How Multi-Sector Community Networks Are Shaping COVID-19 Pandemic Trajectories and Outcomes Across the U.S.

Strategies to Achieve Alignment, Collaboration, and Synergy Across Delivery and Financing Systems

Deena N. Brosi, MPH

S4A
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Agenda

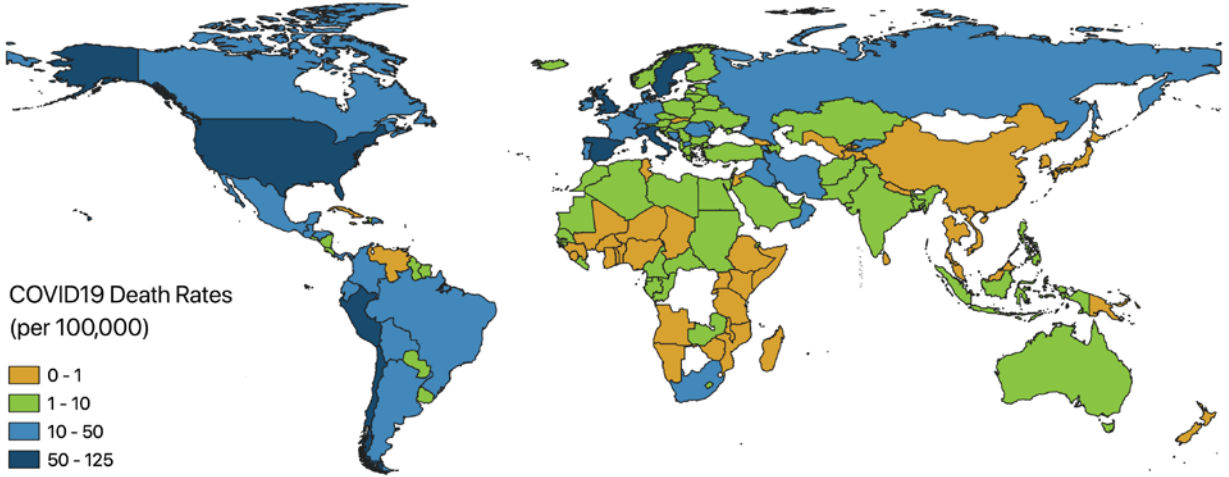
Welcome: **Chris Lyttle, JD**
Deputy Director for Systems for Action

Presenters: **Deena Brosi, MPH**
Colorado School of Public Health
Systems for Action Intramural Research Team

Q&A: **Chris Lyttle, JD**

Introduction: COVID-19 Pandemic

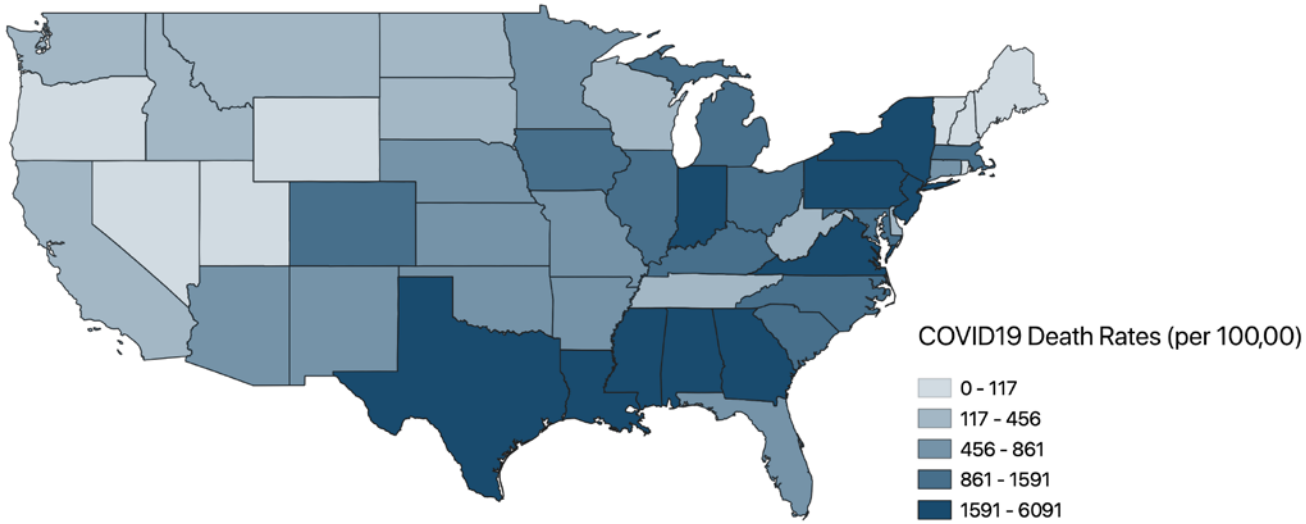
- January 20, 2020 was the first documented case of the novel coronavirus (SARS-CoV-2) in the United States.
- Over **5 million** documented cases and over **170,00** reported dead in the U.S.
- The United States has the highest reported death rate among developed nations.



Mortality Analyses. Johns Hopkins Coronavirus Resource Center. Accessed August 17, 2020. https://coronavirus.jhu.edu/data/mortality

Introduction: COVID-19 Pandemic

- The U.S. is also experiencing disparities in cases and deaths across cities and states.
- Policies around COVID-19 safe practices vary by state and localities.



CSSEGISandData. *CSSEGISandData/COVID-19*.; 2020. Accessed August 17, 2020. https://github.com/CSSEGISandData/COVID-19

Introduction: NALSYS

- The National Longitudinal Survey of Public Health Systems (NALSYS) follows a national cohort of U.S. communities over time
- Captures information about:
  - Implementation of guideline-recommended public health activities
  - Network of organizations that participate in each activity (multi-sector)
- Completed by the designated local public health official in each community
- Used to construct composite measures of public health system capabilities and network strength

Systems For Action. Accessed August 17, 2020. http://systemsforaction.org/; Mays GP, Mamaril CB, Timsina LR. Preventable death rates fell where communities expanded population health activities through multisector networks. Health Aff (Millwood). 2016;35(11):2005-2013.

Research Question

- Do communities with stronger public health systems experience fewer COVID-19 deaths?
- Which attributes of public health systems are associated with the COVID-19 mortality trajectory:
  - The scope of guideline-recommended public health activities implemented by the system
  - The network density of organizations that participate in these activities

Methods: Sample

- The 2018 wave (N = 725) of the NALSYS consisted of:
  - A national sample of metropolitan communities with at least 100,000 residents (N = 296).
  - A national, stratified sample of rural communities with less than 100,000 residents (N = 254).
  - A statewide sample of communities in 4 states (OH, KY, WA, OR) (N = 173).
- Response rate for the 2018 wave was 71%.
- Reduced models excluded the 4-state samples.

Methods: Measures

- The main covariate of interest is the System Composite Score from the NALSYS dataset.
  - Score is calculated using a combination of activity scope and network density variables using cluster analysis.
  - The three natural categories for this variable are: Comprehensive, Conventional and Limited
- Comprehensive public health systems implement the most public health activities and have the largest networks of organizations that participate those activities.

Methods: Data

- NALSYS.
- John Hopkins's Center for Systems Science and Engineering.
- Services Administration's Area Health Resource File (AHRF).
- The Atlantic's COVID Tracking Project.
- Center for Disease Control's (CDC) Compressed Mortality File.
- New York Times 2016 Presidential Election Data

Methods: Analysis

- Due to the higher than expected number of counties with zero COVID-19 deaths, we employed a two-part model analysis.
  - 1st Part: Models the probability of a county having at least one COVID-19 death versus no COVID-19 deaths using a logistic regression.

$$log(\frac{\mathrm{P[COVID{-}19{>}0]}_i}{1-\mathrm{P[COVID{-}19{>}0]}_i}) = \beta_0 + \beta_1 \mathrm{System\ Composite\ Score}_i + X'\beta + \epsilon_i$$

  - 2nd Part: Estimates COVID-19 death rates among counties with at least one death using a log transformation to approximate a normal distribution.

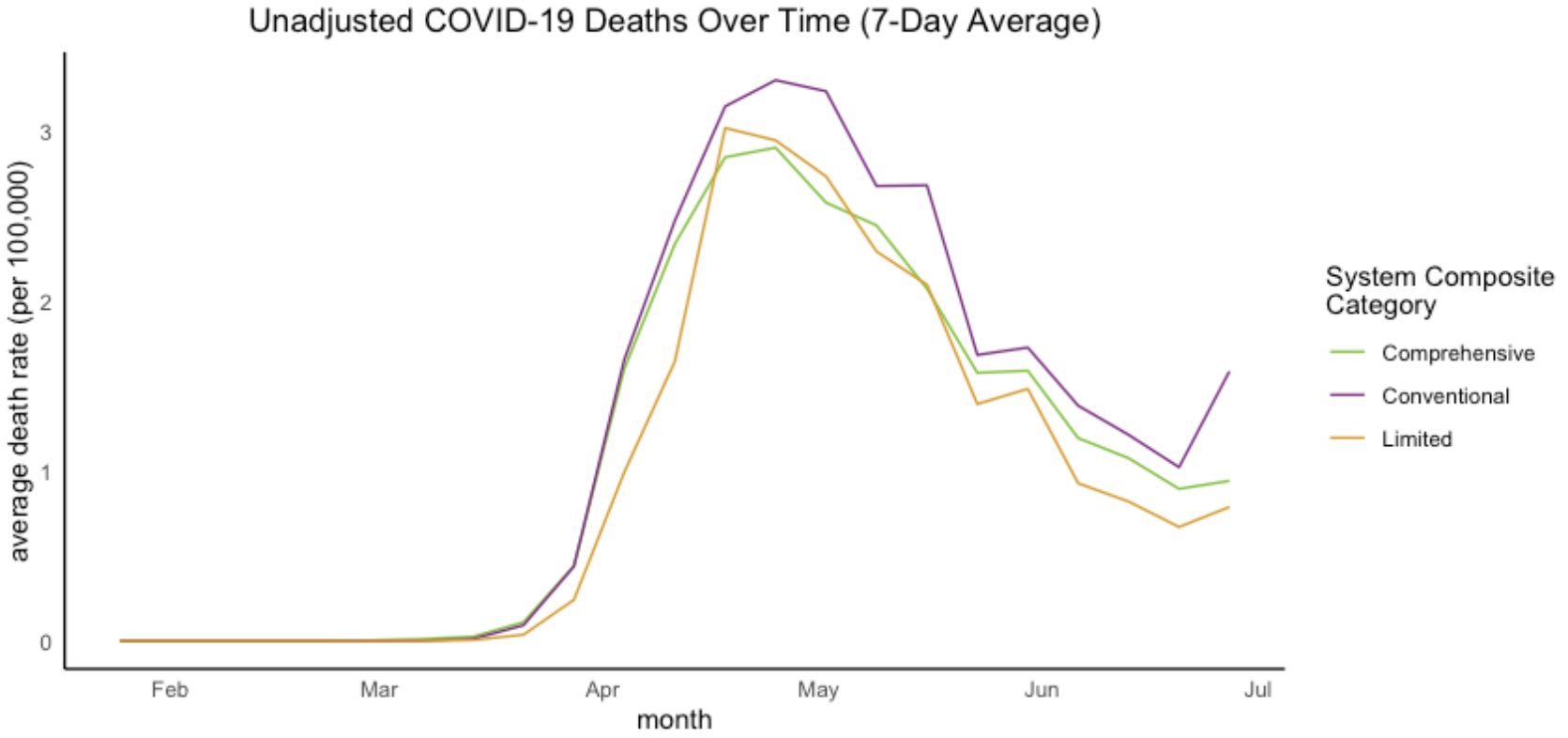
$$(\mathrm{COVID{-}19}_i | \mathrm{COVID{-}19}_i > 0) = e^{\beta_0 + \beta_1 \mathrm{System\ Composite\ Score}_i + X'\beta_i + \epsilon_i}$$

Results: County Characteristics

	Comprehensive (n = 237)	Conventional (n = 98)	Limited (n = 390)	p-value
County Characteristics				
COVID-19 Deaths (per 100,000)	18.8	25.3	22.9	0.356
COVID-19 Deaths > 0 (%)	74.9	67.9	66.5	0.114
Household Size	2.49	2.48	2.48	0.859
Rurality (%)	51.3	47.4	65.7	< 0.001***
Population (10,000)	30.0	22.5	15.9	0.0279*
Average Distance Traveled to Work (mins)	24.0	24.7	24.7	0.300
Public Transportation Use (%)	0.66	0.66	0.60	0.889
Population Density (per sq. mile)	489.0	369.2	282.7	0.173
Male (%)	49.7	49.8	49.9	0.524
Population ≥ 65 Years Old (%)	17.7	18.3	18.3	0.136
Uninsured (%)	8.33	8.57	9.11	0.064
Non-white (%)	17.2	16.2	15.3	0.350
Unemployed (%)	4.79	5.08	4.69	0.155
4-year College Degree (%)	0.35	0.27	0.20	0.166
Income per capita ($10,000)	4.36	4.38	4.17	0.179
Nursing Home (per 100,000)	682.9	648.3	746.2	0.028*
COVID-19 Risk Deaths (per 100,000)	605.2	647.4	654.4	0.0031**
Voted for Trump in 2016 (%)	83.0	83.3	85.0	0.776
Republican Governor (%)	47.4	37.7	60.1	<0.001***
State COVID-19 Tests (per 100,000)	9,174.6	9,055.2	8,778.4	0.250

Weighted County Averages Across Public Health Department Composite System Rating

Results: County Characteristics



Results: Two-Part Model

- Composite system rating was significant in the **GLM**, but not the **logit**.

	Logit[a] (n = 725)	GLM[b] (n = 553)
Variables	Probability (S.E.)	Linear (S.E.)
Composite System Rating		
Conventional	-0.023 (0.078)	14.9*** (3.94)
Limited	-0.026 (0.057)	10.5*** (2.33)
Household Size	0.41 (0.25)	-3.60 (9.98)
Rurality	0.41 (0.057)	-6.42 (5.35)
Population (10,000)	1.71e-6 (1.39e-6)	-2.62e-6* (1.19e-6)
Average Distance Traveled to Work (mins)	0.0011 (0.0059)	1.89** (0.59)
Public Transportation Use (%)	0.11 (0.13)	-3.16*** (0.81)
Population Density (per sq. mile)	0.0021** (0.00074)	0.0089*** (0.0019)
Male (%)	-0.014 (0.0091)	1.17 (1.52)
Population ≥ 65 Years Old (%)	0.0088 (0.0086)	0.77 (0.49)
Uninsured (%)	0.00082 (0.0072)	-0.59 (0.49)
Non-white (%)	0.0024 (0.0027)	-0.067 (0.15)
Unemployed (%)	-0.044** (0.017)	5.06* (2.47)
4-year College Degree (%)	-0.099 (0.096)	1.67** (0.53)
Income per capita ($10,000)	-2.14e-6 (2.51e-6)	3.36e-4*** (7.62e-5)
Nursing Home (per 100,000)	3.76e-5 (5.46e-5)	0.029*** (0.0046)
COVID-19 Risk Deaths (per 100,000)	1.74e-6 (2.12e-4)	-0.061*** (0.016)
Voted for Trump in 2016	0.0064 (0.11)	-21.5** (6.29)
Republican Governor	0.11* (0.047)	6.80* (3.17)
State COVID-19 Tests (per 100,000)	1.17e-5 (7.73e-6)	0.0025*** (0.00037)
Weighted Two-part Model Estimates for COVID19 Death Rate per 100,000 People		

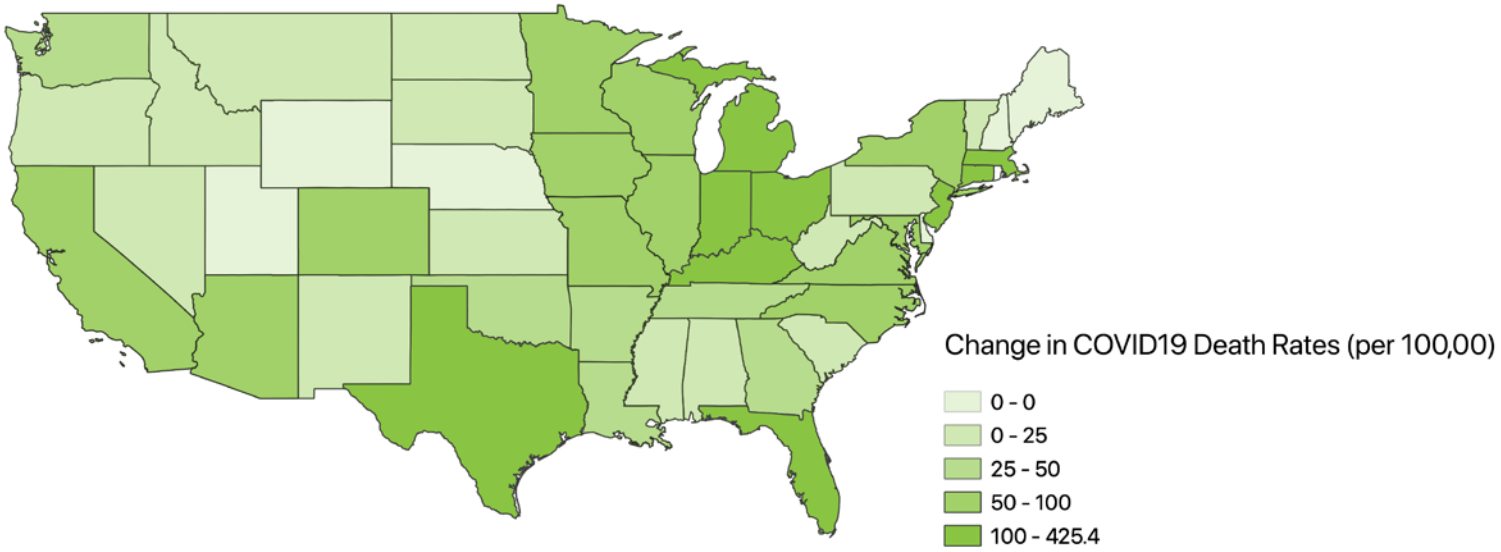
Results: Reduced and Full Models

- Compared with Comprehensive health systems, there were **13.1** more COVID-19 deaths per 100,000 people in counties with Conventional public health systems and **9.12** more COVID-19 deaths per 100,000 people in counties with Limited public health systems.
- Reduced sample and covariate models also showed a significant association between health system composite score and COVID-19 death rates.

Variables	Reduced Sample & Covariate Model (N = 484)	Reduced Covariate Model (N = 725)	Reduced Sample Model (N = 484)	Full Model (N = 725)
Composite System Rating				
Conventional	14.7** (4.46)	12.6** (4.45)	15.6*** (4.30)	13.1*** (3.63)
Limited	11.6** (3.46)	9.14** (3.20)	11.4*** (2.79)	9.12*** (2.18)
Linear Estimates of COVID-19 Death Rates (per 100,000) in Comparison to Comprehensive Public Health Systems				

Results

- Many states could have avoided COVID-19 death rates if they had Comprehensive health system composite scores.



Discussion

- There is a **negative correlation** between COVID-19 death rates and local public health system capabilities.
- Anecdotal reports suggests that many public health departments lacked the resources and staffing necessary to address the pandemic.
- Local public health departments with more resources and stronger partners were able to put more efforts towards COVID-19 response.

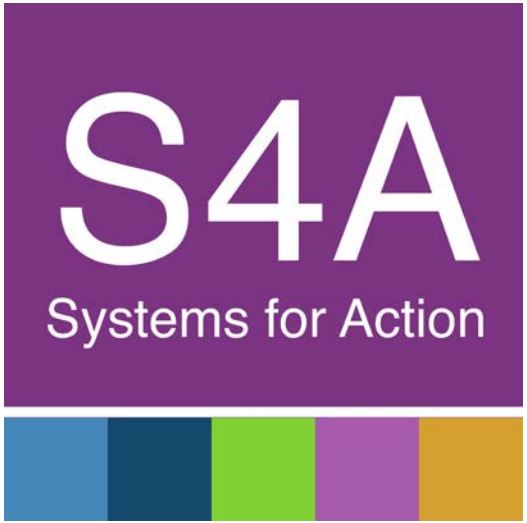
Discussion: Limitations

- Local public health officials as respondents may not have the full knowledge of public health system capabilities in their jurisdiction.
  - Especially if the activities are occurring outside of the local public health department purview.
- Only 71% of NALSYS sample responded, which if influenced by unobserved variable could confound results.
- COVID-19 deaths were under-reported in beginning months (Jan-Mar).
- This analysis is cross-sectional and there may still be additional unobserved confounding.

Discussion: Future Steps

- This analysis looked at the first wave of COVID-19 in the United States (January 2020 – June 2020), but cases and deaths are continuing to rise as counties and states re-opened in July.
- More research needs to be conducted on public health system capabilities and COVID-19 deaths.
- Interviews from public health agencies would supplement our findings and help explain why communities with low composite system scores are related to more deaths in the county.

Questions?



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Daniel J. O'Connell, PhD and Christy Visher, PhD, University of Delaware

Sep 16th | 12pm ET

Addressing the Health and Social Needs of Justice-Involved Young Adults

George Naufal, PhD and Emily Naiser, PhD, Texas A&M University

Acknowledgements

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