Did pre-COVID public health spending improve *early* COVID-19 control? Evidence from US counties

Sneha Lamba, Carrie Wolfson, Carolina Cardona, Natalia Alfonso, Alison Gemmill, David Bishai

Johns Hopkins Bloomberg School of Public Health

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Motivation

- Dramatic failure to control COVID-19 in the US
- Doubts over capability and emergency preparedness of local public health departments
- Debates over restructuring

Research Question

- Did **pre-COVID** local health department spending shield county populations from COVID-19 ***early in the pandemic***?
  - Wide variation in spending of local (county) public health departments pre-COVID
  - Beyond the first 6 months CDC deployments and Cares Act Funds would weaken any relationship between past spending and early success

Data

- **COVID-19 cumulative cases at county level from New York Times**
- **Historical spending variables from Census**
  - Most recently available: 2015-2017 for county; 2016-2018 for state
    - County level public hospital spending
    - County level ***public health spending***
    - County level public welfare spending
    - State level public health spending
    - State level public health spending on communicable diseases
    - State level public health spending on hazard preparation
- Socio-economic, demographic characteristics, state testing rates, health system variables, population health measures, temperatures and other controls at county level from various sources

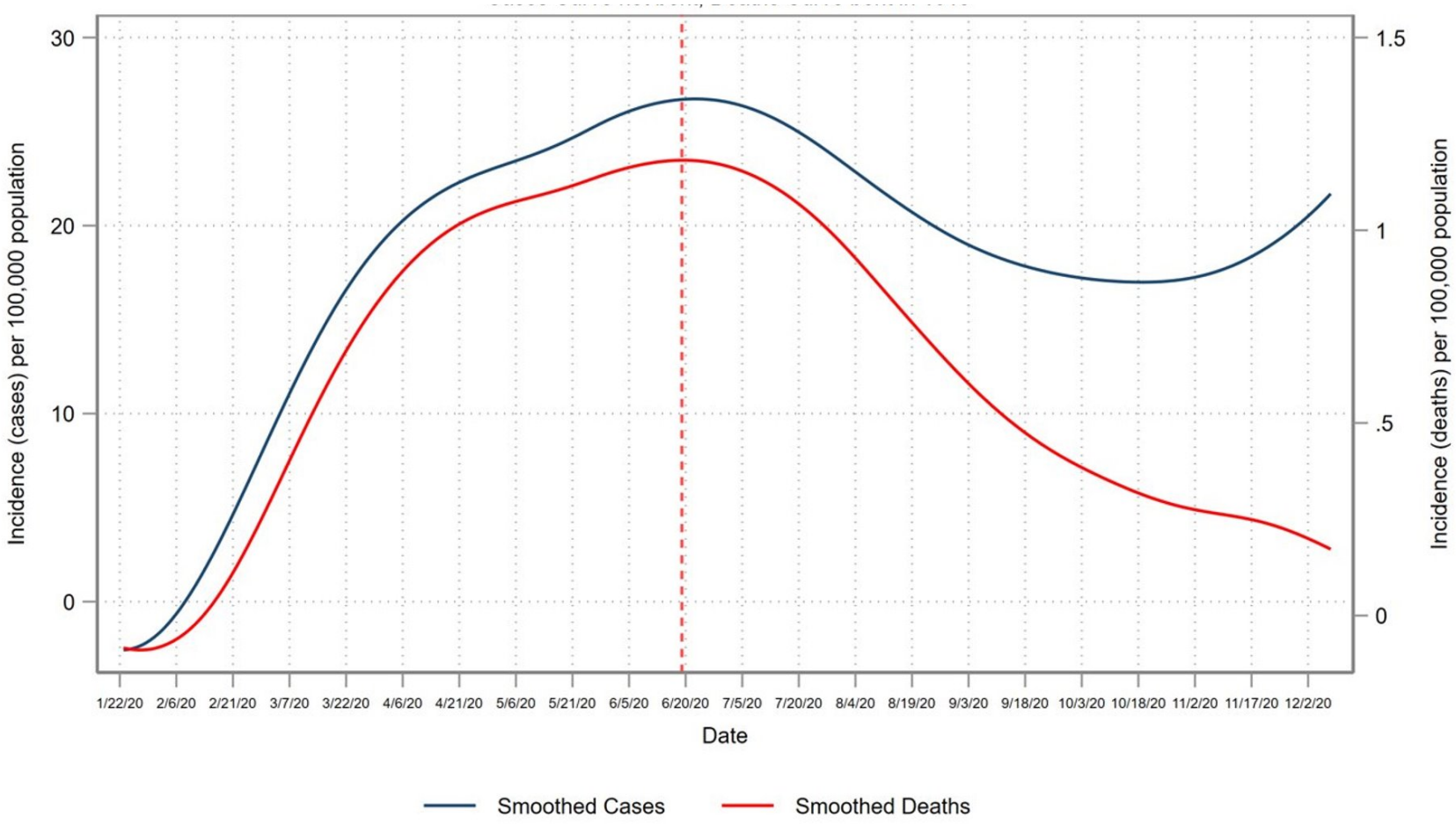
Methods 1

- Included n=2775 counties that reported 10 or more COVID-19 cases between January 22 and July19 2020

- COVID-19 control at the county level ~ **"bending"** of case incidence curve

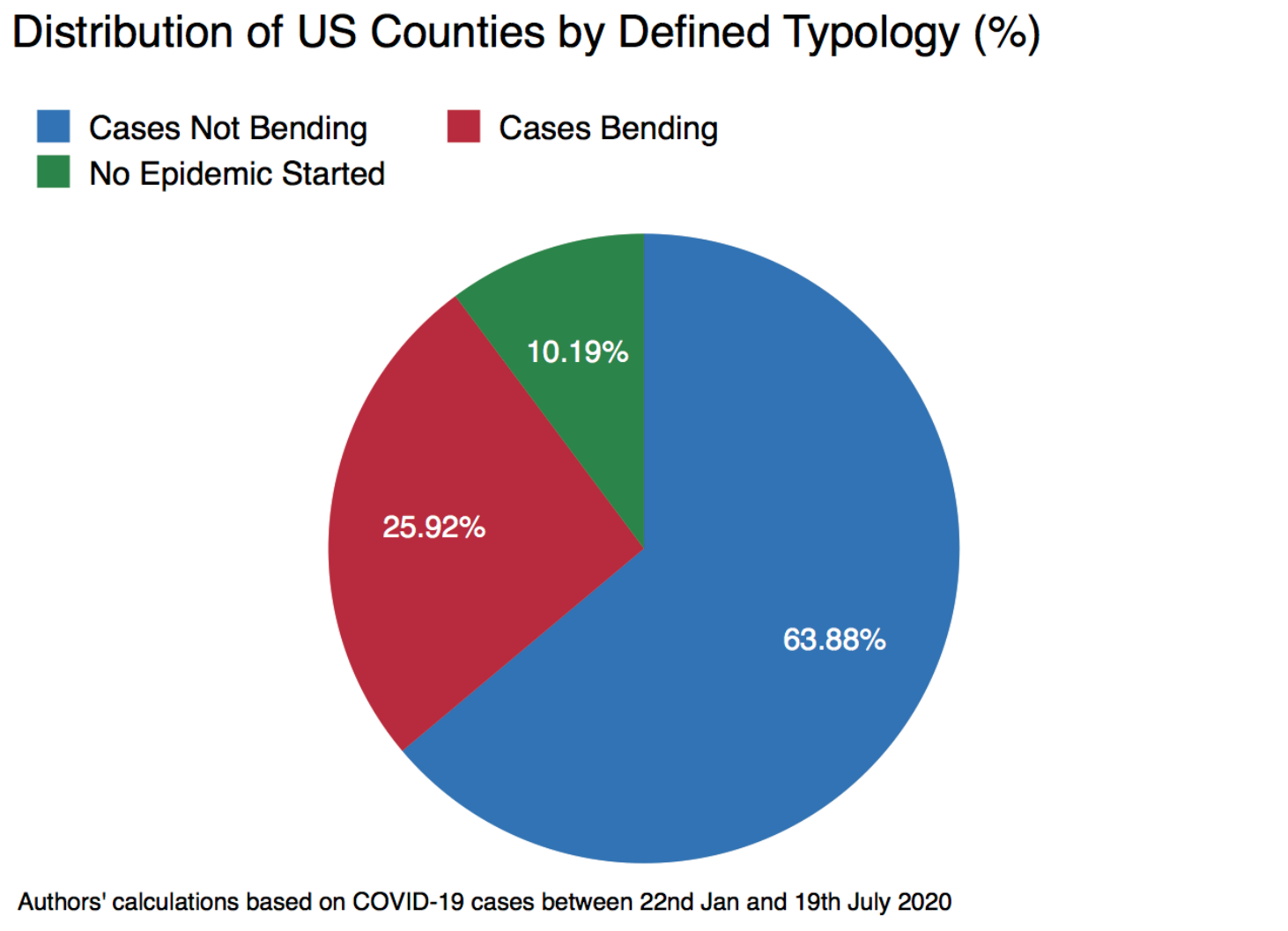
- "Bending" =
  - Existence of a transition from a rising to a falling first derivative of the smoothed case curves
  - Case incidence should have dropped down to 0.5 of peak incidence by 19th July
  - Case incidence should not rise more than 0.75 of peak incidence after 19th July

Example of Case Incidence Curve "Not Bending" for Butler, Alabama



Blue dotted line indicates cases reached apex and red dotted line indicates deaths reached apex

Between Jan 22-July 19, 2020 only 26% of counties had "bent" their case curves



Methods 2

1. **Time to event models** with **time to curve bending** as dependent variable (all counties)
   - All counties with more than 10 cases
2. **Generalized linear models** with **doubling times of case incidence in first 30 days** of the local epidemic as dependent variable
   - All counties with more than 10 cases
3. **Generalized linear models** with **peak incidence rates** as dependent variable (only ”bent” counties)
   - Only “bent” counties

- Controls included in a stepwise fashion to check for robustness of findings

Main Results 1- Estimated Odds Ratios from Time to Event Models with Time to Peak as DV **(County Level Spending)**

	Spending only	Spending + Testing + Demographic	Spending + Testing + Demographic + Income	Spending + Testing + Demographic + Income + Health	Spending + Testing + Demographic + Income + Health + Temperature	Spending + Testing + Demographic + Income + Health + Temperature + Political
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Ln(Hospital County Health Spend Per Capita)	1.043	0.992	0.990	0.993	0.993	0.993
Ln(County Revenue Per Capita)	0.449***	0.638*	0.664	0.715	0.751	0.756
Ln(Non Hospital County Health Spend Per Capita)	0.983	0.986	0.986	0.981	0.980	0.980
Ln(1 + Public Welfare Spending per capita)	0.983	0.988	0.992	1.002	1.017	1.018

Main Results 2- Estimated Odds Ratios from Time to Event Models with Time to Peak as DV **(State Level Spending)**

	Spending only	Spending + Testing + Demographic	Spending + Testing + Demographic + Income	Spending + Testing + Demographic + Income + Health	Spending + Testing + Demographic + Income + Health + Temperature	Spending + Testing + Demographic + Income + Health + Temperature + Political
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Log(State per capita spending - Total)	0.701	0.716	0.721	0.917	0.915	0.911
Log(1 + State Per Capita Spending - Hazard Prep)	0.593**	0.517***	0.512***	0.542***	0.600**	0.600**
Log(1 + State Per Capita Spending - Communicable Disease Control)	1.042	0.973	0.978	1.018	0.934	0.936

Summary of Results

- No statistically significant association between historical county public health spending and rapid control of COVID-19 incidence in terms of time to peak and doubling time in first 30 days of local epidemic
- Log(state level spending per capita on hazard preparation) is associated with a 40% shorter time to peak
- State level spending per capita on communicable diseases was negatively associated with value of the peak incidence rate *among counties that could bend their curve*

Limitations

- Spending data was collected until 2017 (county) or until 2018 (state)
  - assume no significant changes between 2017-2020 in spending patterns
- Do not consider COVID-19 cases beyond first 6 months of the pandemic
  - relevance of historical spending reduces with Cares Act
- Establishing causality
  - cannot disentangle social and political characteristics from local public health spending
- Different categories of public health spending for state and county
  - Limited by census definitions and categories

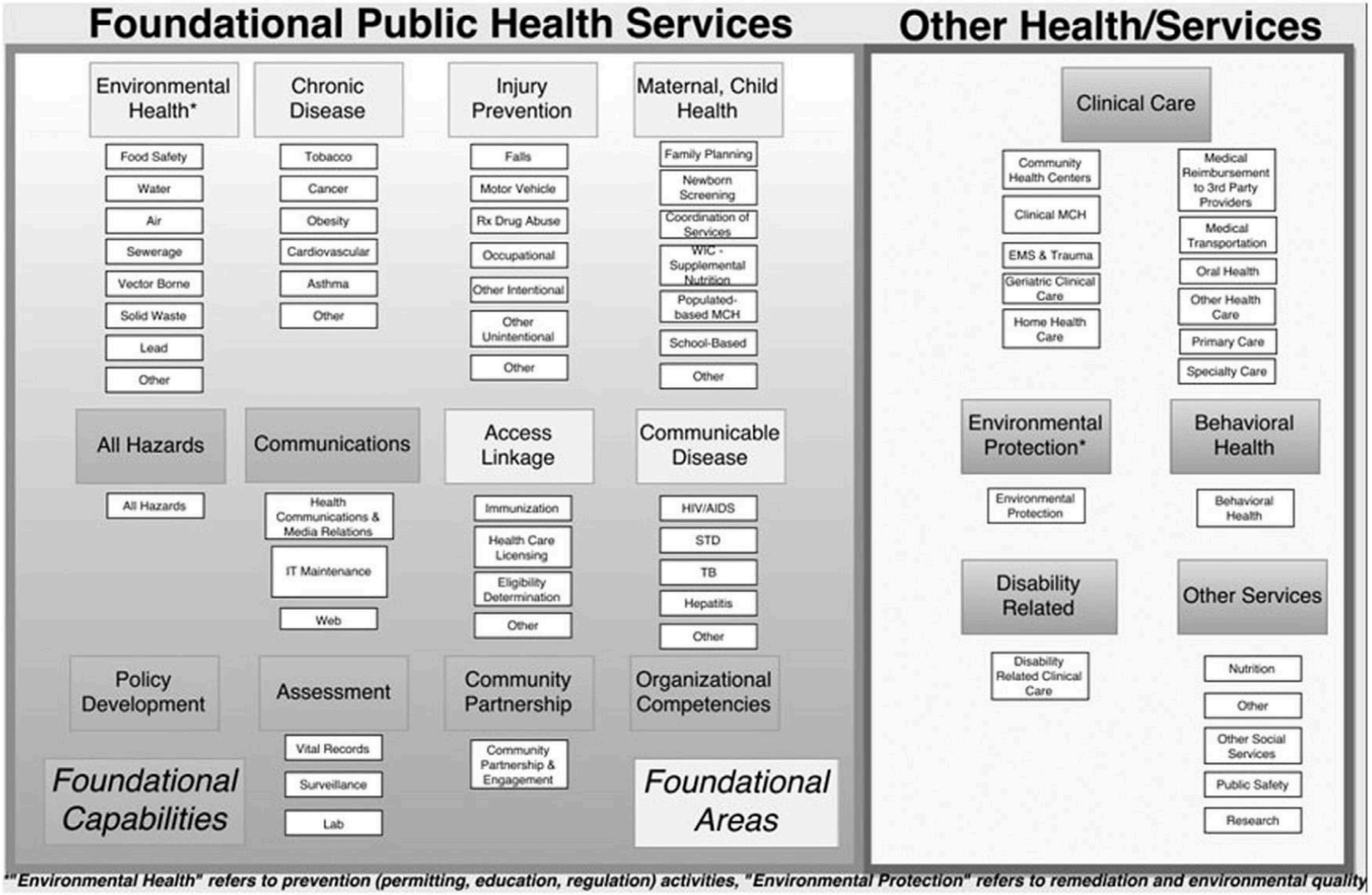
Conclusion

- Results suggest that just increasing resources at the local level is unlikely to be sufficient to prepare counties for future crises
- Public health reform will need thoughtful restructuring

Thank you!

My email: slamba1@jhu.edu

Appendix: Categorizing Health Spending at the State level



Source: Resnick BA, Fisher J, Colrick I, Leider J. (2017) The Foundational Public Health Services as a Framework to Estimate Spending. American Journal of Preventative Medicine 53(5) 646–651.

Appendix: County Level Spending Definition

Expenditure Category	Census Bureau Definition
Community Health Care and Public Health	Provision of services for the conservation and improvement of public health, other than hospital care, and financial support of other governments' health programs. (Referred to by Census Bureau as "Health – Other")
Public Hospitals	Expenditures related to a government's own hospitals as well as expenditures for the provision of care in other public hospitals. Own hospitals are facilities directly administered by the government, including those operated by public universities. Other expenditures cover the provision of care in other hospitals and support of other public hospitals. This function also covers direct payments for acquisition or construction of hospitals (whether or not the government will operate the completed facility) and payments to private corporations that lease and operate government-owned hospitals.
Public Welfare	All classes of welfare programs, including direct benefit transfers and administrative programs.