

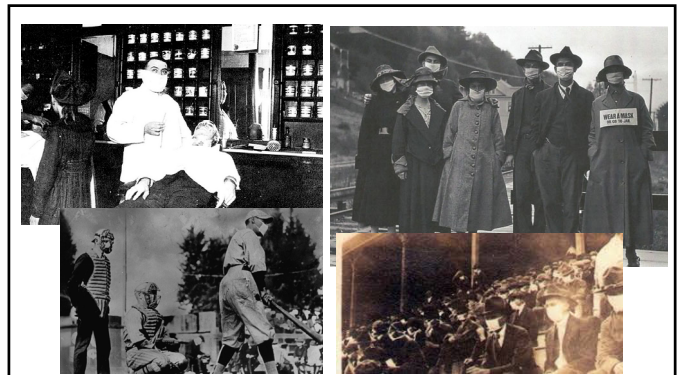
The 1918 Influenza Pandemic

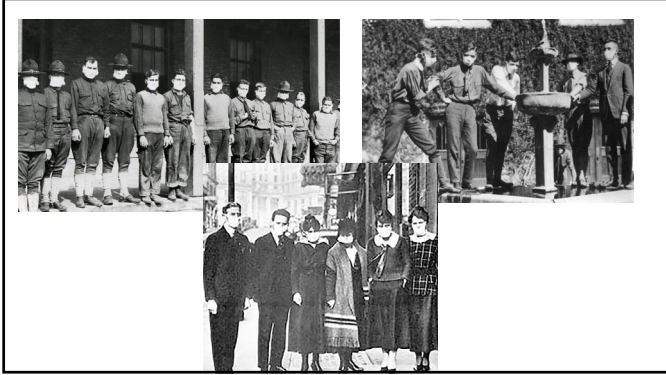
1918 Pandemic

- Thought to have started in Spring 1918 in Haskell, KS
 - But could have been in Europe or China, we really do not know
- Spread throughout the summer via troop movements for WWI
- Showed symptoms of flu but for many, quickly developed into pneumonia and death
- Most deaths were due to secondary infections, e.g. pneumonia
- Thought to have migrated from pigs to human – but unknown

1918 Pandemic

- Estimated that 1/3 of world was infected
- Massive worldwide mortality
 - Patterson and Pyle (1991): 25-39 million, 1.3-2.1% of world's population
 - Johnson and Mueller (2002): 50-100 million, 2.7-5.4%
 - Spreuwenberg et al. (2018): 17 million, 0.95%
- Deaths in the US were estimated to be 675,000 (US population ~ 100 million)
- Death rate in US per million
 - 1918: 6,750
 - COVID: 666





Timeline

- April 1917 – US enters WWI w/ 375K soldiers
- June 1917 – US establishes a draft – builds 32 training camps, 25-50K soldiers each
- March 1918 – Flu-like outbreak Camp Funston in Kansas
- April 1918 – reports of 18 deaths from flu-like symptoms in Haskell, KS
- May 1918 – hundreds of thousands US soldiers head for Europe
- Sept 1918 – Flu appears in Camp Devens, MA and Boston navy yard
- Oct 1918 – peak of the epidemic in the US, killing almost 200K
- Nov 1918 – Armistice for WWI
- Jan 1918 – 3rd wave of the pandemic starts – SF hard hit
- April 1918 – Woodrow Wilson collapses at Versailles Peace conference. Some suspect flu – others a stroke.

Camp Funston, KS



General lack of information

- Most press in countries involved in WWI did not discuss the event
- Thought to damage the war effort
- “Fear is the real enemy”
- Spain was neutral – so there was lots of discussion about the disease in Spanish newspapers. King came down with it in May.
- This is how it became known as the Spanish Flu
- US press rarely covered the topic
- Some thought the press was afraid of prosecution under the Sedition Act

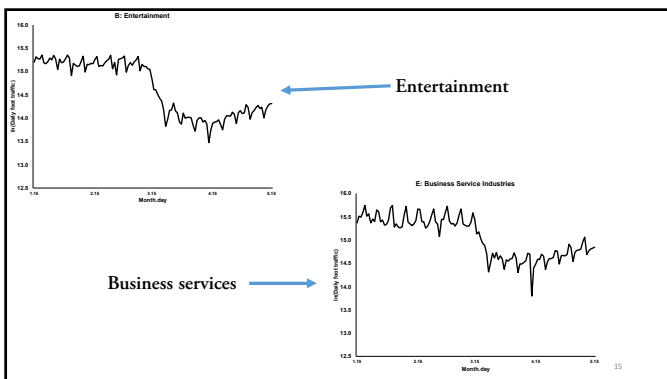
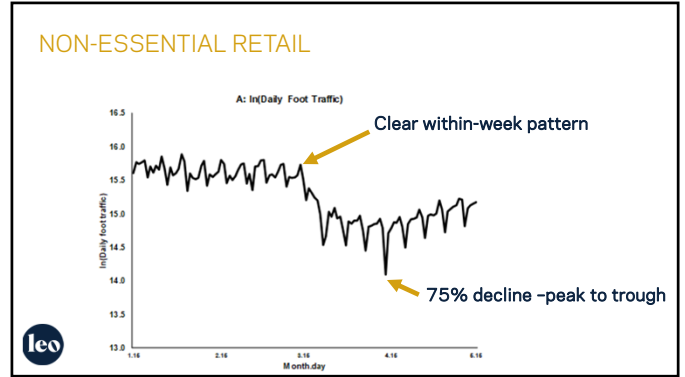
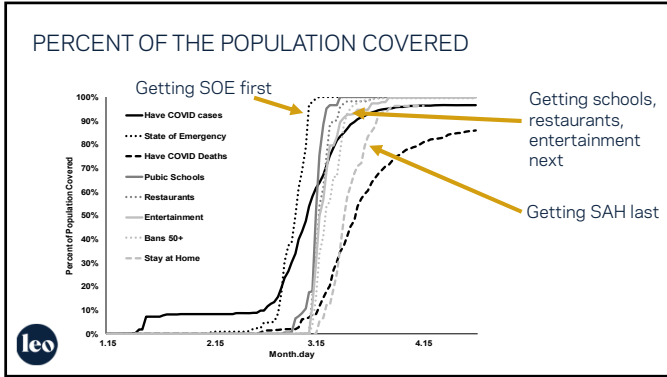
Sedition Act of 1918

- Passed in May
- Punishable offense to cast the government or the war effort in a negative light or hurt war bond sales
- Passed with little opposition from the press
- Incredibly broad authority
- Problem – many newspapers thought reporting on the flu would hurt the war effort
- General lack of information about the flu at the local level

- One official in the UK said it is unpatriotic to worry about the flu when you should be worried about the war
- In Philadelphia – local doctors tried to warn about upcoming parade and the local newspaper refused to run

Events in Early March 2020

- March 4 – CA declares state of emergency
- March 6 – SXSW cancelled
- March 7 – NY declares a state of emergency
- March 11 – WHO declares a pandemic
- March 11 – Trump declares foreign travel ban
- March 11 – NBA suspends season
- March 11 – ND cancels in person classes
- March 12 – MLB suspends spring training
- March 12 – NHL suspends season
- March 12 – NCAA cancels M/W basketball tournament

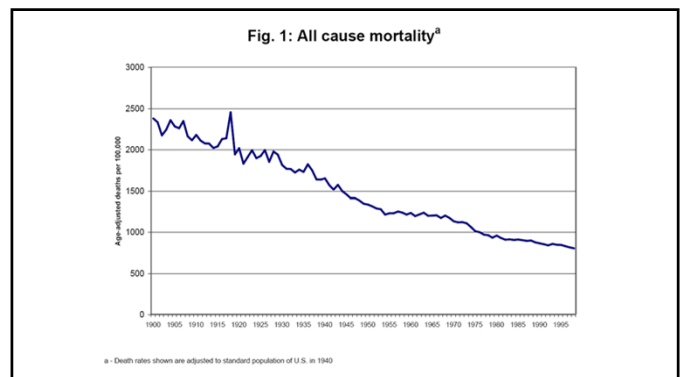
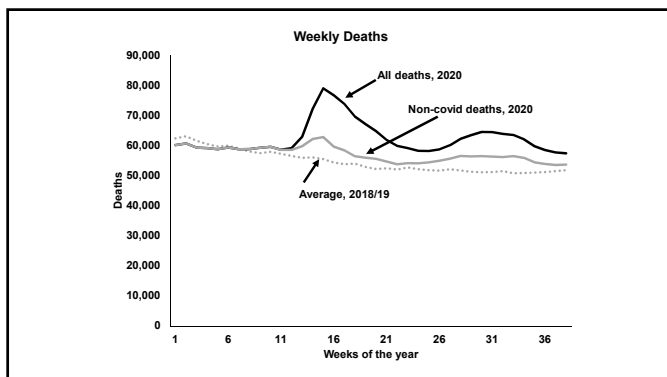
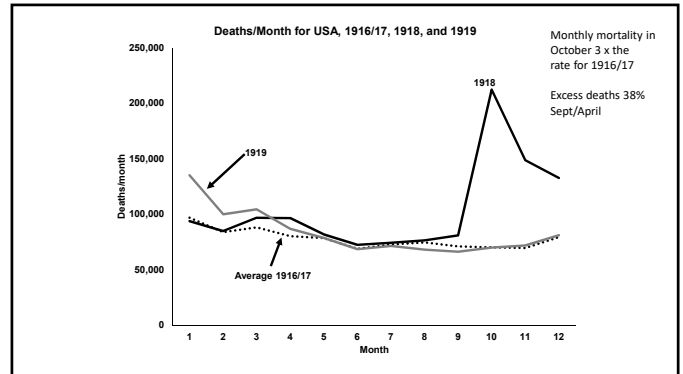


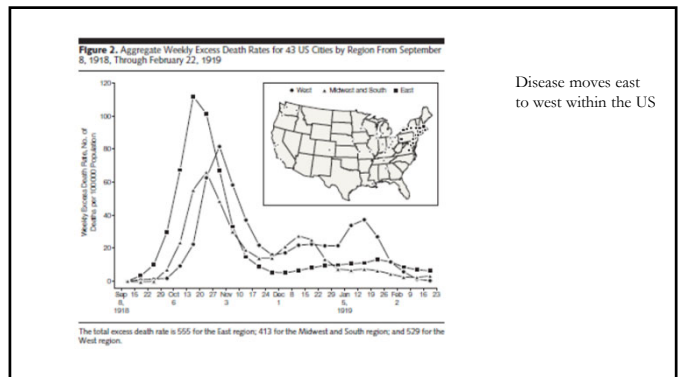
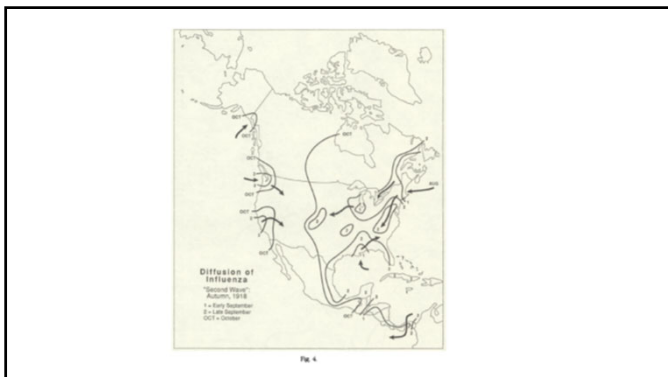
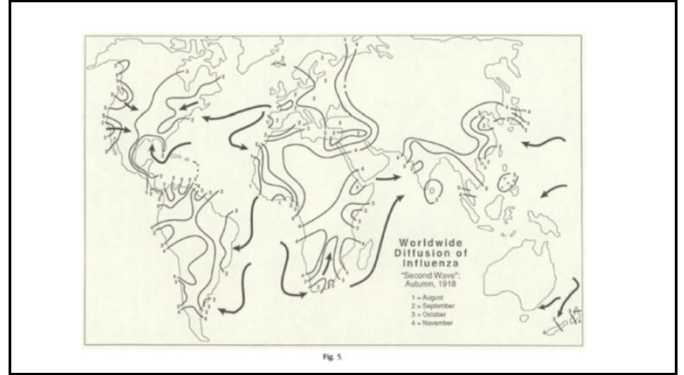
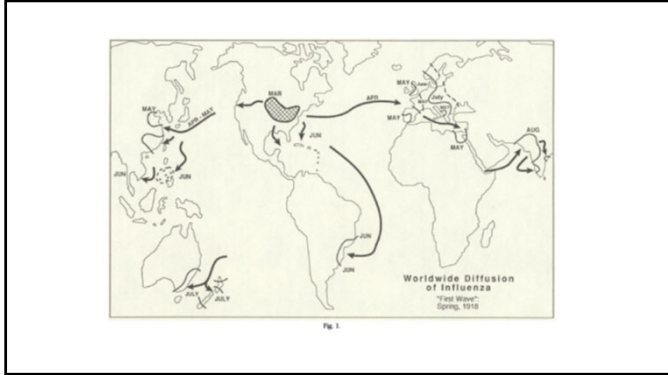
Wilson

- Reluctant to join the war. Won re-election in 1916 with the slogan "He Kept Us Out of War"
- Zimmermann note – Jan 1917 – Germany offer alliance with Mexico if they join the war effort against the US. Germany was going to use submarine warfare against US supply ships in the Atlantic – wanted Mexico to declare war – Germany willing to pay to keep the US occupied
- US could not avoid war – April 6, 1917 – declares war against the axis
- Once in – it was no holds barred
 - Wilson – "Once this leads people into war, and they'll forget there ever was such a thing as tolerance. To fight, you must be ruthless and brutal, and the spirit of ruthless brutality will enter into the very fibre of national life."

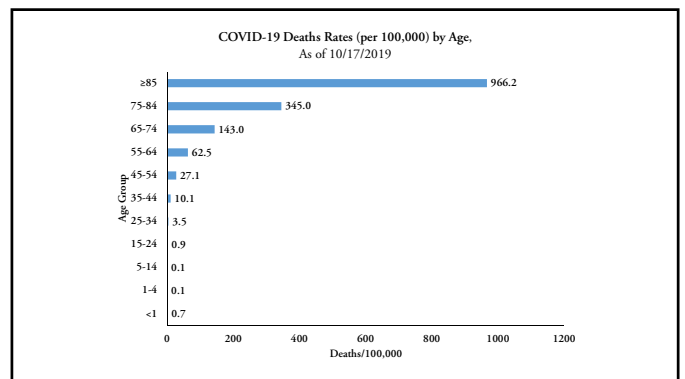
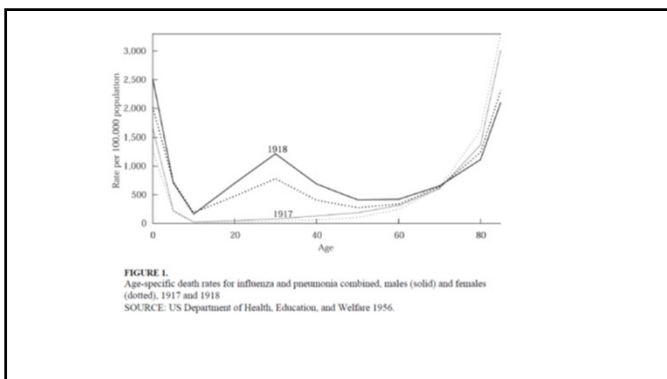
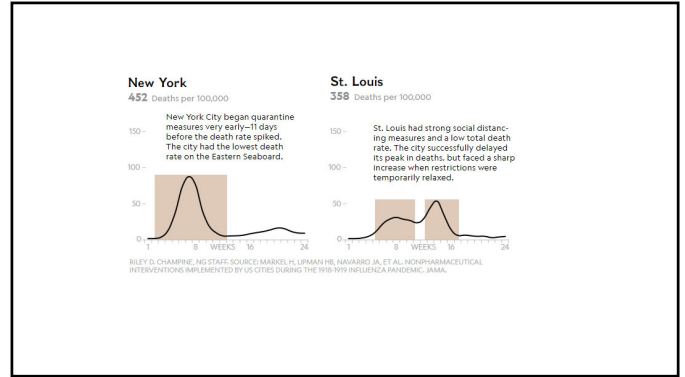
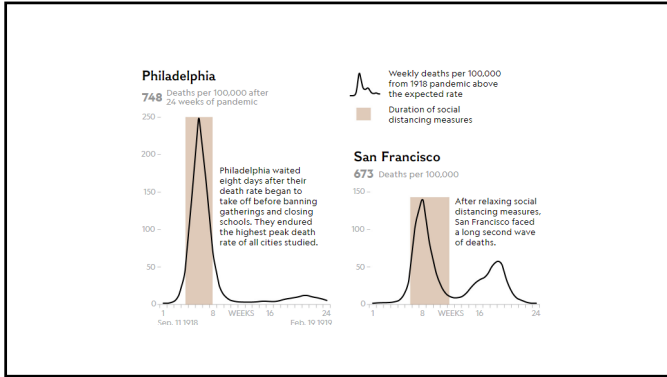
Wilson

- By 1918 – 2 million US soldiers in Europe – another 2 million expected
- Plans to register 13 million men for the draft in the Summer of 1918
- As Devens exploded, Surgeon General implored the Army to stop troop shipments – the disease was out of control
- Army (General Pershing) and Wilson did nothing
- 4 million served in the military during WW I
 - 53K died from combat
 - 63K died from other reason
 - Of those – 45K died of pneumonia/influenza
 - Of those 30K died of the flu before they ever left the US





Disease moves east to west within the US



Why did the disease kill so many young people?

- 1/2 of all deaths aged 20-40
- 3 theories
- 1889 flu provided immunity
 - People over 29 have some immunity
 - Age 29 is peak mortality
 - Problem: lots of deaths in the 30-40 age range – they had immunity
- Young were heavily involved in war effort and so at risk
 - But the young died in high rates in countries NOT in the war
- Young had better immune systems that overreacted
 - Cytokines – proteins secreted in the immune system
 - Cytokine storm – body over-reacts to infection
 - Pro inflammatory response (not good) – shuts down major organs
 - Since the young had “better” immune systems – their systems were more likely to over-react

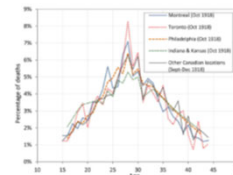
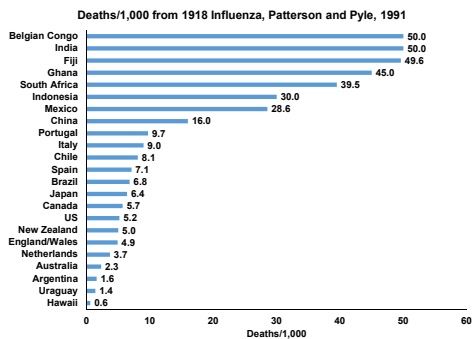
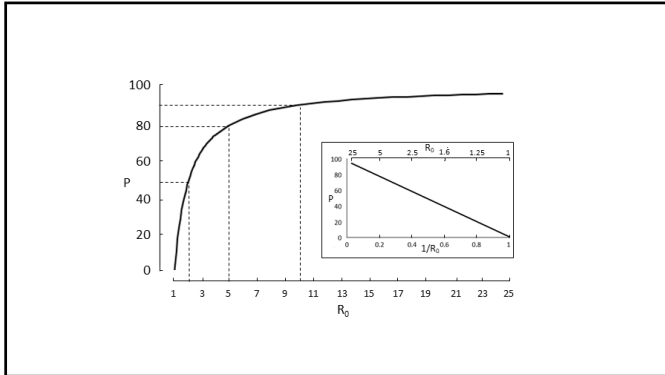


Figure 3. Distribution of deaths from 1918 influenza by age as a percentage of all deaths between ages 15 and 49 in all available Canadian and American locations. *Key for Figure 3: Only age-specific death counts were available from age 15 to 39 for the Philippines, India, and Korea in the 1918-1919 period. For age distribution for those locations in 1918-1919, therefore, the young death counts were only available for certain age groups (i.e., 15, 17, 20, 25, 30, and 35). For those age groups we double the number of deaths (to correspond to single age counts) and use the adjusted number as the relative value of the Mexico, Other Canadian locations, India, Korea, London, Madrid & Spanish Morocco, and Singapore.



R₀

- Pronounced R-naught
- Measures how easily transmittable is the disease – how many people will usually get the disease from one person infected
 - R₀ < 1 – disease will decline and eventually die out
 - R₀ > 1 – disease has the potential to transmit to many people and the possibility of an epidemic or pandemic
- The disease will die out when
 - Herd immunity
 - People are vaccinated
- The higher the R₀, the greater the level of infection needed for herd immunity



Some R_0 of various diseases

Disease	R_0	Disease	R_0
Measles	10-18	Smallpox	3.5-6
Mumps	10-12	SARS	0.19-1.08
Chickenpox	10-12	1918 Flu	1.4-2.8
Polio	5-7	Seasonal flu	0.9-2.1
Cold	2-6	COVID-19	2-4

IFR/CFR

- CFR -- Case-fatality rate (fatality rate for confirmed cases)
- IFR -- Infection fatality rate (fatality rate for actual cases)
- Always as a percent – so multiply by 100
- Easier these days to get the numerator in both numbers
- Harder to construct as the pandemic is ongoing – less knowledge about the denominator (either confirmed cases – certainly actual cases)

IFR for 1918 Flu

- 1/3 of population and 675K deaths, IFR of around 2%
- Other diseases:
 - Seasonal flu: 0.1%
 - COVID-19: 0.25% for non-institutionalized population, estimates range from 0.17 to 1.0% -- depending on what group

3 city stories

- Philadelphia, Pittsburgh, St. Louis
- Philadelphia – ignored concerns – had massive parade as the infection was taking hold – disastrous consequences
- St. Louis – considered to be the model for social distancing and mask wearing – had a modest
- Pittsburgh – state locked down Pittsburgh after Philadelphia. Did what they were supposed to do – but had the highest death rate of any city – why?

Philadelphia

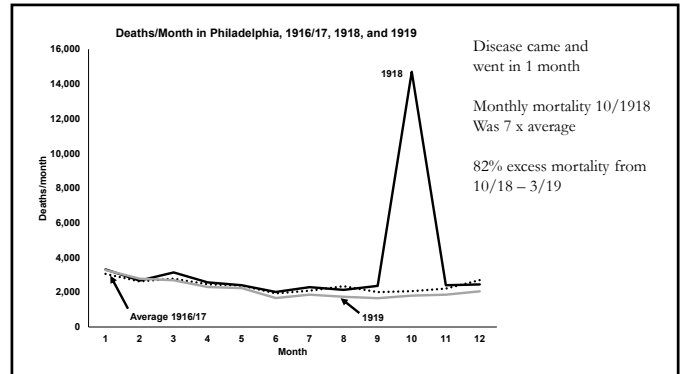
- City was run by a corrupt political machine
- Had been assigned to raise \$259 million in war bonds
- A Liberty Bond parade was scheduled for Sept 28, 1918
- Cases started to appear in late September.
- Historians disparage the Director of Public Safety Wilmer Krusen, as not reacting to the outbreak and allowing the parade to continue
- Facts are probably different – Krusen has little ability to stop the parade
- Parade was a political event – attended by Governor, mayor, US senator and CEO of Bethlehem Steel, largest munitions producer in the country

Philadelphia timeline

- Sept. – outbreak at Camp Devens and Boston Navy Yard
- Sept 9: 300 sailors arrive from Boston
- Sept 11: 19 reported ill
- Sept 15: 600 sailors/marines report ill to the Navy hospital
- Sept 18/21: 41 die from the flu
- Sept 26: US Army cancels draft given outbreaks at Army camps
- Sept 27: 200 are admitted to the city hospitals with influenza

Philadelphia timeline

- Sept 28: Liberty bond parade held – 2 miles long 200K participants
- Oct 1: virtually all hospital beds filled with flu patients
- Oct 3: City bans all public meets and closes churches, schools, theaters
- Oct 4: Saloons are closed by the state. 1st emergency hospital opened – all 500 beds filled the 1st day
- Oct 26: new cases have dropped rapidly and public meeting ban is lifted
- Nov 11: new cases have virtually stopped



St. Louis

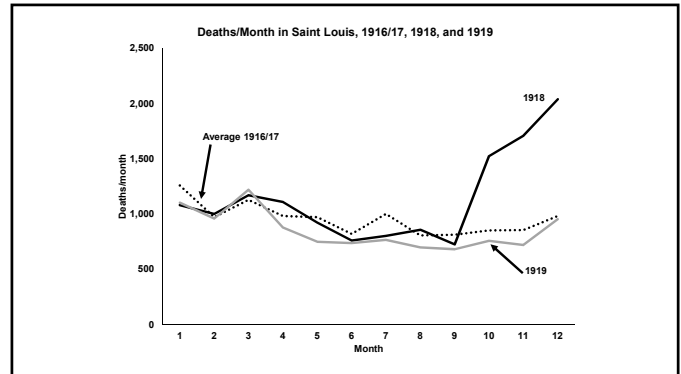
- In late Sept, Health Commissioner for the city monitors the situation in Boston closely
- Knew was matter of time the flu would make it to the midwest
- Required all cases of influenza be reported to city
- Jefferson Barracks was WWI training ground nearby. Had 1st case Oct 1. Quickly prohibited visitors to the facility and banned all passes
- 1st cases in the city Oct 5
- Cancelled Liberty Loan parade
- Closed theaters, pool halls, etc. and banned public gatherings on Oct 8th

St. Louis

- Churches closed Oct 8
- School closed Oct 9
- Private hospitals refused flu patients – Red Crossed organized massive home visits by nurses
- Police that walked a beat filed reports of where there were outbreaks
- Oct 10 – encouraged stores to limit weekend sales to decrease foot traffic
- Oct 20th – restricted business hours at downtown retail/restaurants
- Nov 2nd – placed police in stores to keep traffic moving
- Nov 9th – closed all essential business
- Nov 11th – Armistice day – stores remained closed so celebration could be outside where transmission rates were lower

St. Louis

- Cases fall through November
- Dec 9th – schools reopen for juniors and seniors
- Dec 20th – all restrictions removed
- St. Louis considered a model of response – had the 6th lowest excess mortality rate

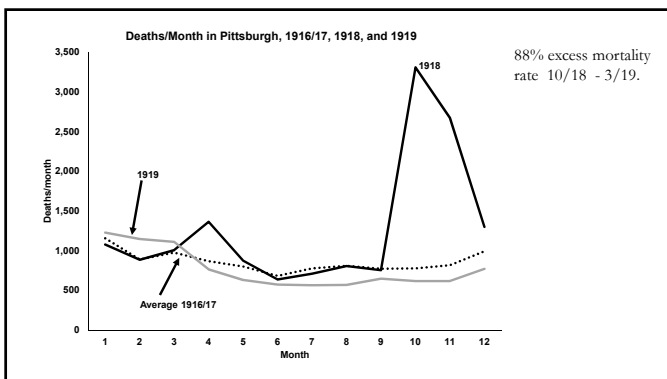
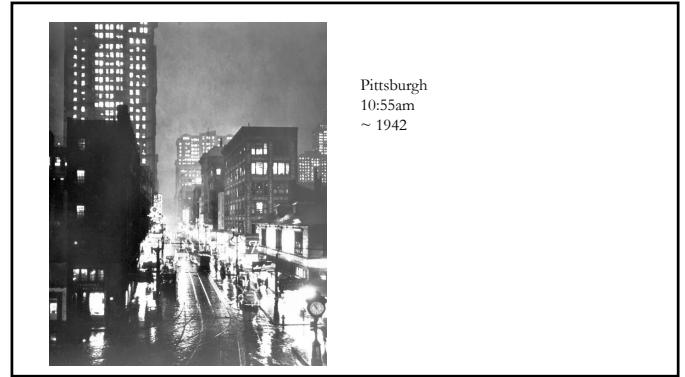
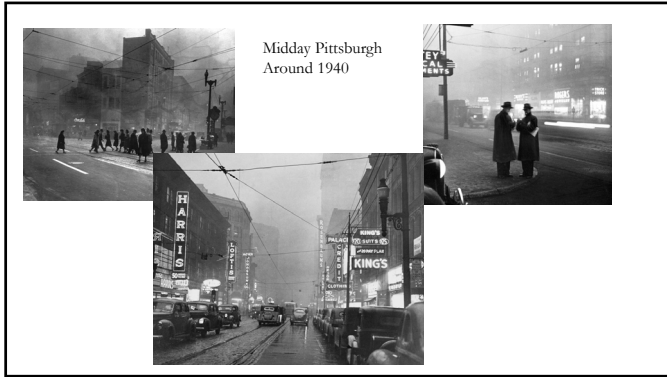


Pittsburgh

- Pittsburgh does not get its 1st case of influenza until Oct 1
- Same day – Philly had 635 cases in 24 hours
- State issues statewide closure of saloon, theaters, movie houses, bans all public meetings, funerals, parades, visits to the sick. School and church closings left to local jurisdictions
- Churches asked to limit attendance
- Attendance at schools fell 40% as parents feared the flu. Due to dwindling attendance, schools were eventually closed Oct. 24

Pittsburgh

- By the end of Oct., saloon owners were actively lobbying the state to re-open bars. Mayor traveled to Harrisburg to lobby the state health commissioner
- Nov. 4, state agrees to lift bans, but state health commission extends until Nov. 9. Mayor says residents will ignore and open anyway.
- Schools re-opened Nov 18th
- Pittsburgh followed orders – but why did they have the highest death rate of any city?



Clay et al. (2019)

- Data on excess mortality in 438 cities in 1918
 - 11 years worth of data by city (1915-2015)
 - $y_{ct} = a_c + b_c t + \epsilon_{ct}$
 - Drop 1918
 - Regress on a time trend
 - Predict mortality for 1918 – call this y_{ct}^p
 - $(y_{ct} - y_{ct}^p) / 10,000$
- Explain the demographic determinants of excess mortality

	(2)
Urban mortality in 1918	-18.46***
High vs. low	(4.12)
Middle vs. low	(1.40)
Infant mortality 1910-1916	20.06***
High vs. low	(4.01)
Middle vs. low	(1.97)
Illiterate in 1910	21.20***
High vs. low	(4.00)
Middle vs. low	(1.84)
Proximity to WWI base	5.25
High vs. low	(1.41)
Middle vs. low	(1.76)
Coal capacity	4.27**
High vs. low	(1.47)
Middle vs. low	(1.41)
Observations	438
R-squared	0.203

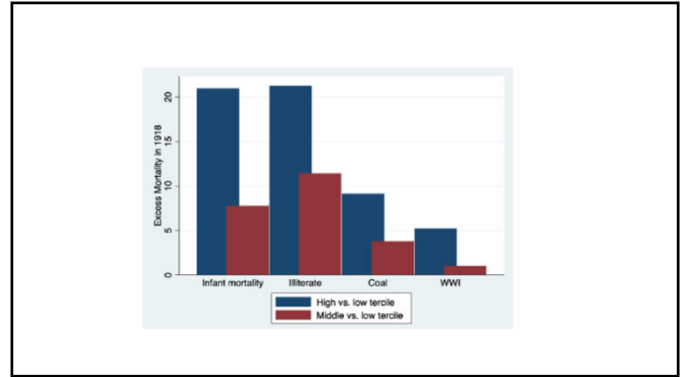
Urban areas hit less

Areas with poor infant Outcomes hit worse

Areas with high illiteracy Rates hit worse

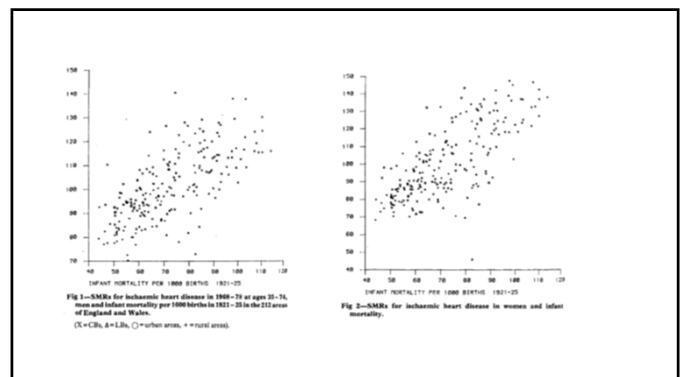
Proximity to a WWI training facility had no impact

High use of coal in Electricity made it worse



Barker hypothesis

- In utero conditions pre-program the fetus for future metabolic conditions
 - A fetus deprived of calories will learn to live off less
 - When the environment improves as an adult, the body, used to living off of less, is more prone to metabolic disorders (obesity, type II diabetes)
- Alternative name – Thrifty phenotype
- Original test – adult cardiovascular disease rates more likely in low birth weight infants



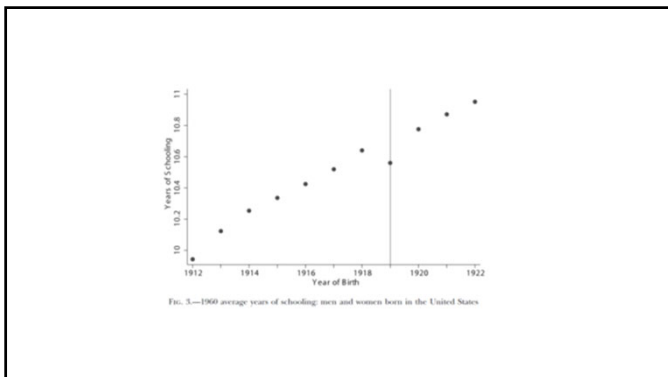
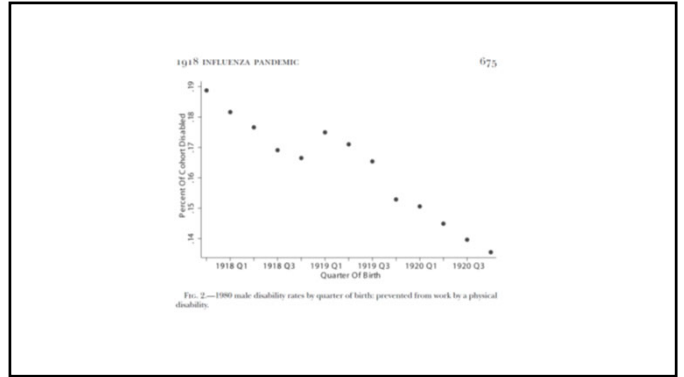
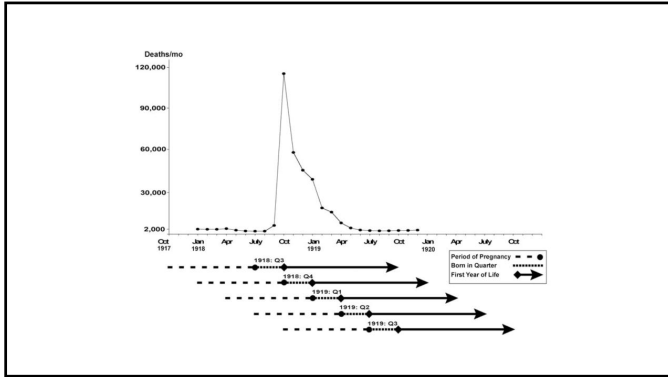


FIG. 5.—1960 average years of schooling: men and women born in the United States