The Value of Health Insurance during a Crisis: Effects of Medicaid Implementation on Pandemic Influenza Mortality

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(a) Fort Riley Hospital, KS, 1918   (b) Wuhan Red Cross Hospital, 2020

- Pandemics pose significant threats to population health
- To what extent does improved access to medical services mitigate the consequences?

Does Access to Health Care Reduce the Adverse Effects of Severe Health Shocks?

- Setting:
  - Two severe influenza pandemics mid-20th century
    - 1957-58 Asian flu pandemic
    - 1968-69 Hong Kong flu pandemic
    - Geographic variation in pandemic severity associated with underlying county characteristics
  - Expansion in public insurance under 1965 Medicaid program
    - Potential to offset mortality during the 1968-69 pandemic
    - Cross-state differences in eligibility based on underlying welfare recipiency through AFDC
  - We combine *cross-state* policy variation with *cross-county* diffs in underlying severity to estimate the impact of Medicaid on pandemic-related infant mortality

Summary of Findings

- Significant heterogeneity in pandemic severity
  - ↑ mortality in polluted areas (Clay et al., 2018; Hanlon, 2018)
  - ↑ mortality in urban areas (Clay et al., 2019; Grantz et al., 2016)

- Medicaid implementation significantly offset these adverse effects in 1968-69 pandemic
  - Increased access to health care saved about 2,700 infant lives
  - Differential health benefits from insurance relative to non-pandemic years
  - Positive health externality among the broader population

# Influenza Pandemics & IMR, 1950-1979
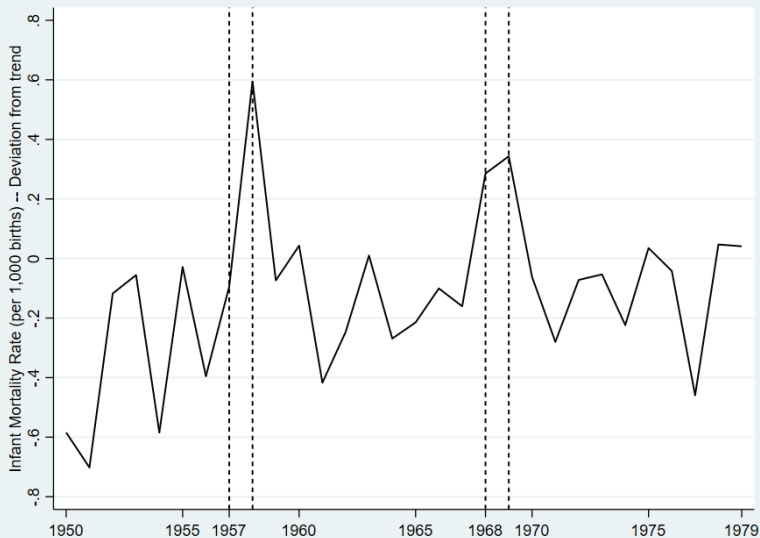
The Influenza Pandemics of 1957-58 and 1968-69

- Each outbreak was responsible for $\sim$ 100K deaths in the U.S.

- Wide differences in susceptibility and disease progression
    - Most experienced minor symptoms, others developed severe complications often due to pneumonia
    - Elevated mortality among infants, elderly, and pregnant women

- Significant geographic variation in pandemic severity
    - Air pollution and urban density were potential contributors

- Access to medical care likely influenced pandemic mortality
    - Vaccinations developed too late to influence spread
    - Intravenous antibiotics and fluids were effective treatments for bacterial pneumonia
    - Postnatal care for low-birthweight deliveries

Establishment of Medicaid

- Medicaid established under 1965 Social Security Amendments
    - Goal to improve medical access to the poor
    - Federal government expanded payments to states for costs of health services
    - Implemented in 37 states in 1966 and 1967
    - Share of uninsured children fell by 40% from 1963 to 1968

- Mandated coverage for all recipients of federally funded welfare programs
    - Cross-state variation in baseline AFDC recipiency is closely tied to Medicaid eligibility
    - Goodman Bacon (2018) finds that Medicaid implementation reduced infant and child mortality

LOW AFDC-BASED ELIGIBILITY
HIGH AFDC-BASED ELIGIBILITY
MEDICAID STARTED AFTER 1967
MEDICAID STARTED IN 1966, 1967

Data
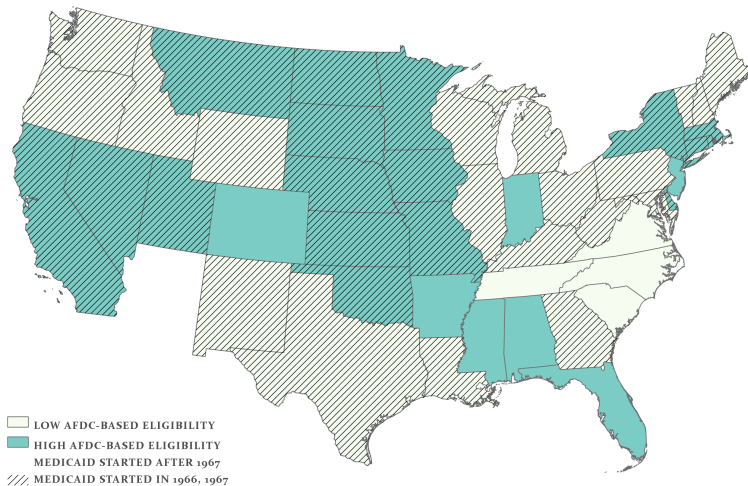
- Main outcome: Annual county-level infant mortality per 1,000 live births from 1950 to 1979

- Modifiers of pandemic severity
  - Coal-fired electricity generating capacity
  - County percentage urban population

- Indicators for access to Medicaid health insurance
  - Fraction of mothers eligible for AFDC in 1965

- Controls for temperature, precipitation, transportation, economic activity, health care infrastructure, and demographic variables

Empirical Framework

$$IMR_{ct} = \beta_1(Pand57_t \times Mod_c) + \beta_2(Pand68_t \times Mod_c)$$

$$+ \beta_3(Pand57_t \times Mod_c \times HighAFDC_s) + \beta_4(Pand68_t \times Mod_c \times HighAFDC_s)$$

$$+ \beta_5(Mod_c \times Post65_t) + \eta_c + \lambda_{st} + \psi X_{ct} + \theta_t Z_{c,baseline} + \epsilon_{ct}$$

- IMR_{ct} denotes county infant mortality rate per 1,000 live births
- Mod_c denotes pandemic modifier (coal capacity, percent urban)
- $Pand57_t$ and $Pand68_t$ are dummies for years 1957-58 and 1968-69
- $HighAFDC_s$ is an indicator for above-median AFDC recipiency
- Controls include county fixed effects (η_c), state-by-year fixed effects (λ_{st}), climatic variables (X_{ct}), and differential trends in baseline economic and demographic county characteristics ($Z_{c,baseline}$)

$$IMR_{ct} = \boxed{\beta_1} \left(Pand57_t \times Mod_c \right) + \boxed{\beta_2} \left(Pand68_t \times Mod_c \right)$$

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- $\beta_1, \beta_2 =$ within-state difference in pandemic mortality based on county-level modifier (in low-AFDC states)

Identification

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- $\beta_3, \beta_4 =$ Differential in this gap for high-AFDC state relative to low-AFDC states (before and after Medicaid implementation)

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- $\beta_3, \beta_4 =$ Differential in this gap for high-AFDC state relative to low-AFDC states (before and after Medicaid implementation)
- Identifying assumption: within-state variation in pandemic severity would have been similar across high- and low-AFDC states absent the introduction of Medicaid
  - No differential pre-trends across states
  - Estimates of β_3 provide placebo test

Medicaid Implementation and Pandemic Severity: Coal

Dep. Var.: IMR	(1)	(2)
Pandemic 1957-58		
x Coal	0.066***	0.066***
	(0.021)	(0.021)
x Coal x High AFDC	-0.022	-0.023
	(0.024)	(0.024)
Pandemic 1968-69		
x Coal	0.049***	0.059***
	(0.015)	(0.016)
x Coal x High AFDC	-0.066***	-0.071***
	(0.019)	(0.021)
$\beta_3 = \beta_4$	0.097	0.065
Dep. Var. Mean [S.D.]	23.6 [13.7]	
Coal Capacity: Mean [S.D.]	5.5 [8.8]	
Observations	83,130	83,130
Counties	2,771	2,771
Adj.R-Squared	0.629	0.632
Fixed effects, Climate Vars, Demographics	Y	Y
Full Controls		Y

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Medicaid Implementation and Pandemic Severity: % Urban

Dep. Var.: IMR	(1)	(2)
Pandemic 1957-58		
x Pct Urban	0.015***	0.015***
	(0.005)	(0.005)
x Pct Urban x High AFDC	-0.004	-0.004
	(0.007)	(0.007)
Pandemic 1968-69		
x Pct Urban	0.017***	0.015***
	(0.005)	(0.005)
x Pct Urban x High AFDC	-0.023***	-0.024***
	(0.006)	(0.006)
$\beta_3 = \beta_4$	0.035	0.019
Dep. Var. Mean [S.D.]	23.6 [13.7]	
Percent Urban Pop: Mean [S.D.]	69.8 [28.2]	
Observations	83,130	83,130
Counties	2,771	2,771
Adj.R-Squared	0.630	0.633
Fixed effects, Climate Vars, Demographics	Y	Y
Full Controls		Y

Robustness Checks and Heterogeneity

- Robustness
  - Similar trends in outcomes across high- and low-AFDC states prior to Medicaid implementation
  - No significant impacts of other War on Poverty programs

- Heterogeneity
  - Horserace regressions show independent effects of Medicaid on coal- and urban-based pandemic mortality
  - IMR effects concentrated within first day of life
  - Differential impacts on non-white IMR

Infant Death Averted

- Better access to health insurance averted 2,646 - 2,777 pandemic-related infant deaths in high-AFDC states
- Large effects per newly insured household imply local health externalities

	Coal + Urban	
	$\beta 4$	$\beta 4 - \beta 3$
	(1)	(2)
	A. High- vs. Low-AFDC Pandemic Infant Mortality	
Δ Infant Mortality Rate	-1.424	-1.357
	[-2.232, -0.616]	[-2.553, -0.161]
	B. High- vs. Low-AFDC Pandemic Infant Deaths	
Δ Infant Deaths	2,777	2,646
	[1,202, 4,352]	[315, 4,798]
	C. Average Treatment Effect on the Treated (ATET)	
Δ IMR per Newly Insured Household	24.79	23.62
	[17.56, 41.63]	[16.74, 39.67]

Conclusion

- Flu pandemics are important negative health shocks
  - Particularly harmful in polluted and urban areas

- Improved health care access helped mitigate the consequences
  - Effects on neonatal mortality suggest a role for improved prenatal health

- Implications
  - Role for both prevention and medical response for pandemics
  - Short-run studies may underestimate the health benefits from public insurance