Preparedness and Public Health Systems Research: Examples from H1N1 and Beyond

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PUBLIC HEALTH
Practice-Based Research Networks

UNIVERSITY OF ARKANSAS MEDICAL SCIENCES

Agenda

- Review conceptual and methodological issues faced in studying public health system preparedness
- Examine examples of recent and current preparedness studies
- Discuss implications for ongoing and planned PBRN studies

I. Concepts and Frameworks

Fundamental empirical questions

- Which programs, interventions, policies (***mechanisms***)….
- Work best (***outcomes***)…
- In which institutional & community settings (***contexts***)…
- And why (**causal pathways, *interactions***)?

Pawson and Tilley 1997

Challenges in research on preparedness

- Thin evidence on preparedness mechanisms, “practices”
- Emergency events/outcomes are variable & rare
- Highly variable institutional and community contexts
- Measurement issues abound
  - Few established/validated measures of mechanisms
  - Measuring before, during, after events

Conceptualizing and Defining Public Health Emergency Preparedness

Nelson, Lurie, and Wasserman AJPH 2007

Preplanned and coordinated rapid-response capability

1. *Health risk assessment*. Identify the hazards and vulnerabilities (e.g., community health assessment, populations at risk, high-hazard industries, physical structures of importance) that will form the basis of planning.
2. *Legal climate*. Identify and address issues concerning legal authority and liability barriers to effectively monitor, prevent, or respond to a public health emergency.
3. *Roles and responsibilities*. Clearly define, assign, and test responsibilities in all sectors, at all levels of government, and with all individuals and ensure each group's integration.
4. *Incident Command System*. Develop, test, and improve decisionmaking and response capability using an integrated Incident Command System (ICS) at all response levels.
5. *Public engagement*. Educate, engage, and mobilize the public to be full and active participants in public health emergency preparedness.
6. *Epidemiology functions*. Maintain and improve the systems to monitor, detect, and investigate potential hazards, particularly those that are environmental, radiological, toxic, or infectious.
7. *Laboratory functions*. Maintain and improve the systems to test for potential hazards, particularly those that are environmental, radiological, toxic, or infectious.
8. *Countermeasures and mitigation strategies*. Develop, test, and improve community mitigation strategies (e.g., isolation and quarantine, social distancing) and countermeasure distribution strategies when appropriate.
9. *Mass health care*. Develop, test, and improve the capability to provide mass health care services.
10. *Public information and communication*. Develop, practice, and improve the capability to rapidly provide accurate and credible information to the public in culturally appropriate ways.
11. *Robust supply chain*. Identify critical resources for public health emergency response and practice and improve the ability to deliver these resources throughout the supply chain.

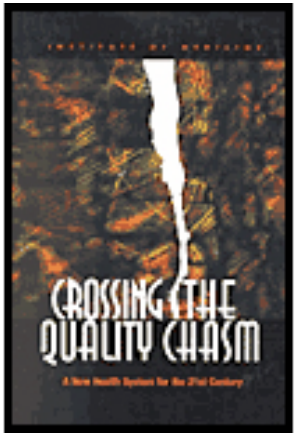
Expert and fully staffed workforce

1. *Operations-ready workers and volunteers*. Develop and maintain a public health and health care workforce that has the skills and capabilities to perform optimally in a public health emergency.
2. *Leadership*. Train, recruit, and develop public health leaders (e.g., to mobilize resources, engage the community, develop interagency relationships, communicate with the public).

Accountability and quality improvement

1. *Testing operational capabilities*. Practice, review, report on, and improve public health emergency preparedness by regularly using real public health events, supplemented with drills and exercises when appropriate.
2. *Performance management*. Implement a performance management and accountability system.
3. *Financial tracking*. Develop, test, and improve charge capture,[a] accounting, and other financial systems to track resources and ensure adequate and timely reimbursement.

Related concepts from health care performance measurement



- **Safe:** Avoid errors and injuries from care that is intended to help
- **Effective:** Match care to evidence; avoid overuse of ineffective care and underuse of effective care
- **Patient-Centered:** Honor and engage the individual and respect choice
- **Timely:** Deliver care at the right time for optimal effectiveness
- **Efficient:** Reduce waste
- **Equitable:** Close racial and ethnic gaps in receipt of care

Institute of Medicine 2001

Applying concepts to public health preparedness

To what extent does the PH system:

- Do the “right” things
  - Effective, evidence-based practices
  - Community-centered, culturally competent
  - Safety – for communities and responders
- For the “right” people
  - Reach to the population at risk
  - Equity in who is reached
- At the “right” times
  - Structures, plans, staff, exercises in place ***pre-event***
  - Timely response ***during event***
  - Recovery, evaluation, QI ***after event***
- At an “acceptable” cost (efficiency)
  - Direct financial cost
  - Opportunity cost – what else gets discontinued or delayed

Applying concepts to public health preparedness

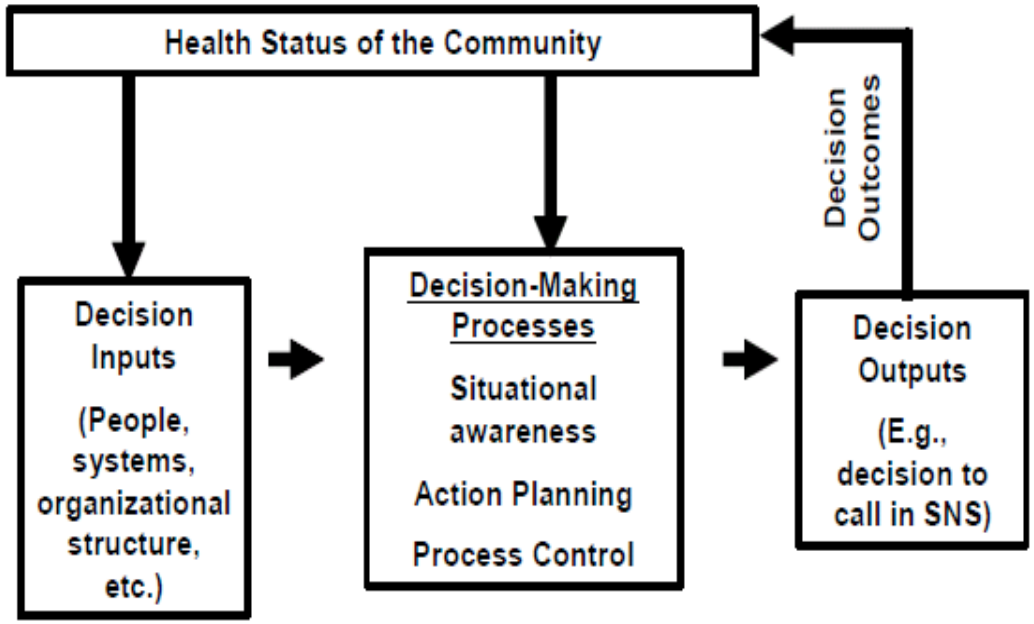


Figure 2.1
Public Health Emergency Decisionmaking as a Production Flow

Parker AM, Nelson C et al. Measuring crisis decision-making in public health emergencies. RAND Working Paper WR-577-DHHS. 2009.

II. Measurement Approaches

Prospective

Concurrent

Retrospective

Measuring preparedness prospectively

A Review of Instruments Assessing Public Health Preparedness

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Michael Stoto, PhD[a,b]
Marc Mendes, MD, MPH[c,d]
R. Burciaga Valdez, PhD[a]
Meghan E. Gallagher, BA[a]
Paul Halverson, DrPh, MPH[e]
Nicole Lurie, MD, MSPH[a,b]

	Assessment*										
Essential Public Health Service	1	2	3	4	5	6	7	8	9	10	11
#1 Monitor health problems to identify and solve community health problems											
Disease reporting: complete				■						■	
Timely			■	■						■	
Compliance										■	
Syndromic surveillance	■	■	■	■	■	■		■	■	■	■
Capacity to receive/analyze data	■	■	■	■	■			■	■	■	
Facility hazard assessment	■		■		■	■	■	■			
#2 Diagnose and investigate health problems and health hazards in the community											
Information system capacity:	■	■	■	■				■	■	■	
Health alert network	■	■	■	■				■		■	
24-hour/7-day capacity								■		■	
Active surveillance		■	■	■				■		■	
Epidemiologic capacity		■	■	■		■	■	■	■	■	
Laboratory capacity	■		■	■		■		■	■	■	
#3 Inform, educate, and empower people about health issues											
Reports on community health	■		■	■		■		■	■	■	
Information Officer			■		■			■			
Contact list	■	■	■	■	■	■		■			■
Preprinted materials		■	■								
Website	■	■							■	■	
Risk communication protocol	■	■	■	■		■		■	■	■	■

Public Health Reports / September–October 2005 / Volume 120

Measuring preparedness prospectively

Public Health Emergency Preparedness at the Local Level: Results of a National

Variable (n)	*Population Size (n) Categories: (1) < 25,000 (2) 25,000–49,999 (3) 50,000–199,999 (4) ≥ 200,000*	*p Value*	*Presence of a Board of Health (n) Univariate ORs and ORs Adjusted for Population Size*	*p Value*	*Participation in Coalitions (n) Univariate ORs and ORs Adjusted for Population Size*	*p Value*
EP-Staff ($n = 1,794$)	2.7% (22) 7.1% (41) 20.0% (58) 58.3% (74)	< .0001	*Proportions* Yes 9.4% (131) No 15.7% (64) *ORs (95% CI)* Univariate: 0.56 (0.42, 0.75) Adjusted: 0.76 (0.54, 1.08)	.0001	*Proportions* Yes 17.7% (40) No 16.8% (20) *ORs (95% CI)* Univariate: 1.06 (0.60, 1.88) Adjusted: 0.89 (0.46, 1.74)	.8293
EP-Capacities ($n = 2,255$)	12.9% (139) 17.2% (119) 30.0% (103) 49.8% (70)	< .0001	*Proportions* Yes 19.0% (326) No 19.9% (106) *ORs (95% CI)* Univariate: 0.94 (0.74, 1.20) Adjusted: 1.05 (0.81, 1.34)	.6357	*Proportions* Yes 27.8% (73) No 19.1% (30) *ORs (95% CI)* Univariate: 1.63 (0.98, 2.72) Adjusted: 1.46 (0.86, 2.47)	.0582
EP-Activities ($n = 2,292$)	58.6% (644) 76.4% (537) 86.1% (301) 92.0% (130)	< .0001	*Proportions* Yes 73.3% (1,279) No 61.5% (337) *ORs (95% CI)* Univariate: 1.17 (1.37, 2.13) Adjusted: 1.86 (1.48, 2.36)	< .0001	*Proportions* Yes 85.8% (227) No 53.9% (85) *ORs (95% CI)* Univariate: 5.19 (3.03, 8.87) Adjusted: 5.03 (2.85, 8.90)	< .0001
EP-Performance ($n = 423$)	29.0% (44) 32.6% (43)	< .0001	*Proportions* Yes 40.3% (130)	.9275	*Proportions* Yes 59.4% (157)	< .0001

Savoia E, Rodday AM, Stoto MA. *Health Services Research* 2009

Measuring preparedness prospectively

Some new work in progress through CDC's NC-PERRC

- Validation of a new instrument for studying variation in preparedness capacities across communities and over time
- Draws on best-performing items from existing instruments
- Testing multiple respondents within the agency and community
- Validation: Summer-Fall 2009
- First wave of implementation: Spring 2010

Measuring preparedness concurrently

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 Namkung, Jonathan Fielding, and Robert Burciaga Valdez

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

LPHA	Region	Population served[a]	Urban/ rural[b]	Mean time until calls returned (minutes)	Longest period before calls returned (minutes)	Number of calls not returned	Percent "warm transfers"
1	Midwest	Small	Rural	93	630	2	44
2	Midwest	Medium	Rural	51	350	1	57
3	Midwest	Medium	Urban	4	6	0	88
4	Midwest	Large	Urban	14	30	0	50
5	Midwest	Large	Urban	10	23	0	38

Lurie et al. 2004

Measuring preparedness retrospectively

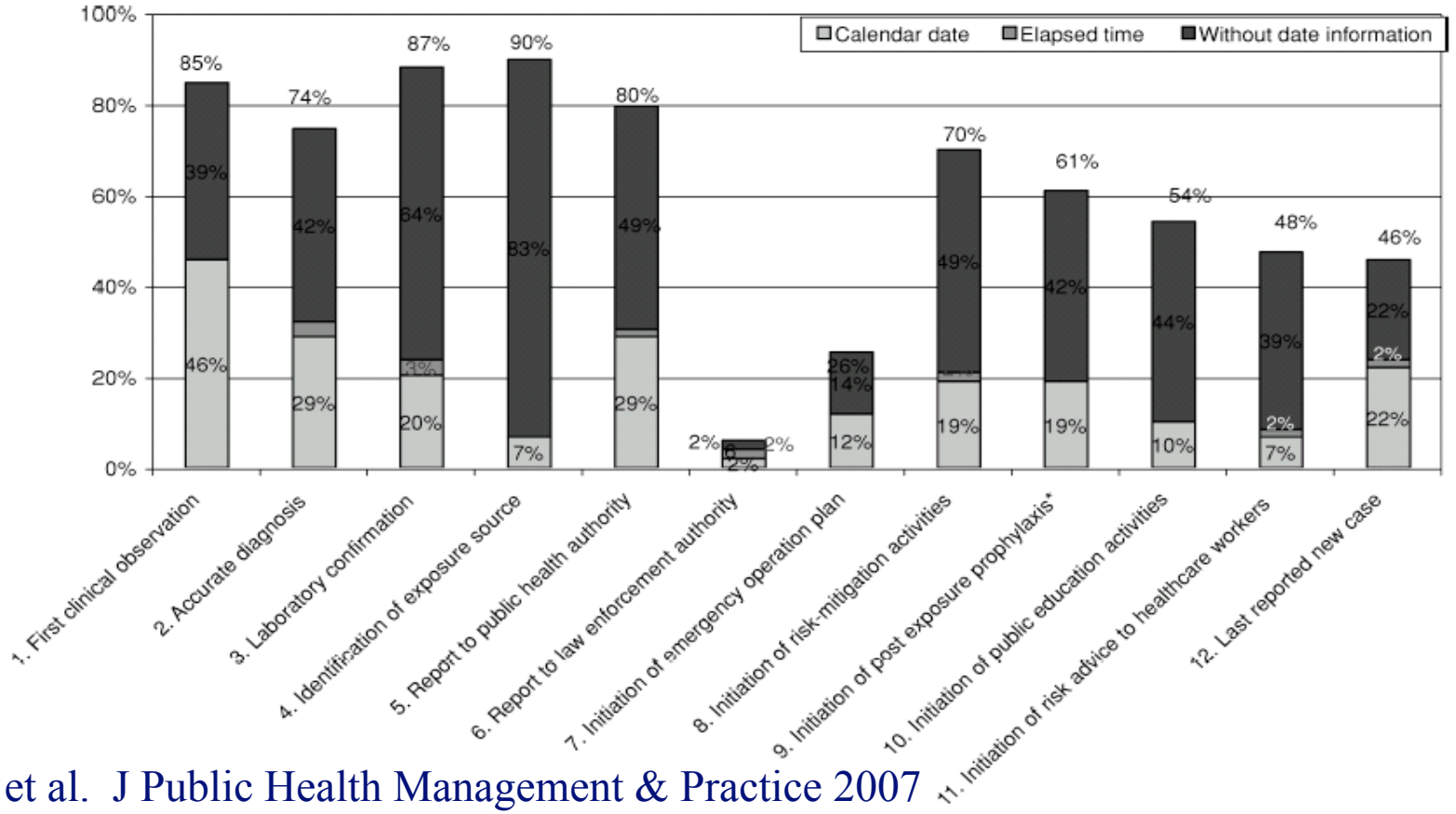
- Existing information flows and documentation
  - Health Alert Network
  - Case reports
  - Electronic disease reporting systems
- Facilitated Look-backs
- After-action Report (AAR) reviews

Measuring preparedness retrospectively

Performance Indicators for Response to Selected Infectious Disease Outbreaks: A Review of the Published Record

Margaret A. Potter, Patricia Sweeney, Angela D. Iuliano, and Michael P. Allswede

FIGURE 1 Percentage of Outbreak Reports ($N = 59$) Including Process Indicators by Calendar Date, by Elapsed Time, or Without Date Information



Potter et al. J Public Health Management & Practice 2007

Measuring preparedness retrospectively

Facilitated Look Backs

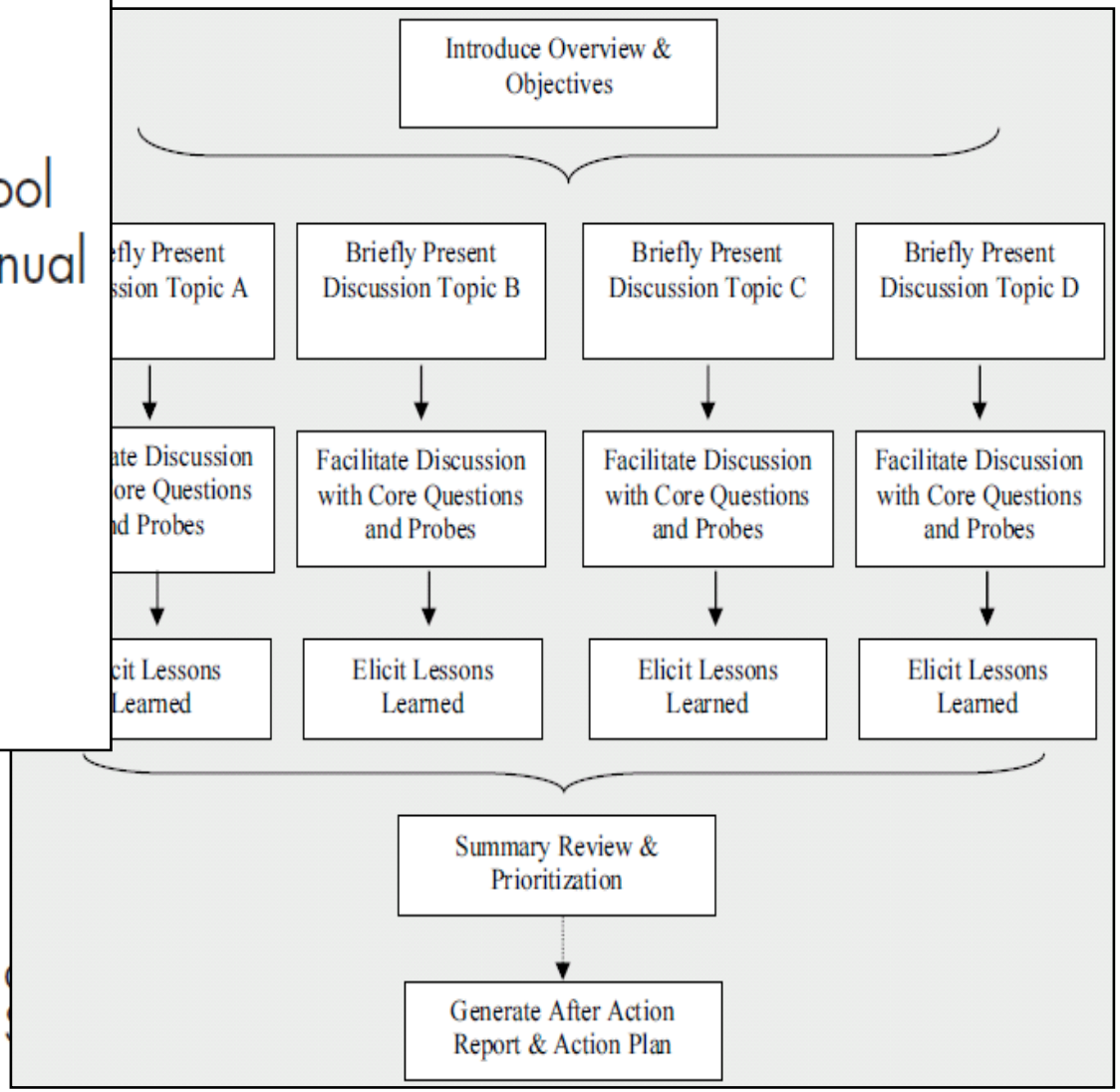
A New Quality Improvement Tool for Management of Routine Annual and Pandemic Influenza

Julia E. Aledort, Nicole Lurie, Karen Ricci,
David J. Dausey, Stefanie Stern

Prepared for the U.S. Department of Health and Human Services

RAND

Center for Domestic
International Health
A RAND HEALTH PROGRAM



RAND 2006

Measuring preparedness retrospectively

AAR Review

- Types of drills and exercises used
- Range of participating organizations
- Target capabilities and response activities tested
- Roles of public health agencies
- Types of recommendations and improvement plans

III. Analytical Considerations (Comparisons & Inferences)

Analytical Considerations

- How to make meaningful comparisons across agencies and systems
  - Variation across settings
  - Change over time
- How to make valid inferences about Context-Mechanism-Outcome relationships

Challenge #1: heterogeneity in context

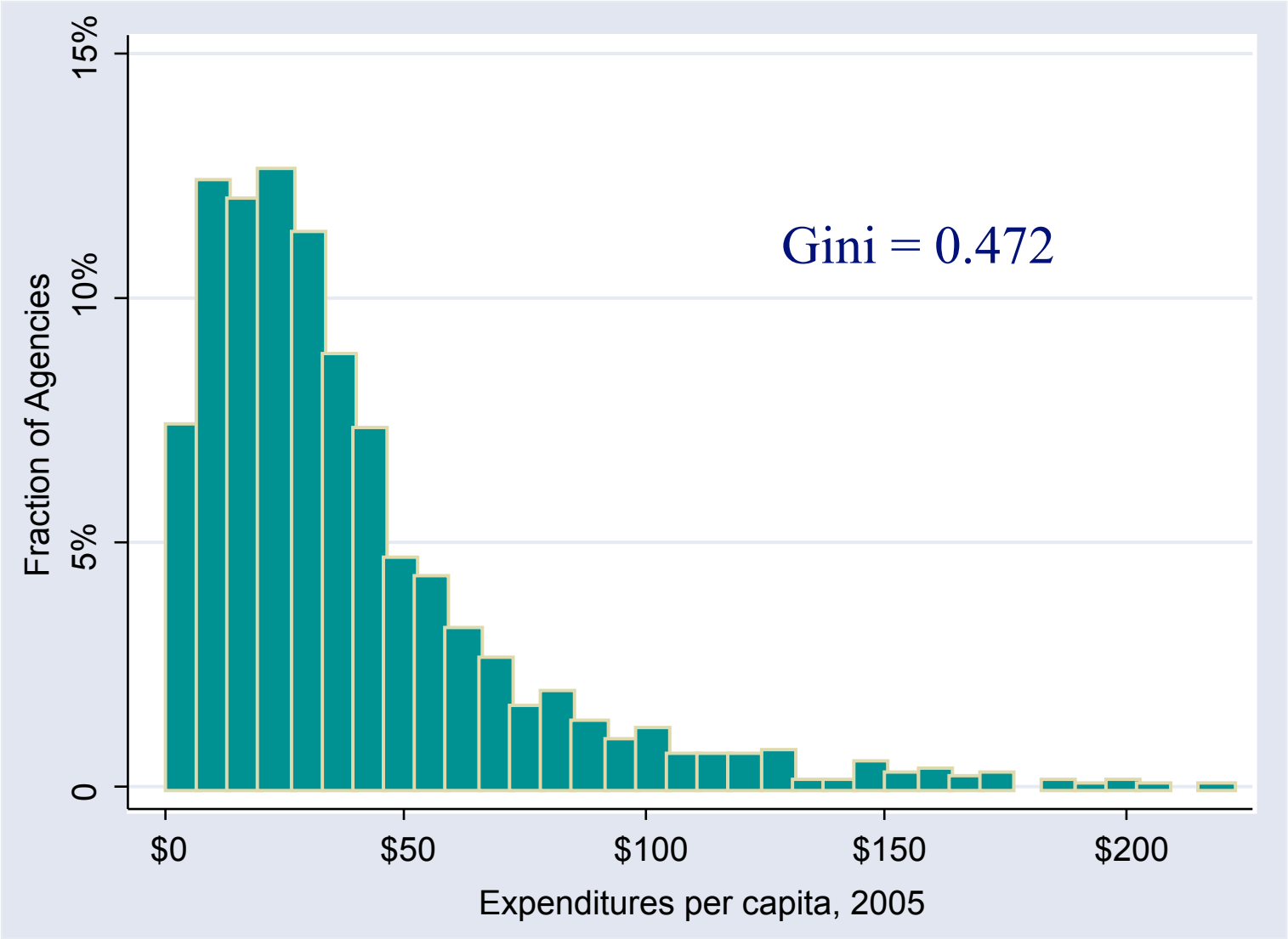
Demand-side:

- Nature and timing of the event
- Population health risks, vulnerabilities, social determinants
- Preferences, values, priorities
- Information

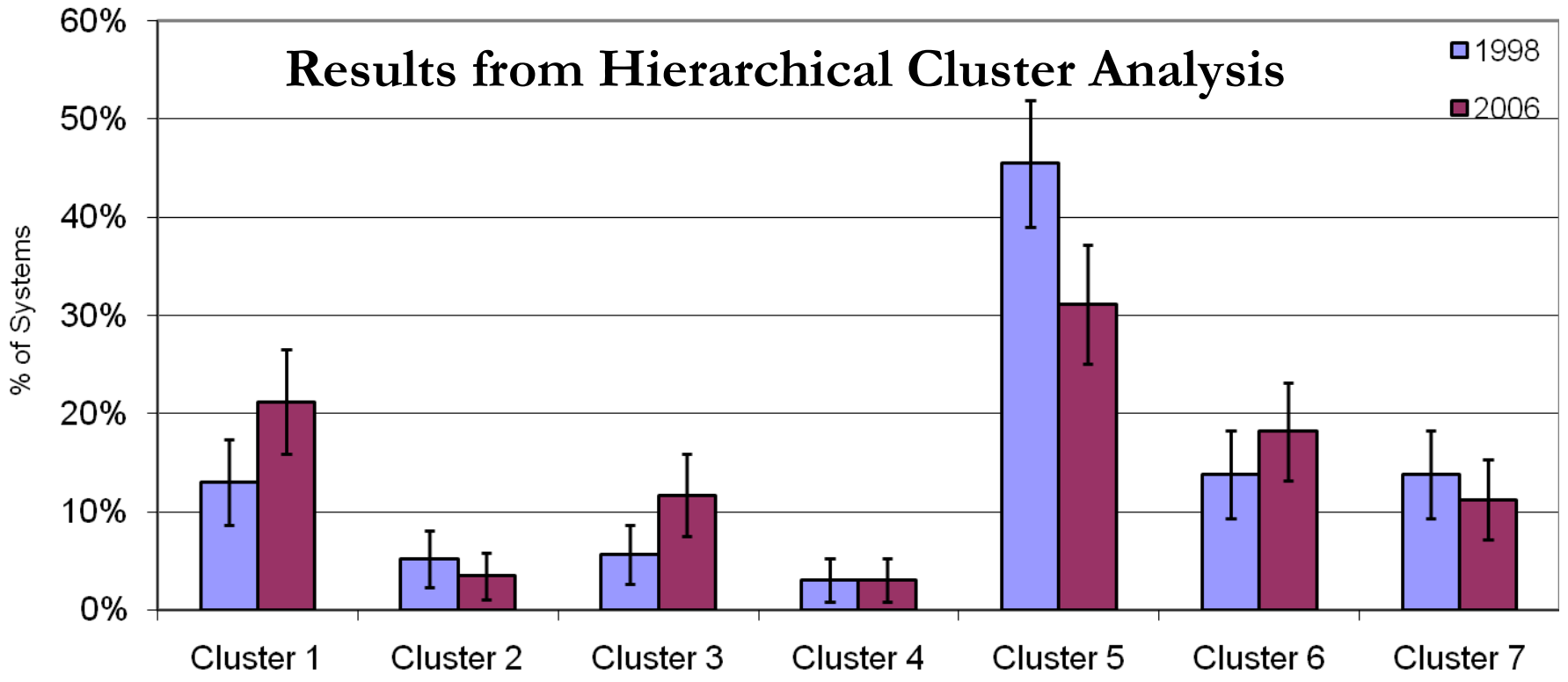
Supply-side

- Institutional & interorganizational structures
- Human capital
- Financing
- Law

Example: variation in local public health agency spending



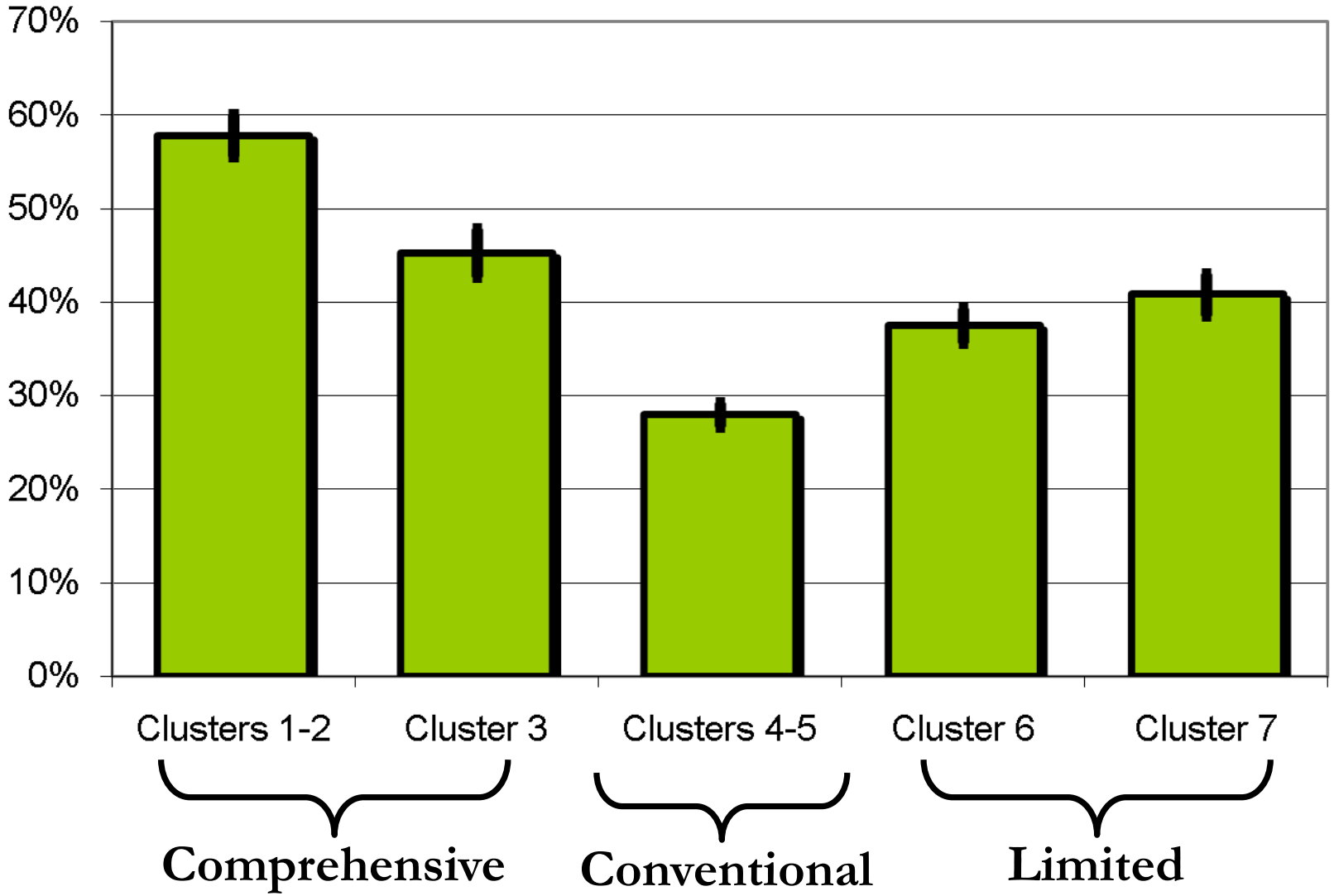
Example: classifying systems into homogenous groups for comparison



Differentiation	High	High	High	Mod	Mod	Low	Low
Integration	High	High	Low	Mod	Mod	Low	Mod
Centrality	Mod	Low	High	High	Low	High	Low

Comprehensive **Conventional** **Limited**

Example: comparing self-rated practice effectiveness

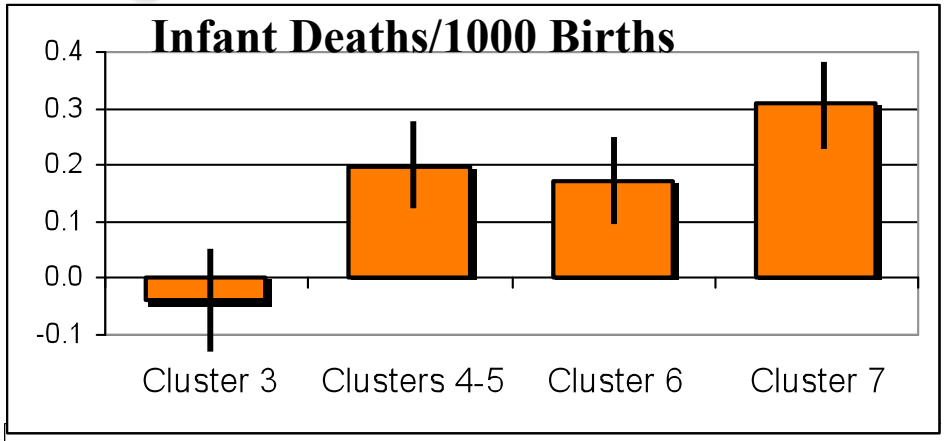


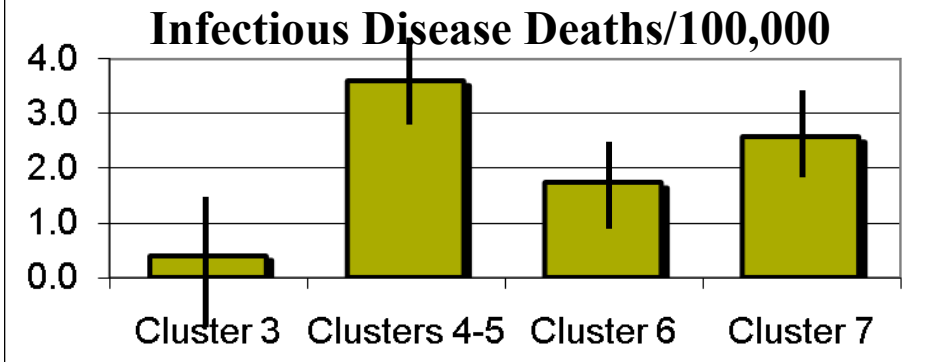
Regression-adjusted means control for population size, density, age composition, poverty status, racial composition, and physician supply

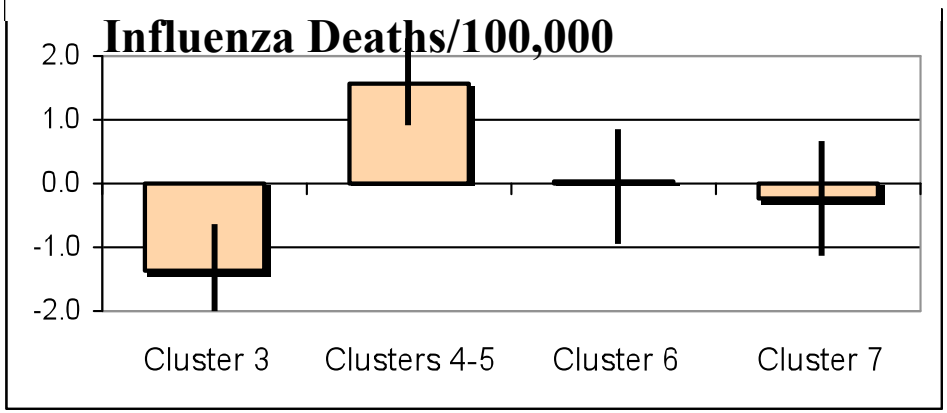
Example: Comparing health status

Fixed-effects Differences (Reference: Clusters 1-2)

- Conventional and limited systems have significantly higher mortality rates than that of comprehensive systems
- Differences persist after controlling for population demographics, SES, health resources, and community fixed effects





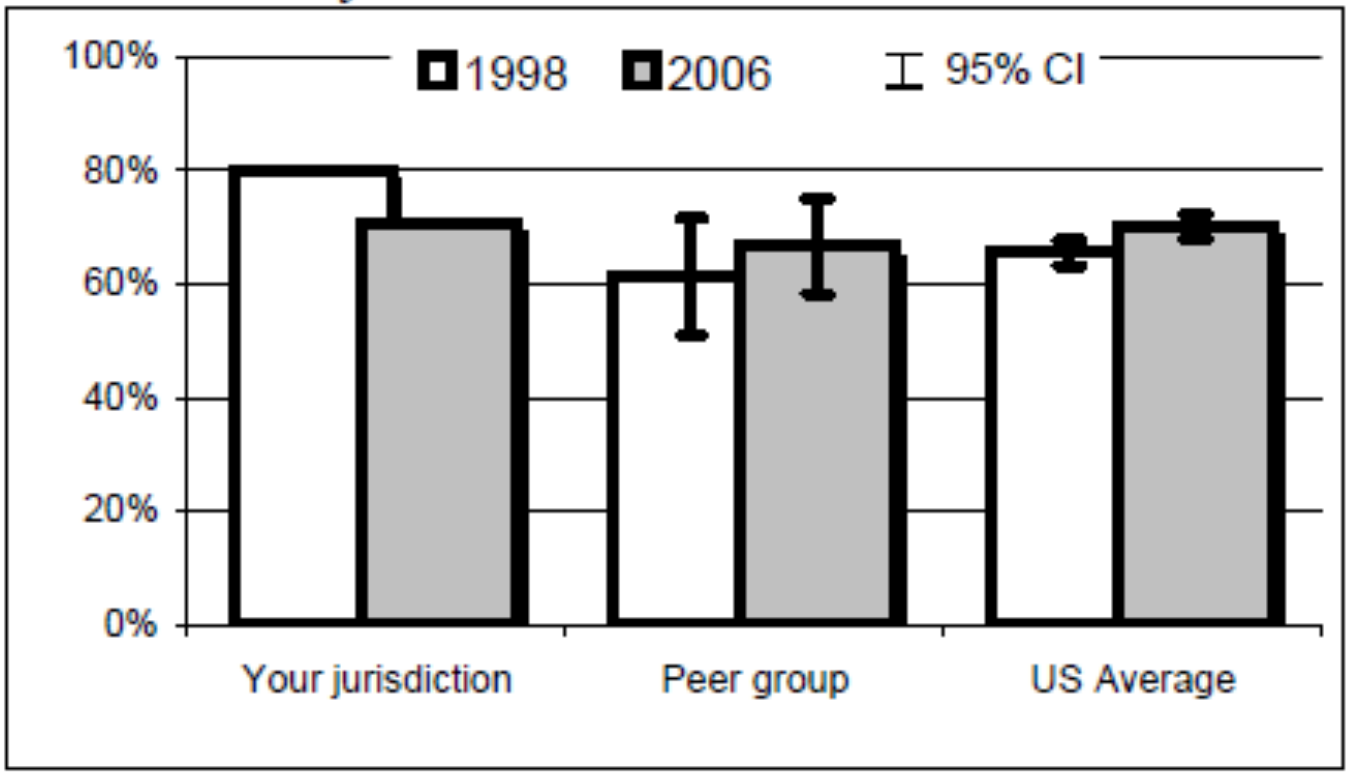


Comprehensive Conventional Limited

Example: constructing peer groups using Euclidean distance

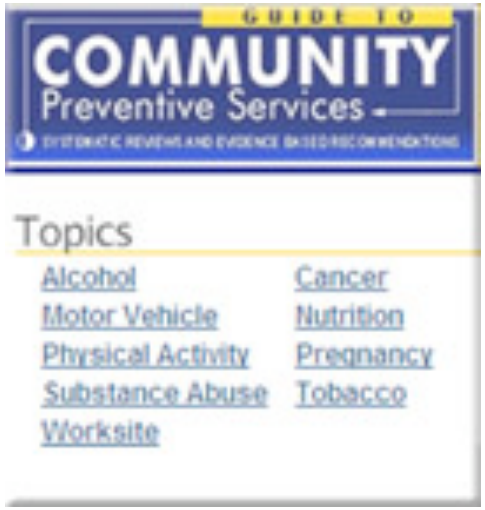
- Identify “nearest neighbor” systems based on institutional and community characteristics
- Population size, density, racial/ethnic composition, SES, state/local division of authority

Figure 1: Proportion of Public Health Activities Available in the Jurisdiction

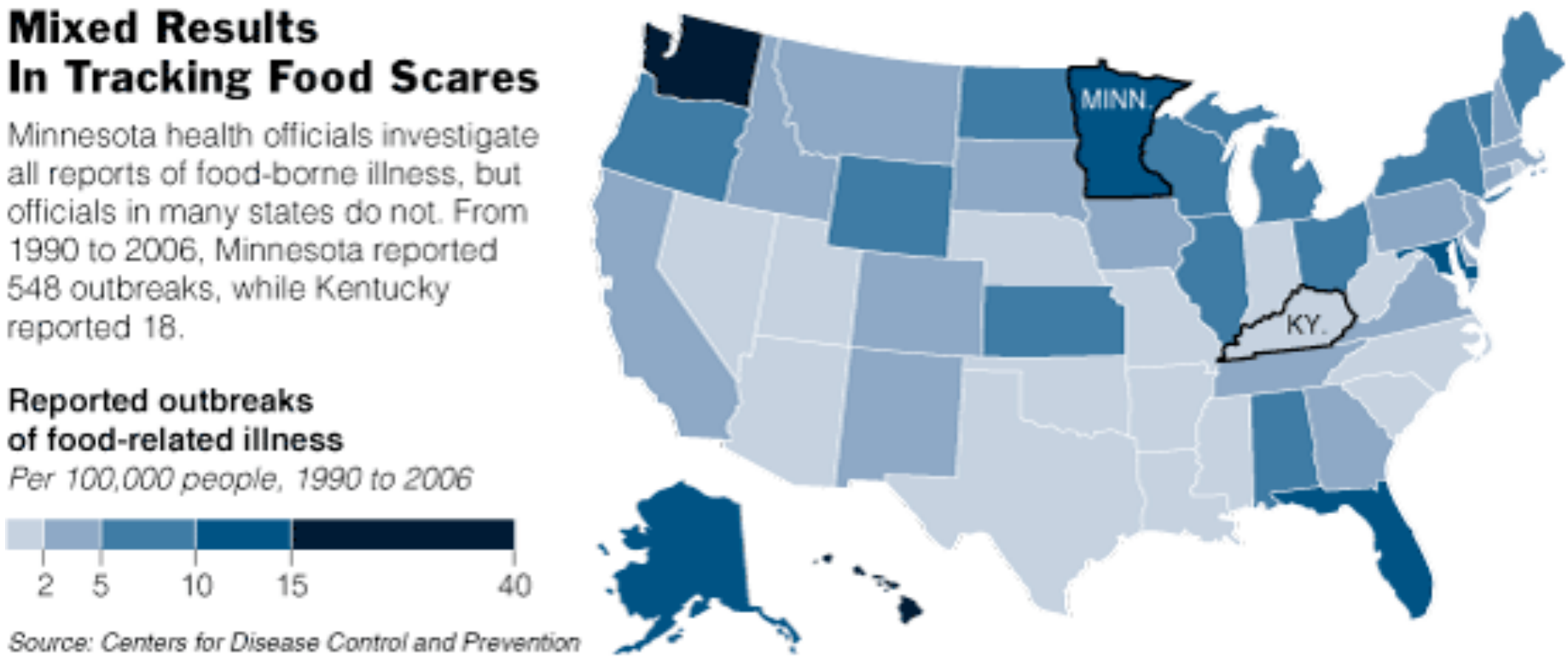


Challenge #2: heterogeneity in mechanisms

- Variations in practice
- Adoption of evidence-based programs and policies
- Fidelity in implementation & enforcement
- Reach to populations at risk
- Timeliness of response

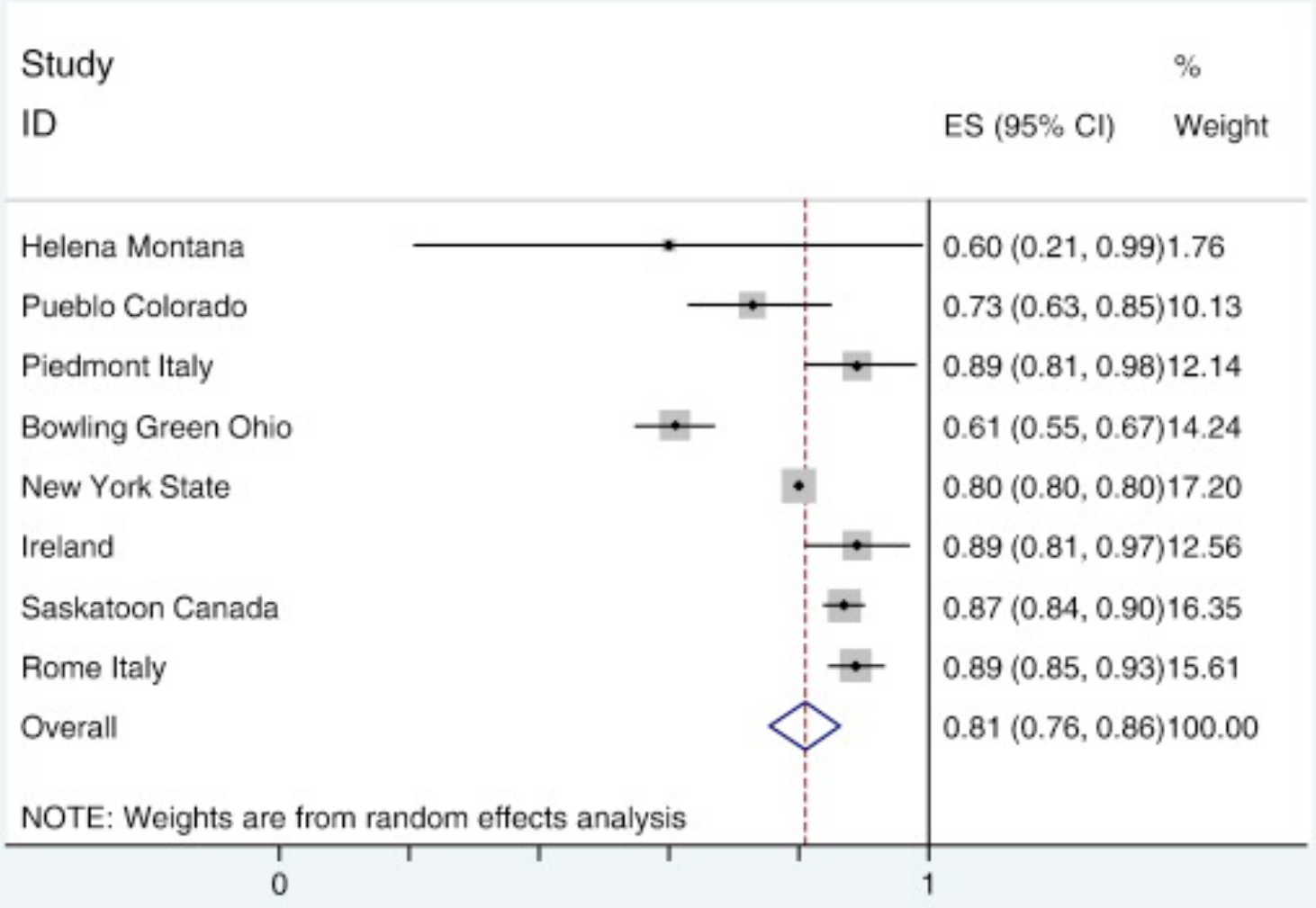


Example: variations in investigation practice



Example: variations in policy design, implementation, enforcement

Estimated Effects of Smoke-free Policies on AMI admissions



Glantz 2008

Analytic strategies for addressing heterogeneity in mechanisms

- Analyze the adoption & implementation processes
  - Extent of implementation
  - Degree of fidelity
  - Success in reaching target population (underuse, overuse, misuse)
  - Barriers and facilitators
- Structure comparisons around the type and/or extent of implementation
- Compare different approaches to implementation

Challenge #3: identifying appropriate outcomes

Problems

- Lagged effects
- Partial effects on multiple outcomes
- Heterogeneous effects on outcomes

Analytic strategies

- Composite outcome measures
- Latent variable analysis
- Process measures with empirical link to outcomes

Challenge #4: untangling the effects of context and mechanisms

- Contextual confounding
- Selection/endogeneity bias in mechanisms
- Interactions between context and mechanisms
- Interaction between multiple mechanisms
  - Economies of scope
  - Synergy
  - Competing/offsetting effects
- Highly correlated/indistiguishable mechanisms

Research design & analytical considerations

- Take advantage of natural experiments (exogenous change in context or mechanisms)
- Use statistical controls for observed and/or unobserved confounding
  - Propensity score methods
  - Instrumental variables methods
- Test for interaction effects between contexts and mechanisms
- Test “standardized” mechanisms in different institutional & community settings

Example: effects of accreditation on preparedness & performance

Group	Pre-accreditation		Post-accreditation		
Early NC agencies			O_{post}	O_{post}	O_{post}
Late NC agencies	O_{pre}	O_{pre}	O_{post}	O_{post}	O_{post}
Propensity-matched comparison agencies outside NC	C_{pre}	C_{pre}	C_{post}	C_{post}	C_{post}

$$\text{Effect} = (O_{post} - O_{pre}) - (C_{post} - C_{pre})$$

Practice-based research networks as vehicles for comparative studies

- Compare a standardized intervention in a variety of practice settings
- Compare variation in adoption and implementation across a variety of practice settings
- Examine multiple context-mechanism pathways that lead to outcomes of interest

PUBLIC HEALTH
Practice-Based Research Networks

Concluding thoughts

- PH system and services heterogeneity poses challenges to comparative research
- This heterogeneity also drives the need for comparative research – is the variation:
  - Wasteful
  - Harmful
  - Inequitable
- Threats to validity must be balanced against:
  - the consequences of error (type I)
  - the consequences of inaction (type II)