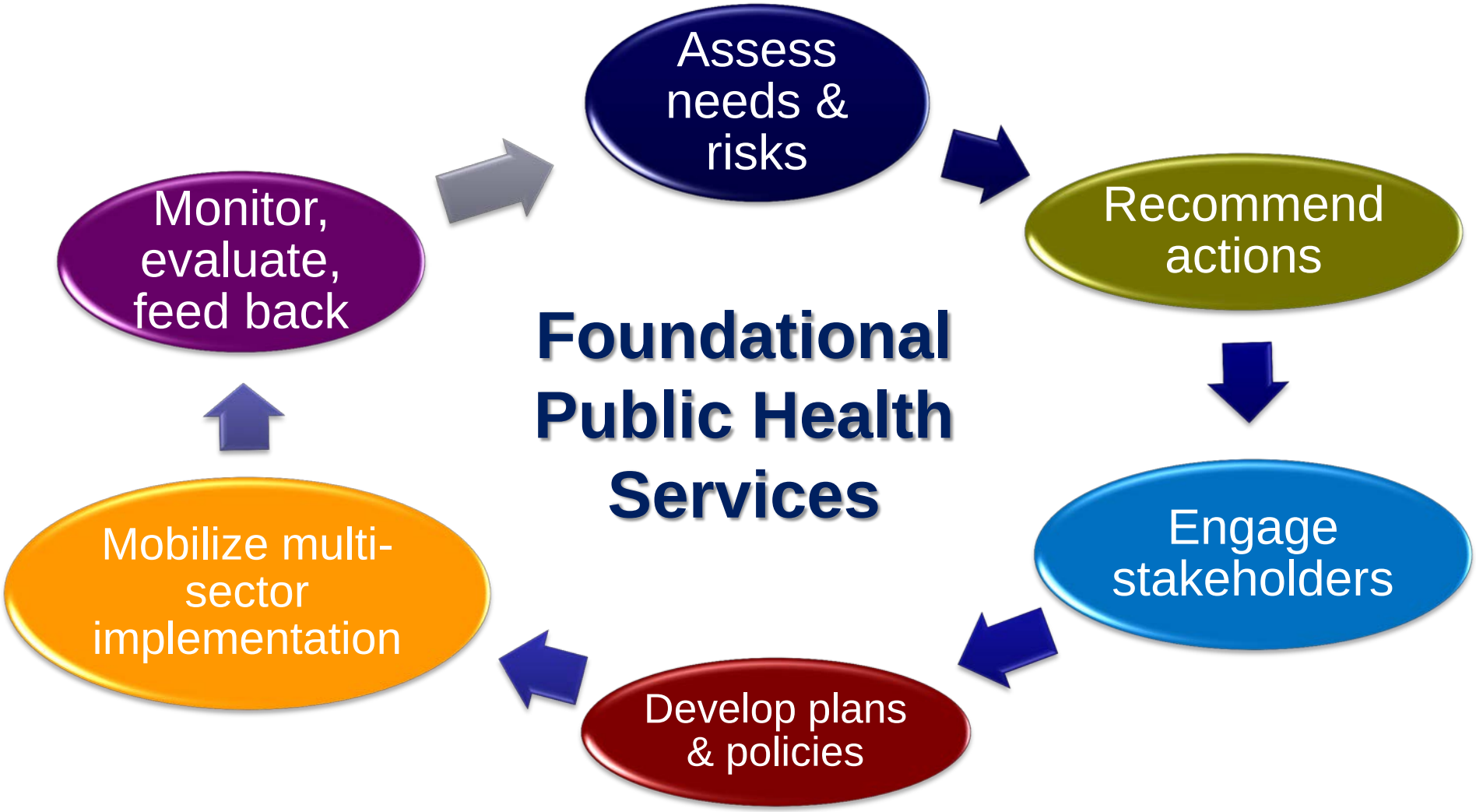


Ostrom E. 1994

- Weak and variable institutions & infrastructure
- Imbalance: resources vs. needs
- Stability & sustainability of funding

Ostrom E. Collective action and the evolution of social norms. ***Journal of Economic Perspectives*** 14(3): 137-58.

Can public health solve collective action problems?

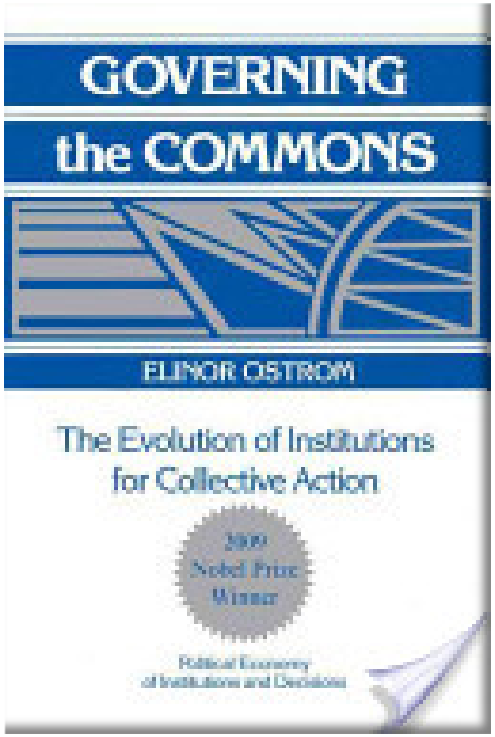


National Academy of Sciences Institute of Medicine: ***For the Public's Health: Investing in a Healthier Future.*** Washington, DC: National Academies Press; 2012.

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

Public health as chief health strategist for the delivery system:

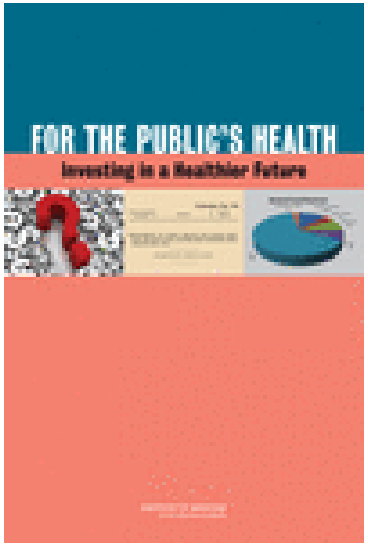
- Articulate population health needs & priorities
- Engage community stakeholders
- Plan with clear roles & responsibilities
- Recruit & leverage resources
- Develop and enforce policies
- Ensure coordination across sectors
- Promote equity and target disparities
- Support evidence-based practices
- Monitor and feed back results
- Ensure transparency & accountability: resources, results, ROI



How do we deploy foundational public health services across the US?

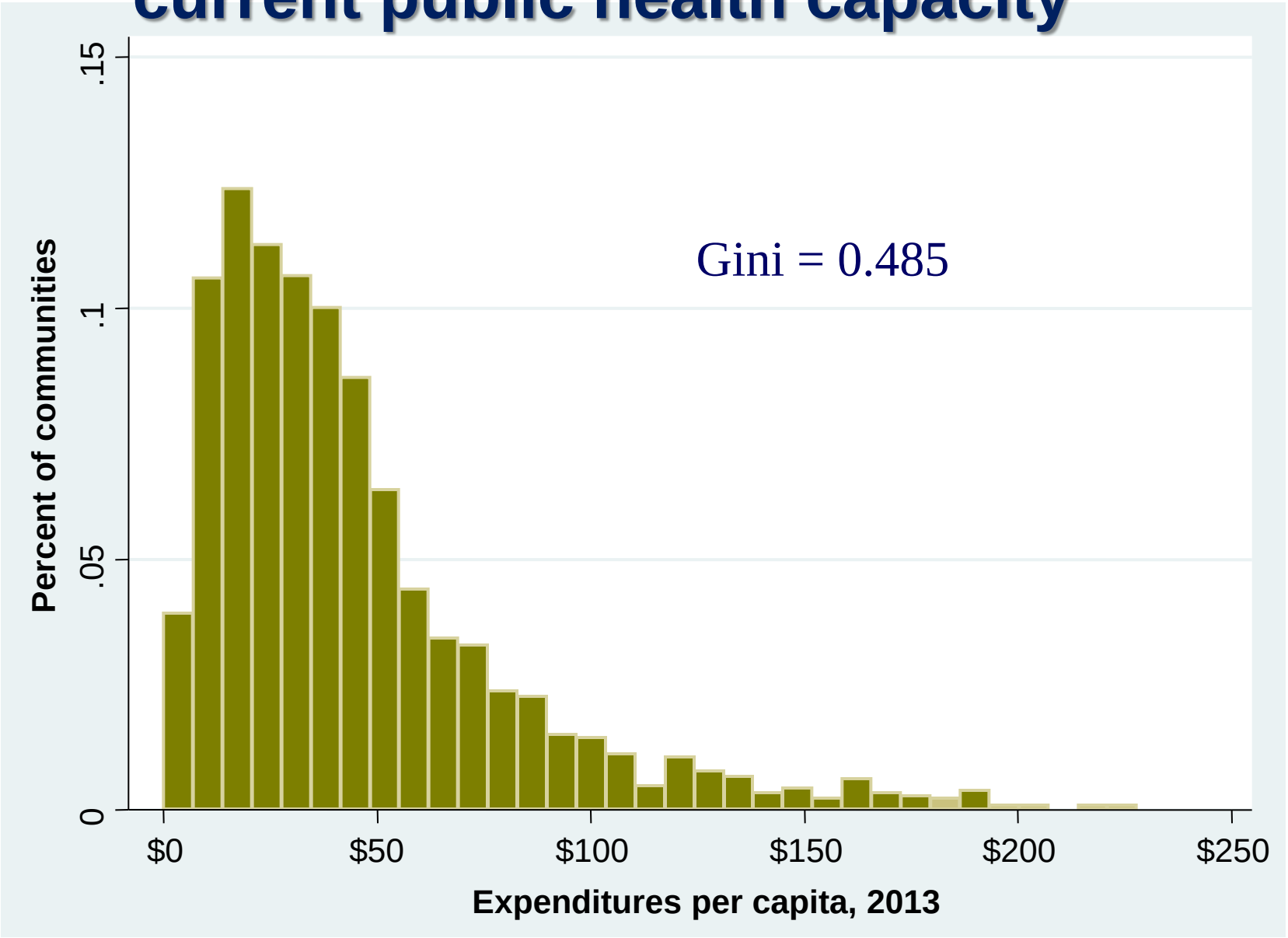
2012 Institute of Medicine Recommendations

- Identify the components and **costs of a minimum package** of public health services
  - Foundational capabilities
  - Basic programs
- Create shared **federal-state financing**
- Identify how to implement these services in every U.S. state and community
- Expand **research on costs and effects** of public health delivery

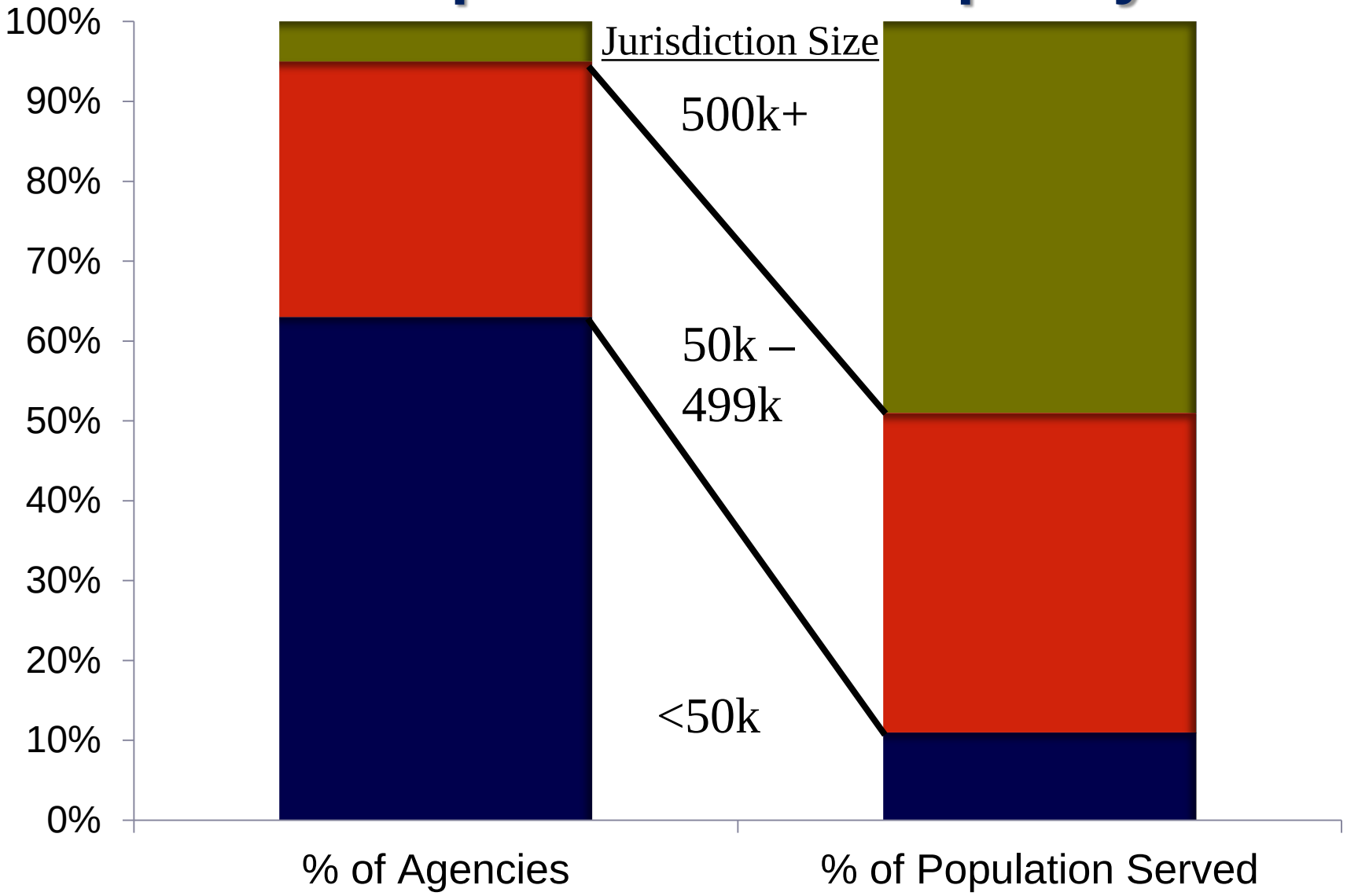


Institute of Medicine. ***For the Public's Health: Investing in a Healthier Future***. Washington, DC: National Academies Press; 2012.

A fundamental problem: wide variation in current public health capacity



A fundamental problem: wide variation in current public health capacity



Source: 2013 NACCHO National Profile of Local Health Departments Survey

Research questions of interest

- Which organizations contribute to the implementation of foundational public health activities in local communities?
- How do these contributions change over time?

  Recession | Recovery | ACA implementation

- What are the health and economic effects attributable to these changes?

Data: public health delivery systems

National Longitudinal Survey of Public Health Systems

- Cohort of 360 communities with at least 100,000 residents
- Followed over time: 1998, 2006, 2012, 2014**, 2016
- Local public health officials report:
  - ***Scope***: availability of 20 recommended public 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

Data: community & market characteristics

- **Area Health Resource File**: physician, hospital and CHC supply; population size and demographics, socioeconomic status, racial/ethnic composition, health insurance coverage
- **NACCHO Profile data**: public health agency institutional and financial characteristics
- **CMS Cost Report & Impact File**: hospital ownership, market share, uncompensated care
- **CDC Compressed Mortality File**: Cause-specific death rates by county
- **Dartmouth Atlas:** area-level medical care spending/capita

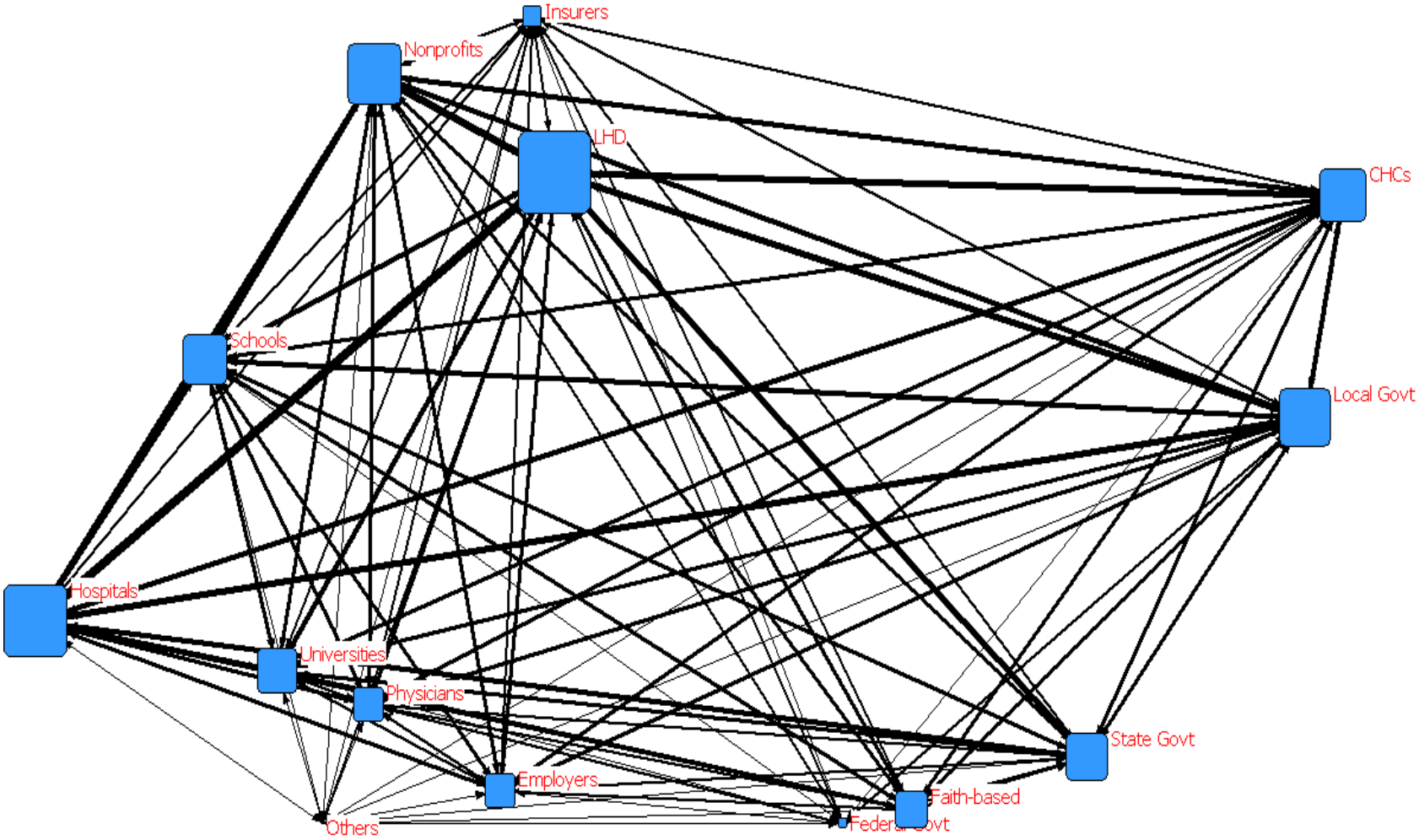
Cluster and network analysis to identify "system capital"

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

Mays GP et al. Understanding the organization of public health delivery systems: an empirical typology. *Milbank Q.* 2010;88(1):81–111.

Average public health system structure in 2014



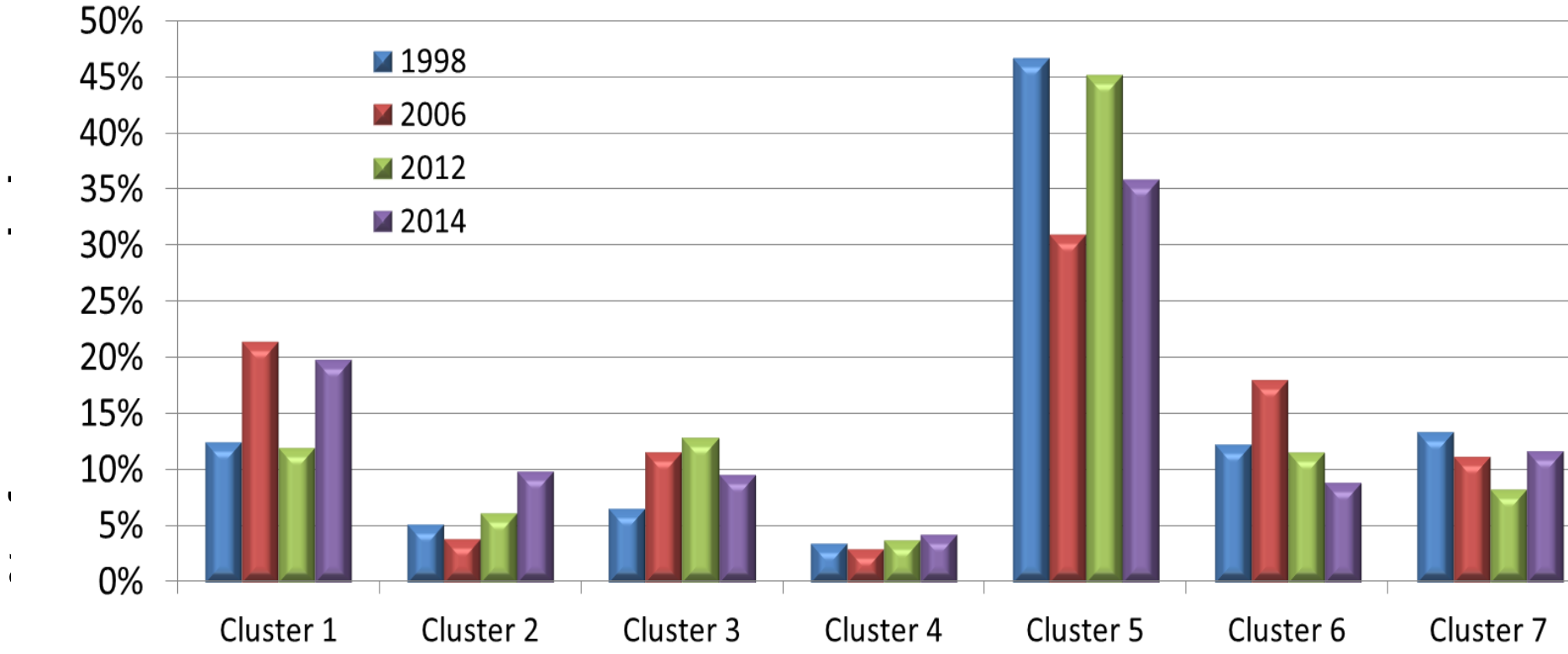
Node size = degree centrality

Line size = % activities jointly contributed (tie strength)

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

Prevalence of Public Health System Configurations 1998-2014



	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
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

One of RWJF's 41 Culture of Health National Metrics

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

http://www.cultureofhealth.org/en/integrated-systems/access.html

Changes in system prevalence and coverage

System Capital Measures	1998	2006	2012	2014	2014 (<100k)
Comprehensive systems					
% of communities	**24.2%**	**36.9%**	**31.1%**	**32.7%**	**25.7%**
% of population	**25.0%**	**50.8%**	**47.7%**	**47.2%**	**36.6%**
Conventional systems					
% of communities	50.1%	33.9%	49.0%	40.1%	57.6%
% of population	46.9%	25.8%	36.3%	32.5%	47.3%
Limited systems					
% of communities	25.6%	29.2%	19.9%	20.6%	16.7%
% of population	28.1%	23.4%	16.0%	19.6%	16.1%

Estimating delivery system effects

Dependent variables:

- ***Health outcomes***: premature mortality(<75), infant mortality, death rates for heart disease, diabetes, cancer, influenza
- ***Resource use***: Local governmental expenditures for public health activities

Independent variables:

- ***Network characteristics***: network density, organizational degree centrality, betweenness centrality
- ***Delivery system structure***: comprehensive, conventional, or limited public health delivery systems

Estimating delivery system effects

Statistical Model

- Log-transformed Generalized Linear Latent and Mixed Models
- Account for repeated measures and clustering of public health jurisdictions within states
- Instrumental variables address endogeneity of system structures

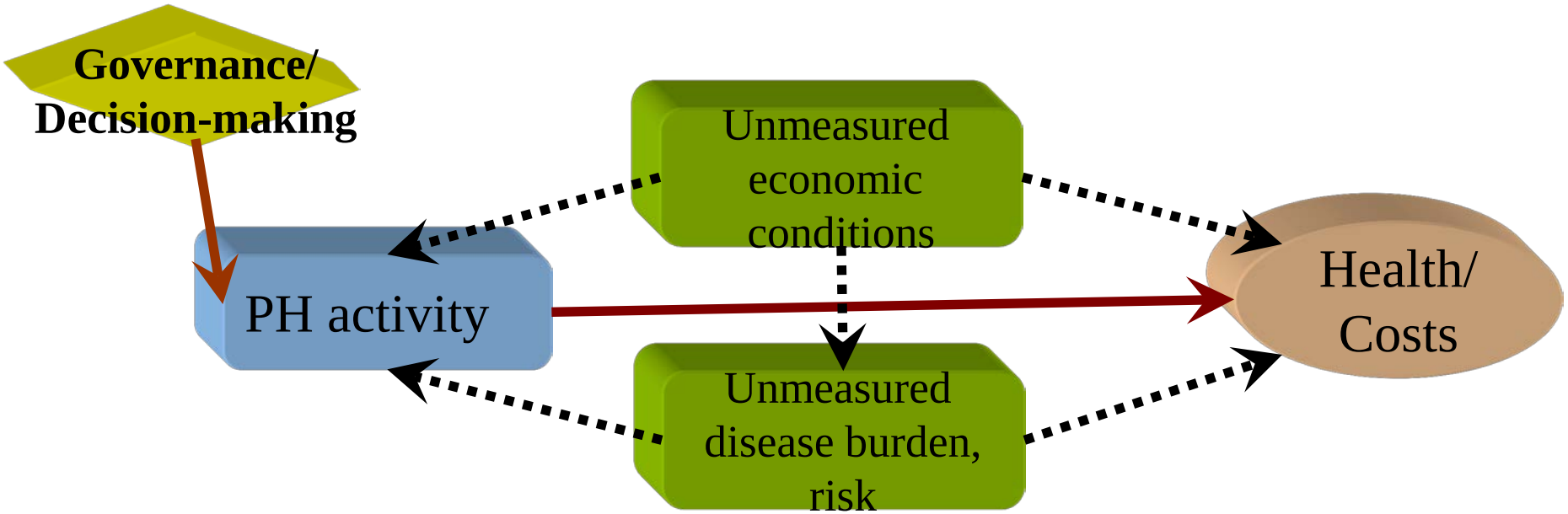
$$\Pr(System_{z,ijt}=1) = \sum \alpha_z Governance_{ijt} + \beta_1 Agency_{ijt} + \beta_2 Community_{ijt} + \mu_j + \varphi_t + \varepsilon_{ijt}$$

$$Ln(Outcomes|Cost_{ijt}) = \sum \alpha_z (\widehat{System}_z)_{ijt} + \beta_1 Agency_{ijt} + \beta_2 Community_{ijt} + \mu_j + \varphi_t + \varepsilon_{ijt}$$

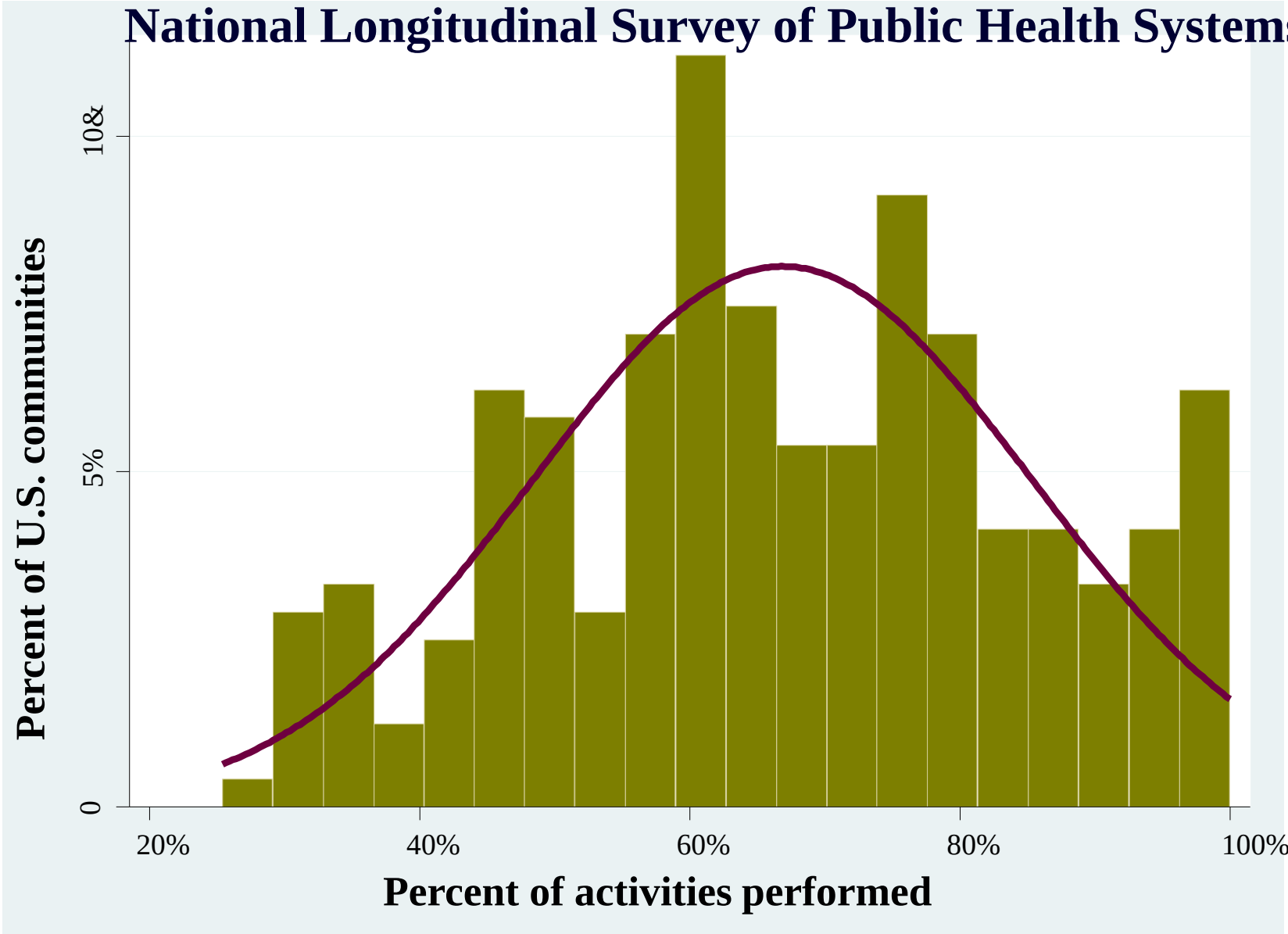
All models control for type of jurisdiction, population size and density, metropolitan area designation, income per capita, unemployment, racial composition, age distribution, educational attainment, and physician availability.

Estimating delivery system effects: IV estimation

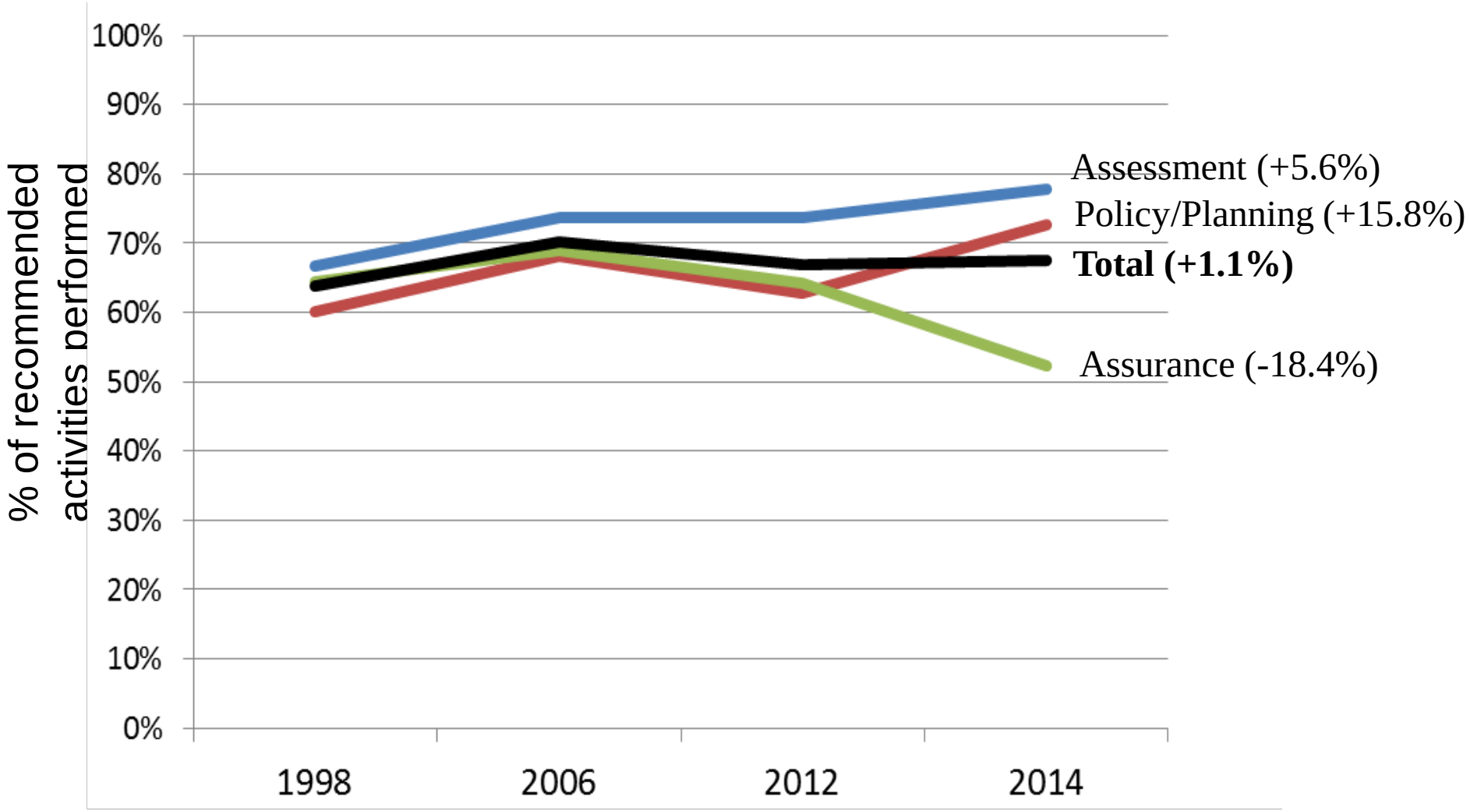
- Identify exogenous sources of variation in system activities that are unrelated to outcomes
  - Governance structures: local boards of health
  - Decision-making authority: agency, board, local, state
- Controls for unmeasured factors that jointly influence activities and outcomes



Variation in public health service delivery



Delivery of recommended public health activities 1998-2014

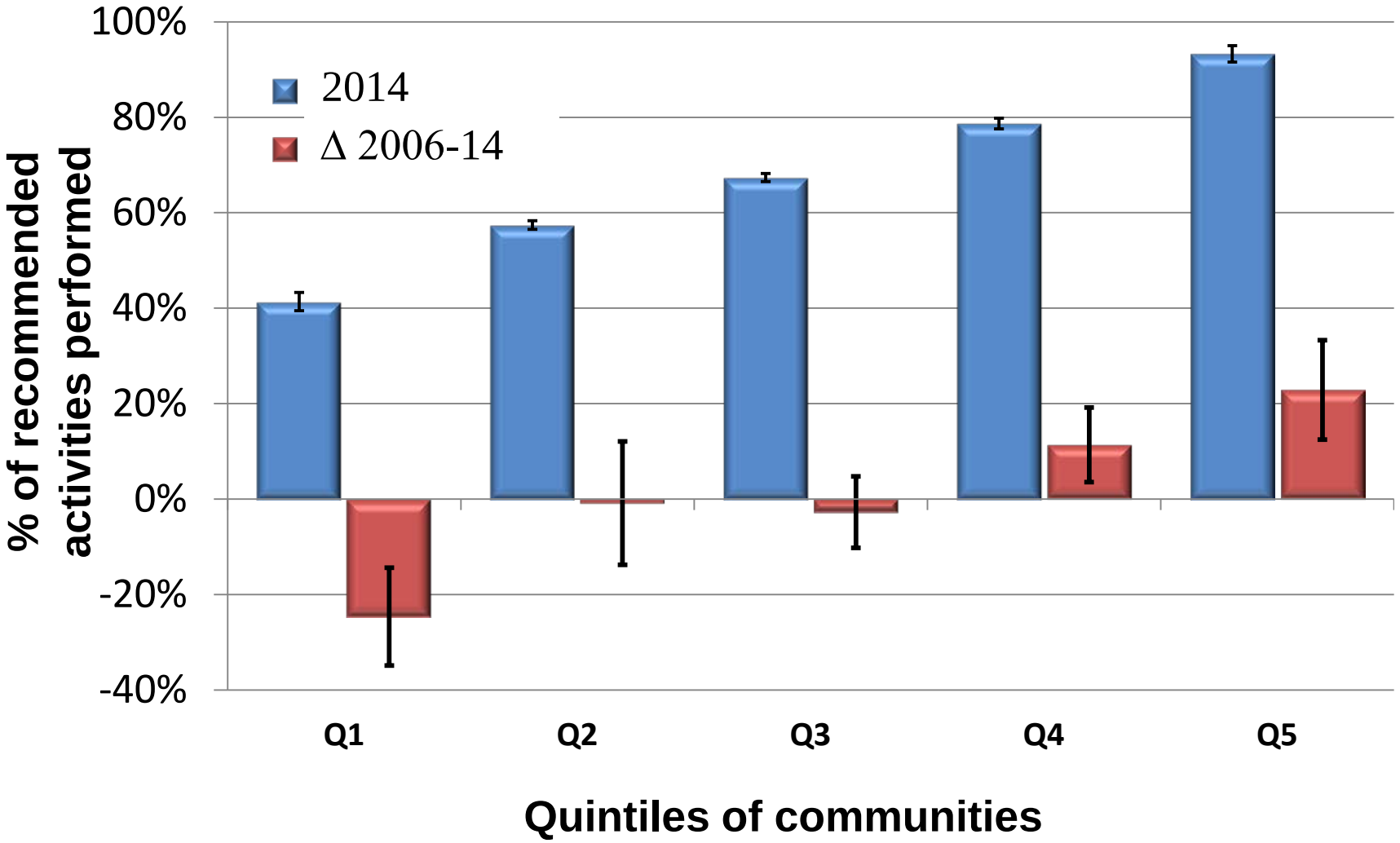


Delivery of recommended public health activities 1998-2014

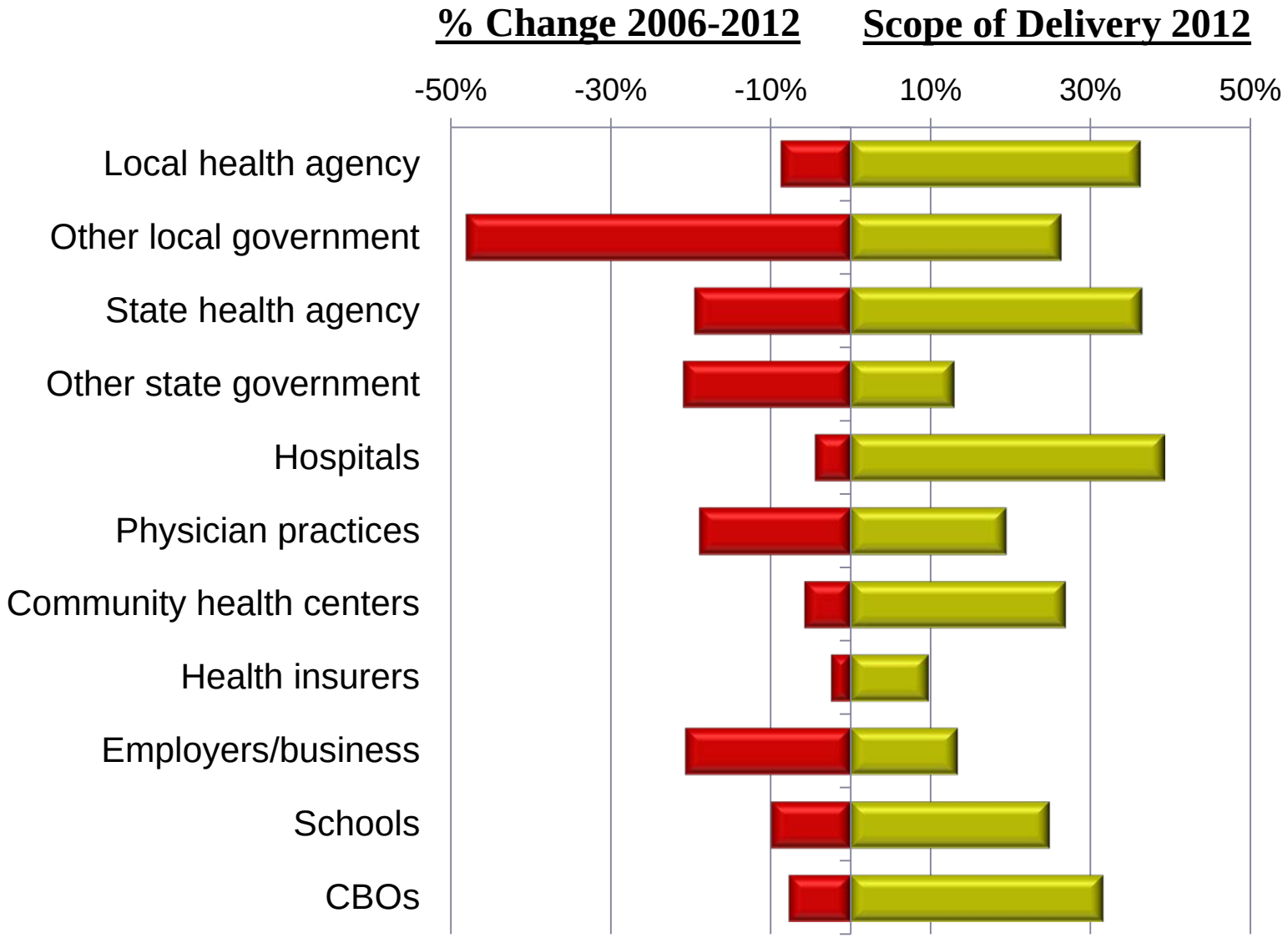
	Public Health Activity	1998	2014	% Change
1	Community health needs assessment	71.5%	86.0%	20.2%**
2	Behavioral risk factor surveillance	45.8%	70.2%	53.2%**
3	Adverse health events investigation	98.6%	100.0%	1.4%
4	Public health laboratory testing services	96.3%	96.5%	0.2%
5	Analysis of health status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

Equity in Delivery

Delivery of recommended public health activities, 2006-14



Changes in intensive and extensive margins during the Great Recession



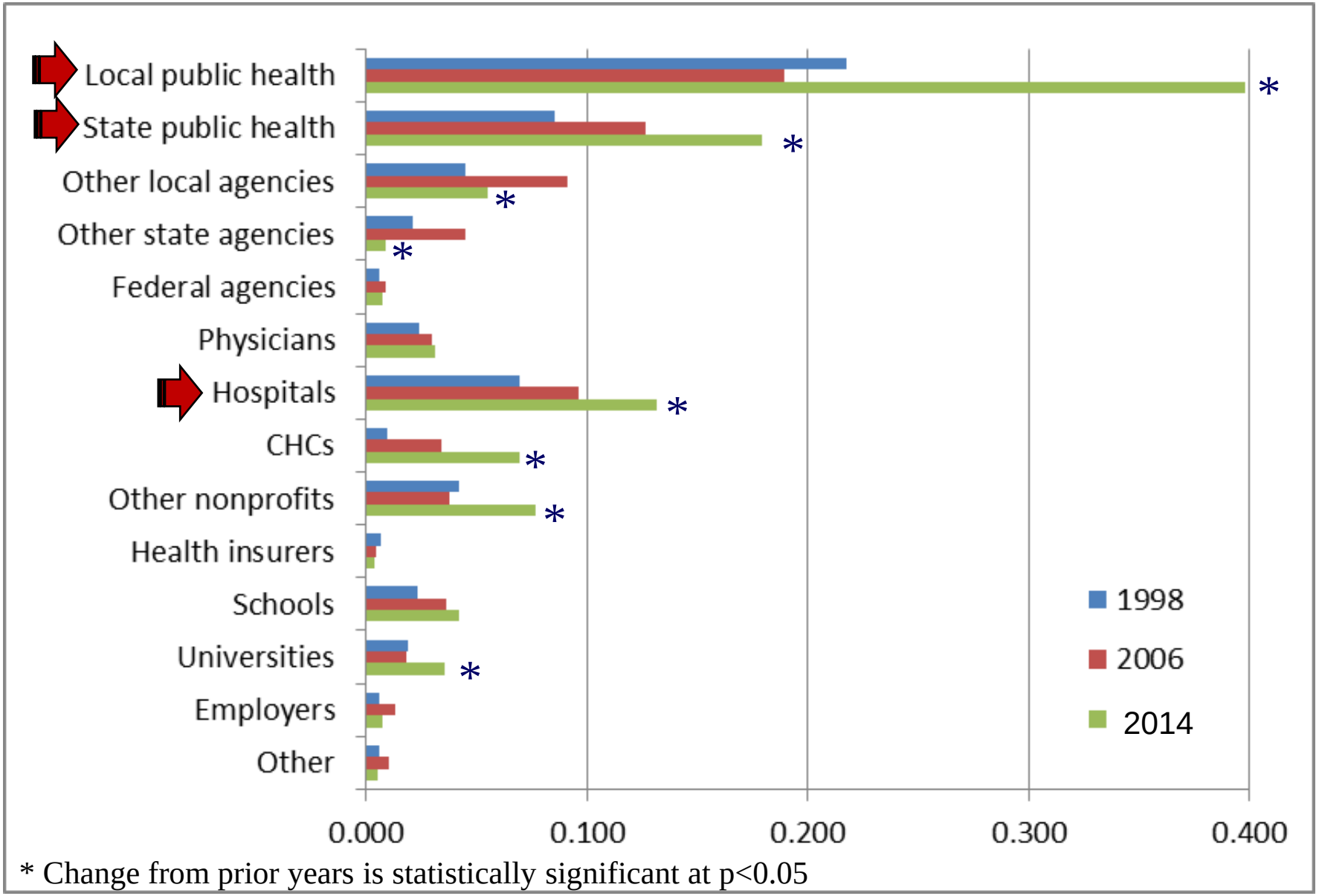
National Longitudinal Survey of Public Health Systems, 2012

Organizational contributions to recommended public health activities, 1998-2014

% of recommended activities performed

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

Bridging capital in public health delivery systems
Trends in betweenness centrality



* Change from prior years is statistically significant at $p<0.05$

Estimating health & economic impact: IV estimation

- Identify exogenous sources of variation in public health activities that are unrelated to outcomes
  - Governance structures: local boards of health
  - Decision-making authority: agency, board, local, state
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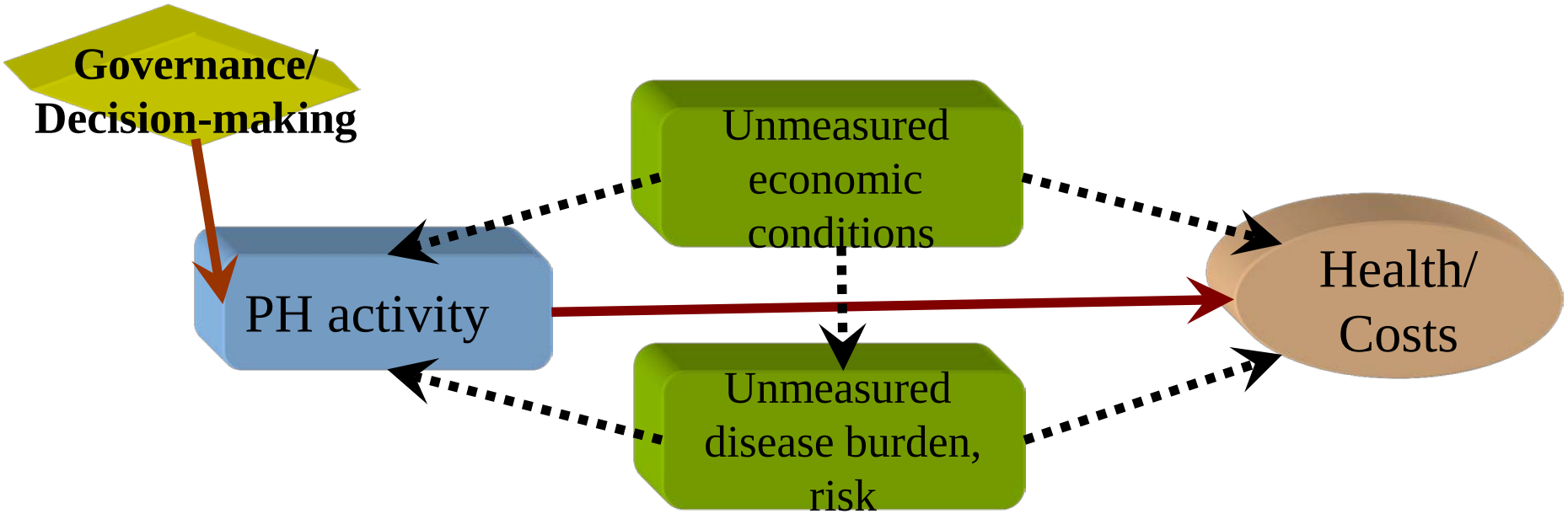


Determinants of Public Health System Comprehensiveness: Local IVs

Governance/Decision Authority	Elasticity Coefficient	95% CI
Governed by local board of health	0.131**	(0.061, 0.201)
State hires local PH agency head†	-0.151*	(-0.318, 0.018)
Local board approves local PH budget	0.388***	(0.576, 0.200)
State approves local PH budget†	-0.308**	(-0.162, -0.454)
Local govt sets local PH fees	0.217**	(0.101, 0.334)
Local govt imposes dedicated PH taxes	0.190**	(0.044, 0.337)
Local board can request local PH levy	0.120**	(0.246, 0.007)

$F=16.4 \quad p<0.001$

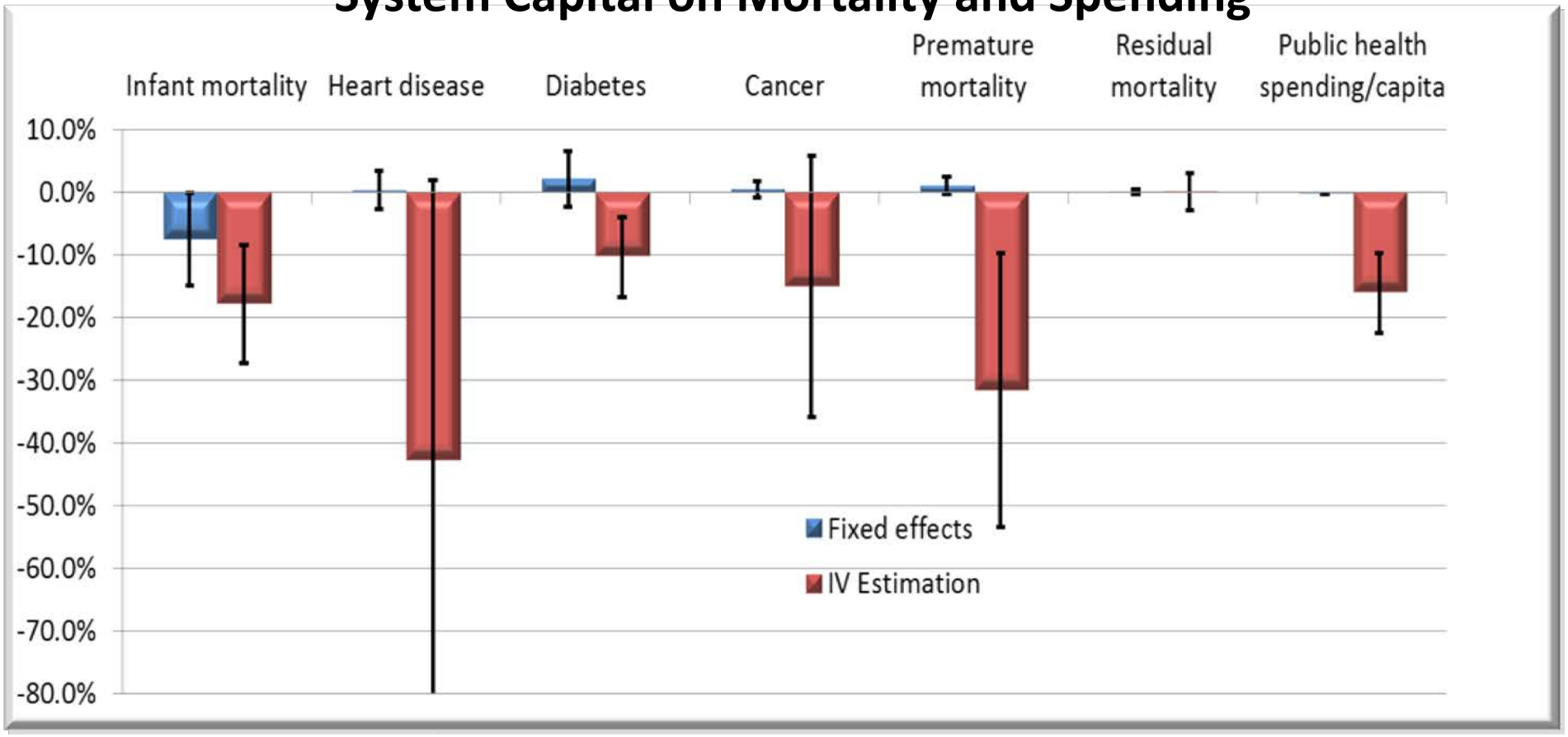
log regression estimates controlling for community-level and state-level characteristics. *p<0.10 **p<0.05 ***p<0.01

†As compared to the local board of health having the authority.

Mays et al. HSR 2009

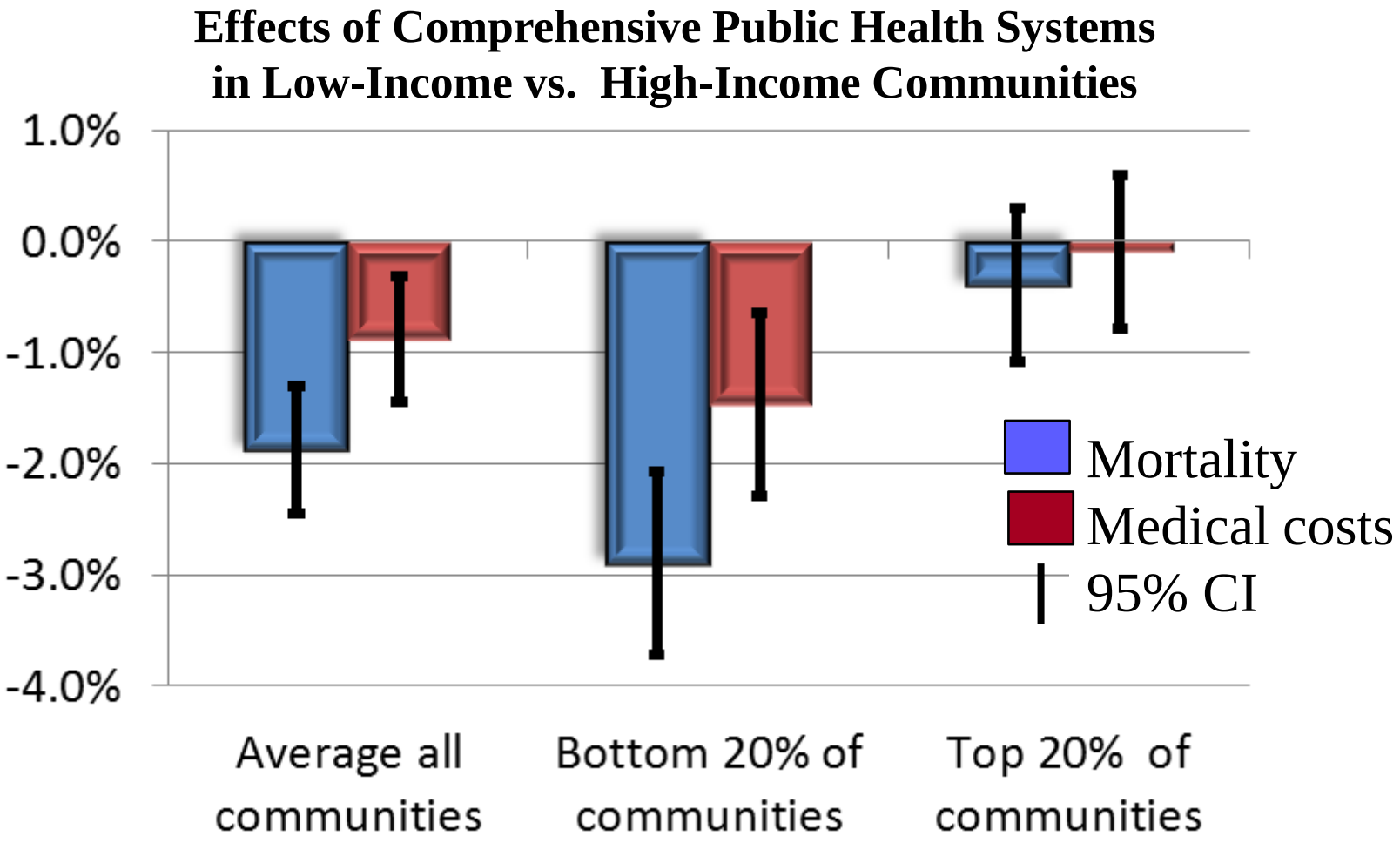
Health and economic impact of comprehensive systems

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



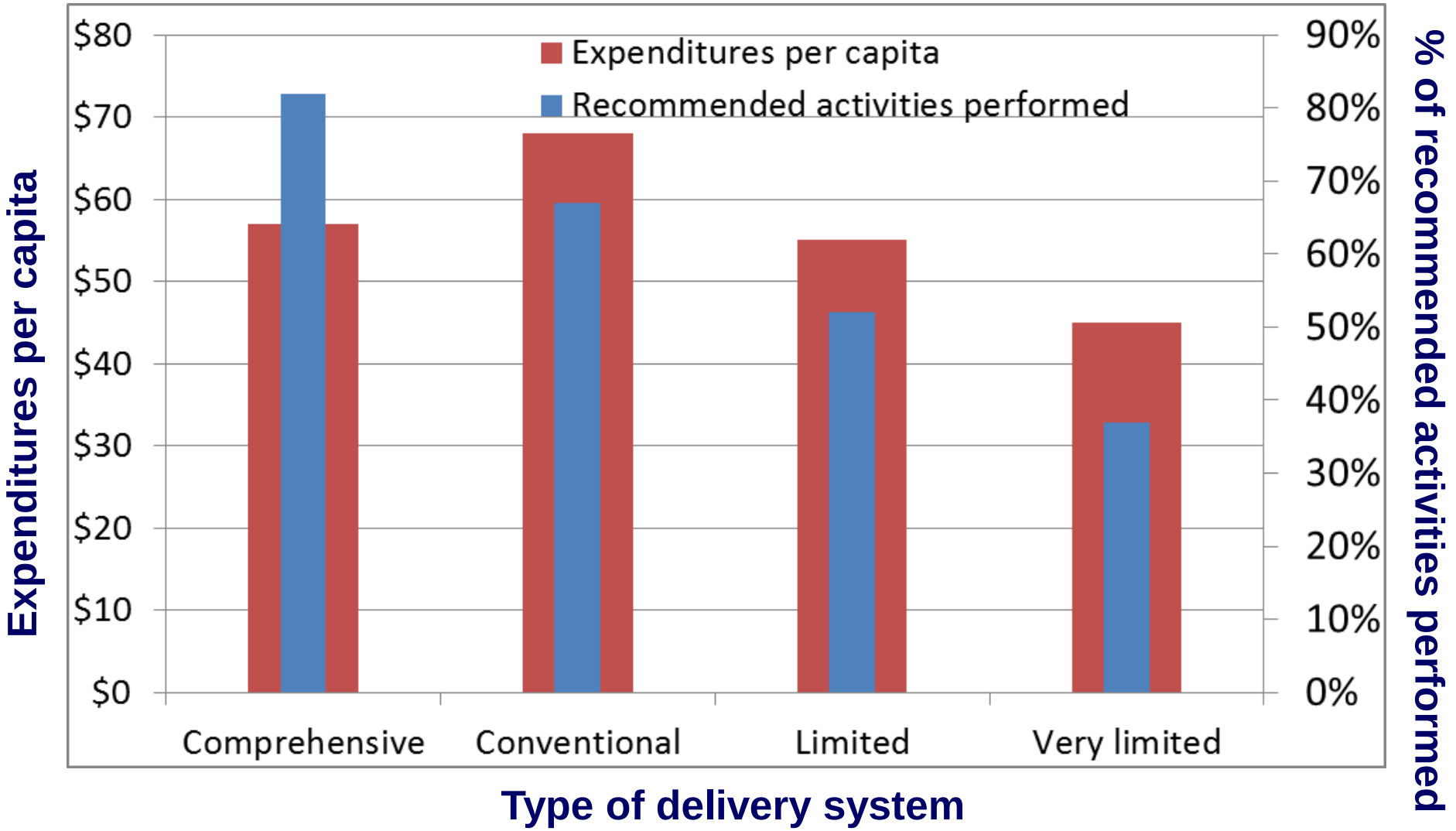
Models also control for racial composition, unemployment, health insurance coverage, educational attainment, age composition, and state and year fixed effects.
N=779 community-years **p<0.05 *p<0.10

Making the case for equity: larger gains in low-resource communities



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

Comprehensive systems do more with less



Conclusions

- Comprehensive and highly-integrated public health systems appear to offer considerable health and economic benefits over time.
  - 10-40% larger reductions in preventable mortality rates
  - 15% lower public health resource use
  - 6-9% lower medical costs
- Low-income communities are less likely to achieve comprehensive public health system capital, as are communities without local governance structures.
- But low-income communities benefit more from comprehensive systems where they exist
- Failure to account for endogenous network structure can lead to biased estimates of impact

Policy and Practice Implications

- Strategies to improve population health and health system efficiency should include initiatives to build public health system capital.
- Public health delivery has become increasingly reliant on nongovernmental & health care contributions
- Increased resiliency during economic shocks
- Heightened need for coordination, monitoring, and accountability
- Vulnerability to instability in contributions over time

Next Steps

Ongoing and future studies:

- ACA impact
- Hospital community benefit activities
- PHAB accreditation
- Economic mobility and public health

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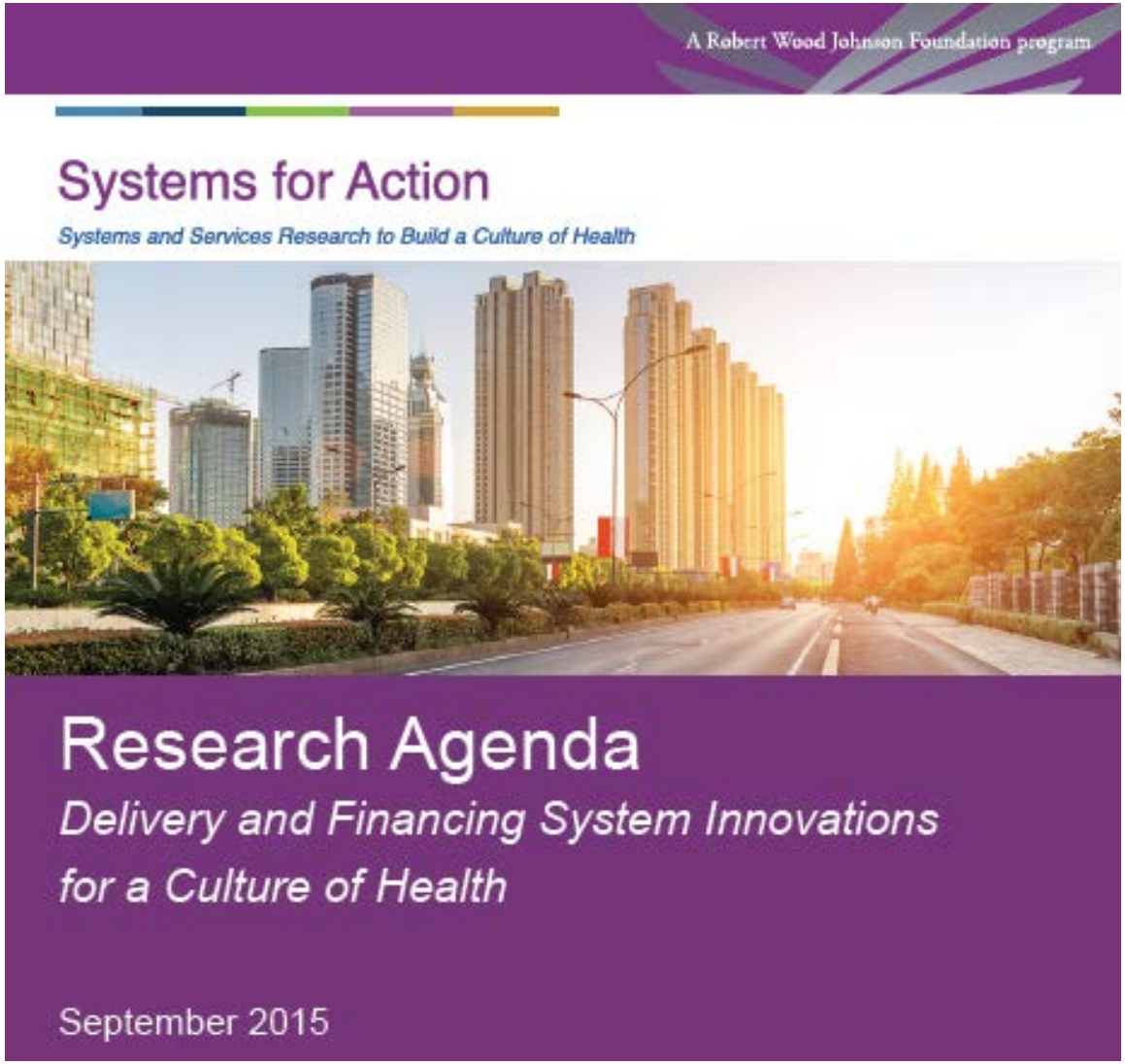
New research program focuses on delivery and financing system alignment



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Systems and Services Research to Build a Culture of Health

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