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New methods and measures to assess the impact of the economic recession on public health outcomes

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Context

- **Local public health spending has been shown to be associated with local health department (LHD) to performance of essential services and improved community health outcomes**

- **The economic recession in 2008 resulted in decreased funding for LHDs**

- **We wanted to know:**
  If more spending means better performance and improved health outcomes…..is the opposite true?

- **We examined the impact of reductions in LHD spending, staffing and services on community health outcomes**

What do we know already?

- **Local public health spending is associated with:**
  - **Increased performance of essential services**
    Mays GP, et al. 2006
  - **Improved infant mortality and mortality from cancer, heart disease and diabetes**
    Mays GP & Smith SA 2011
  - **Improved infectious disease morbidity**
    Erwin PC, Greene SB, Mays GP, Ricketts TC, Davis MV, 2011, and Erwin PC, Mays GP & Riley, 2012
  - **Reduction in years of potential life lost**
    Erwin PC, Mays GP & Riley, 2012

What data sources are available?

- **Spending, staffing and services**
  - **NACCHO profiles**
    - Periodic surveys of local health departments
  - **ASTHO profiles**
    - Periodic surveys of state health department
  - **National Longitudinal Survey of Public Health Systems**
- **Community health outcomes**
  - **Mortality**
  - **Morbidity (notifiable conditions)**

Study Aims

- **Aim 1. Assess the relationship between the public health spending and the provision of public health services at the local level in the context of the economic recession.**
  - **Decreased public health funding will be associated with reductions in staffing.**
  - **Decreased public health funding will be associated with reductions or elimination of services.**
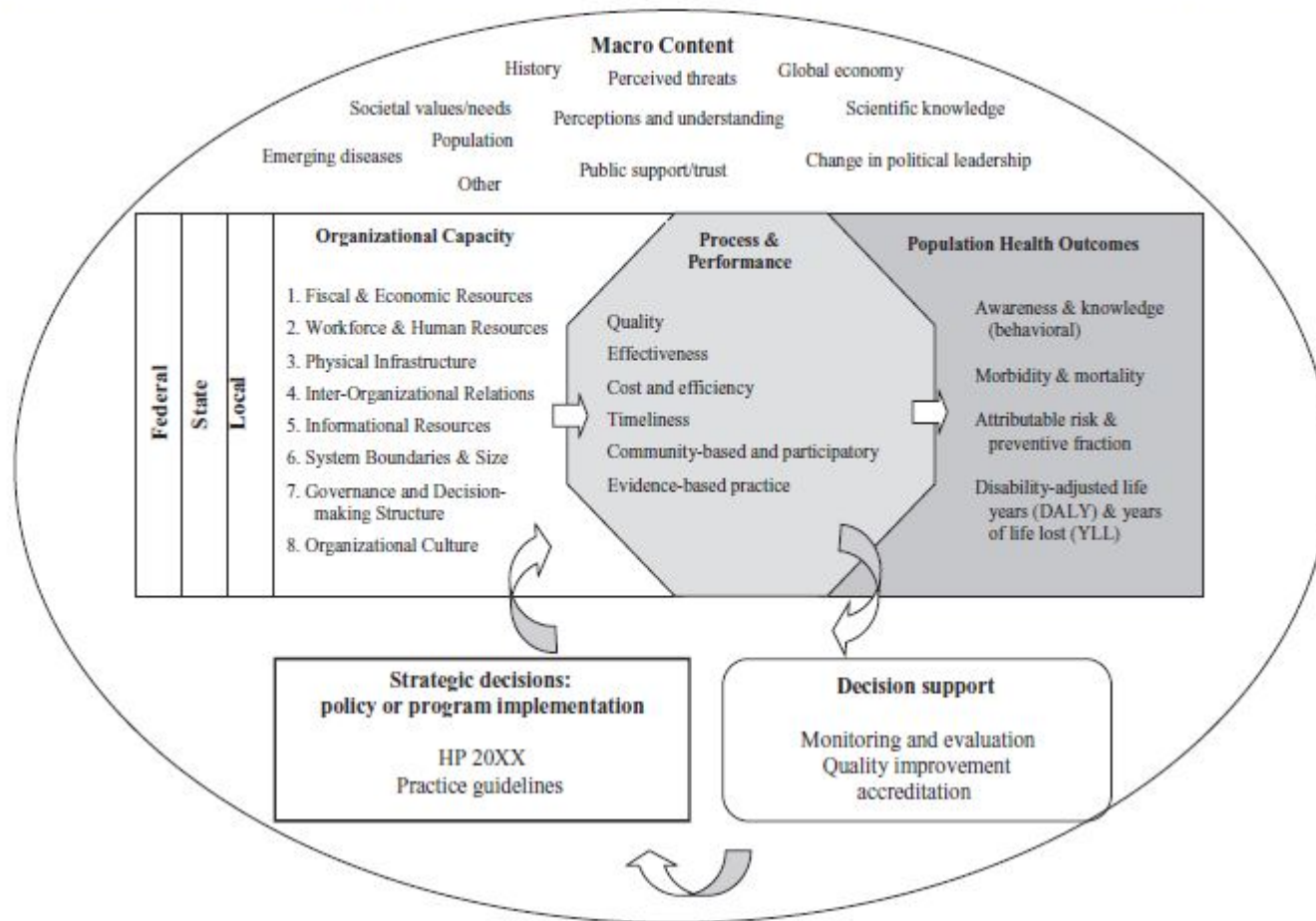
Aims, continued

- **Aim 2. Assess the relationship between public health spending, staffing and services and community health outcomes in the context of the economic recession.**
  - Decreased local public health funding will be associated with worse mortality.
  - Decreased local public health staffing will be associated with worse mortality.
  - Decreased local public health services will be associated with worse mortality.
  - Specific locations within the state will have greater disparities in public health funding and associated outcomes after controlling for area-level covariates and spatial autocorrelation within a geospatial model.

Aims, continued

- **Aim 3. Develop and examine the feasibility and responsiveness of new measures of community health indicators to respond to changes in public health spending.**
  - Community level morbidity measures constructed using insurance administrative and service claims will be feasible.
  - Community level morbidity measures constructed using insurance administrative and services claims data will be responsive to changes in spending, staffing and services.

Conceptual Framework

FIGURE ● Conceptual Model for Public Health Systems and Services Research

Macro Content

History   Perceived threats   Global economy

Societal values/needs   Perceptions and understanding   Scientific knowledge

Population

Emerging diseases   Change in political leadership

Public support/trust

Other

Organizational Capacity

Federal | State | Local

1. Fiscal & Economic Resources
2. Workforce & Human Resources
3. Physical Infrastructure
4. Inter-Organizational Relations
5. Informational Resources
6. System Boundaries & Size
7. Governance and Decision-making Structure
8. Organizational Culture

Process & Performance

Quality
Effectiveness
Cost and efficiency
Timeliness
Community-based and participatory
Evidence-based practice

Population Health Outcomes

Awareness & knowledge (behavioral)

Morbidity & mortality

Attributable risk & preventive fraction

Disability-adjusted life years (DALY) & years of life lost (YLL)

Strategic decisions: policy or program implementation

HP 20XX
Practice guidelines

Decision support

Monitoring and evaluation
Quality improvement
accreditation

Meyer

Methods

- **Study design**
  - **Using a natural experiment design, we followed North Carolina LHDs from 2005 - 2010**
    - North Carolina was a state that was hit particularly hard by the recession
    - NC LHDs have asked for ways to better measure their value
- **Data sources**
  - **National Association of County and City Health Officials (NACCHO) profiles of LHD (2005, 2008)**
  - **CDC and NC Mortality and population data**
  - **Integrated Cancer Information and Surveillance System (ICISS) – a multi-payer claims database**

About ICISS

- **Developed to study cancer in North Carolina**
  - data are not limited to cancer cases
- **Contains administrative and claims data for NC residents covered under Medicare, Medicaid, and private insurance plans**
- **Represents ~5.5 million people and about 55-65% of the entire state population.**

Measures for LHD spending, staffing and services

- **NACCHO profiles from 2005 and 2008**

- **Spending was captured using expenditure data for most recent fiscal year**
  - Our measure was expressed as dollars per capita, based on service delivery area of LHD

- **Services were measured in two ways, grouping services provided or contracted for by the LHD**
  - As a percent of the total services that could be offered
  - Examining whether individual services were provided

Mortality outcomes

- **Constructed rates for five outcomes for the service delivery area of each LHD**
  - **cancer, heart disease, diabetes, influenza and infant mortality**
    - **Codes from ICD9 National Vital Statistics**
- **Rates calculated separately for each outcome for two time periods using three years of data:**
  2005 – 2007 and 2008 - 2010

Morbidity Outcome

- **Rates were constructed using the ICISS claims data for the service delivery area of each LHD :**
  - hospitalizations for heart disease, cancer, diabetes and influenza (ICD-9 Vital Statistics)
  - treatment for sexually transmitted diseases (STDs) (Literature Review)
  - mammography and colorectal cancer test use using age and sex appropriate denominators (HEDIS screening measures)
  - *measures for food borne illnesses and vaccine preventable disease still in development*

Constructing population-based rates of disease from claims

- **Membership files of each 'payer' dataset are used to identify a count of unique individuals to define the denominator**
  - Membership files include identifiers such as age, county/zipcode, and gender
  - Summed age 65 and older in Medicare < 65 in Medicaid sample, < 65 represented in the private payer data
  - Each unique individual is 'assigned' to an LHD service area
- **Numerator defined by the unique 'event' counts identified though diagnosis and procedure codes in claims files**

Analytic approch

- **Multilevel model that incorporates the longitudinal structure of the data**
  - **Every LHD has two time points**
    - **Interpretation of coefficient is the effect within each LHD accounting for both time points**
- **Used prediction estimates from the model for each LHD to map and explore geographic variation of each exposure and outcome**

Spending, staffing and services results

- **Spending**
  - We observed a wide variation in spending across LHD (from $35 per capita to $218 per capita)
  - In the aggregate, spending increased from 2005 to 2008 – but 10 LHDs saw a decrease in spending (all 10 served rural areas)
  - Higher spending was associated ($p < 0.0001$) with increased staffing, measured as full time equivalent (FTE)
  - Higher spending was associated with provision of selected services (medical care and specialty care)

Spending, staffing and services results

- **Staffing**
  - Wide variation in staffing across LHDs
  - In the aggregate, staffing decreased from 2005 to 2008 – with 36 LHDs having fewer staff
- **Services**
  - Services analyzed using groupings from previous studies (*Mays GP and Smith SA 2009*)
  - Wide variation on the types of services provided
    - Almost all provided clinical preventive services
    - Fewer provided environmental services

Mortality results

- **Spending was not associated with any of the mortality outcomes examined**

- **Staffing was associated with infant mortality**
  - **Increase FTE associated with decrease infant mortality ($p < 0.05$)**

- **Provision of medical treatment services was associated with decreased mortality**

Translating the mortality finding

- **Looking at individual services within the medical treatment services category, two services only were associated with reduced infant mortality**
  - **Prenatal care**
  - **Obstetrical care**
- **Implication of these findings is that provision of these services by LHDs in 2008 may have resulted in 191 fewer infant deaths**

Morbidity results (preliminary)

Outcome Rates per 1000 population	2005	2008		Coefficient associated LHD Spending (95% CI)
Heart disease	11.1	9.7		-0.757* (-1.504, -0.009)
Flu/pneumonia	4.3	3.5		0.007 (-0.543, 0.557)
STD	3.9	3.5		-0.1537 (-0.789, 0.481)
Breast cancer screening	433.1	441.0		-7.782 (-24.864, 9.300)
Colorectal cancer screening	209.0	158.7		-6.535 (-21.093, 8.024)
Cervical cancer screening	369.5	365.7		2.4683 (-17.303, 22.239)

* $p < 0.05$

Validation with State Inpatient Data (SID)

- **Synthetic population estimate created using census data and claims enrollment for denominators and rates from claims in numerator**

$$\frac{[\geq 65\ Medicare +\ (< 65\ Medicaid + < 65\ Private *)]}{\geq 65\ Medicare + < 65\ (all\ insured\ census)}$$

Where Private* = (Private event rate) x [Insured<65 (from census) − Medicaid <65]

- **Pearson correlation coefficient 0.77 for heart disease and 0.93 for flu or pneumonia.**
  - **Slightly lower than the data from SID because it excludes uninsured and multiple hospitalizations.**

Geospatial Methodologies

"Local Indicator of spatial auto-correlation" (LISA)

- Generated from GeoDa software
- Method which 'accounts' for spatial auto-correlation of 'neighbors' using all the data/covariates.
- Can be used to identify areas that are high or low in an outcome relative to the neighboring areas

Infant mortality rates per 100,000
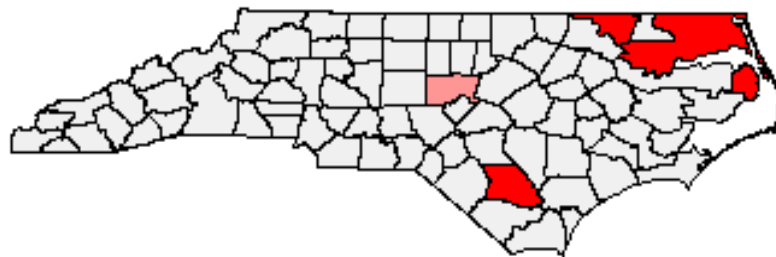
Challenges

- **NACCHO data are self-report**
  - **Unknown validity and reliability**
  - **We used state reported fiscal data to help clean outliers and obtain face validity**
- **Funding for how services are provided is highly variable across LHDs**
  - **Imperfect crosswalk between NACCHO categories and service categorization at the local level**
- **Unable to identify a valid instrumental variable (IV) as in Mays, et al.**
- **Conceptual framework & untangling effects**

Next steps

- **In the current study**
  - Complete the foodborne and vaccine preventable disease analyses
  - Dissemination of findings and methodological approaches
- **Validation of commonly used data sources for PHSSR studies**
- **Exploration of new data sources for use in PHSSR studies**

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Research Team:

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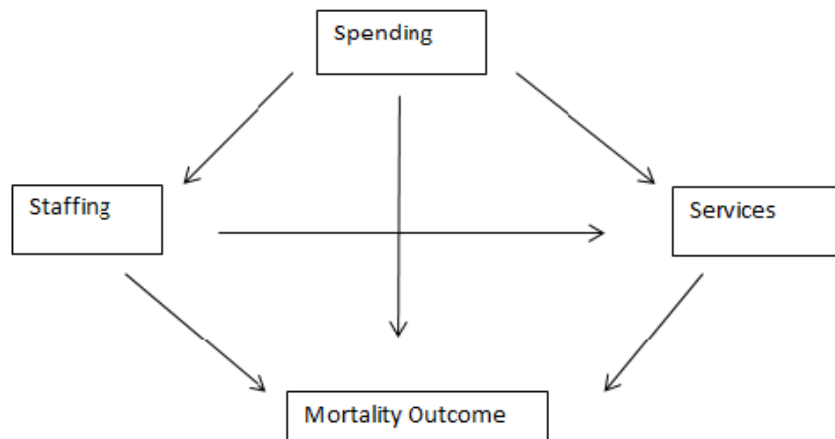
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Questions?

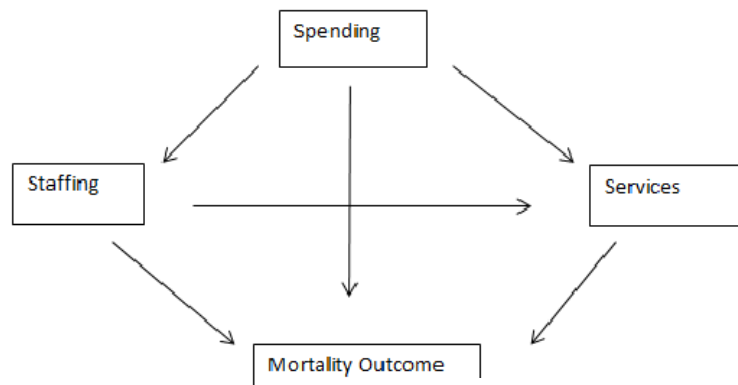# SUPPLEMENTAL SLIDES

Directed Acyclic Graphs (DAGs)

A. Paths for estimating the relationship between spending and mortality outcome:

Spending → Mortality outcome
Spending → Staffing → Mortality outcome
Spending → Staffing → Services → Mortality outcome
Spending → Services → Mortality outcome

All the paths are open, so no need to condition on any of the variables. Models examining spending only need to adjust for community factors

DAGs

B. Paths for estimating the relationship between staffing and mortality outcome:

Staffing → Mortality outcome
Staffing → Services → Mortality outcome
Staffing ← [Spending] → Mortality outcome
Staffing ← [Spending] → Services → Mortality outcome

Models need to condition on spending which blocks the last three paths.

C. Paths for estimating the relationship between services and mortality outcome:

Services → Mortality outcome
Services ← [Staffing] → Mortality outcome
Services ← [Spending] → Mortality outcome
Services ← [Spending] → Staffing → Mortality outcome

Models need to condition on Staffing and Spending, as they block the paths as shown above.

2005 NACCHO Profile – spending data

For your most recently completed fiscal year, what were the LPHA's total expenditures? (q10_expeR)

Amount $_____

For *the year prior to your most recently completed fiscal year* (the fiscal year prior to the one for which you just provided data), what were the LPHA's total expenditures?

Amount: (q14_amouR)

$_____

For *your most recently completed fiscal year*, what percent of your revenues came from:

(Your responses should total 100)

_____ %   City/township/town sources (q10a_citRa)

_____ %   County sources (q10b_couRa)

_____ %   State sources (EXCLUDING pass-through from Federal) (q10c_staRa)

_____ %   Federal sources (passed through by State) (q10d_fedRa)

_____ %   Federal sources (direct) (q10e_fedRa)

_____ %   Medicaid (q10f_medRa)

_____ %   Medicare (q10g_medRa)

_____ %   Private foundations (q10h_priRa)

_____ %   Private health insurance (q10i_priRa)

_____ %   Patient personal fees (q10j_patRa)

_____ %   Regulatory fees (q10k_regRa)

_____ %   Tribal sources (q10l_triRa)

_____ %   Other (q10m_othRa) Specify (q10othertext)

2008 NACCHO Profile – spending data

_____

For your most recently completed fiscal year, what were the LHD's total *expenditures?*
Amount (Enter whole number):

_____

For your most recently completed year, what were the LHD's total *revenues?*
Amount (Enter whole number):

_____

For *your most recently completed fiscal year,* what were the total revenues (enter whole number in dollars) from:

(Your responses should total the amount from the revenue item above.)

$ _____	City/township/town sources
$ _____	County sources
$ _____	State sources (EXCLUDING pass-through from Federal
$ _____	Federal sources (passed through by State)
$ _____	Federal sources (direct)
$ _____	Medicaid
$ _____	Medicare
$ _____	Private foundations
$ _____	Private health insurance
$ _____	Patient personal fees
$ _____	Regulatory fees
$ _____	Tribal sources
$ _____	Other (specify below)

If you answered, "other," above, please provide an explanation:

Spending measures

- **State plus Federal**
- **Total minus state and Federal direct**
- **Medical care**
- **City /county**
- **Ratios**
- **Absolute dollars**

Services Grouping – Mays and Smith 2009

Composite Variable	Services Included
Clinical preventive services	Adult immunizations, childhood immunizations, HIV screening, STD screening, tuberculosis screening, cancer screening, cardiovascular disease screening, diabetes screening, blood pressure screening, family planning, EPSTD services
Medical treatment services	HIV treatment, STD treatment, tuberculosis treatment, prenatal care, obstetrical services, primary care services, home health care, school based clinics
Specialty care services	Dental services, mental health services, substance abuse treatment
Population-based activities	Tobacco prevention, injury prevention, occupational safety, school health, health education, epidemiological investigation
Regulatory/licensing activities	Swimming pool inspection, food and milk inspection, food service licensing, public drinking water inspection, private drinking water inspection, health facilities licensing
Environmental health activities	Indoor air quality monitoring, radiation control, animal control, vector control, ground water protection, surface water protection, hazardous waste response

Services measures

- **Individual service items**
- **Total counts**
- **Ratios of performed versus contracted**
- **Groupings - proportion of total services offered**

Differences in analytic approach

- **No CPI adjustment because:**
  - **Only 3 years**
  - **CPI samples only urban whereas NC largely rural**

Instrumental Variable

- Social capital index
- Voting
- Local board of health
- Governance structure – BOH and state centralized control