Defusing COVID-19: Lessons Learned from a Century of Pandemics

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BACKGROUND

- There are common patterns to the stories told as pandemics unfold.
- Amidst COVID-19, we found it crucial to identify and apply lessons from the behavior and spread of previous pandemics to gain insight into their interruption.
- We conducted a historical review of pandemics in the 20th century and compared their epidemiological aspects, as well as their social, environmental, and public health impacts.
- Our goal was to understand the biosocial influences on the rise and spread of pandemics to identify the most effective public health responses.

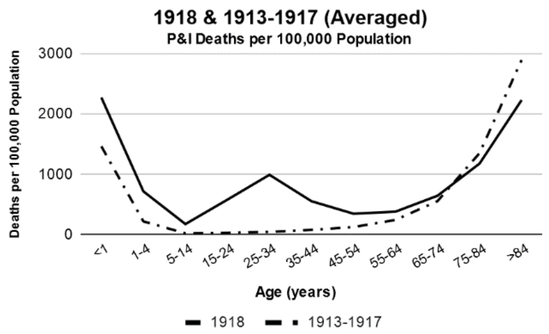
Pandemic	Total Deaths (Globally)	Case Fatality Rate (%)	Basic Reproductive Number (R_0)
Spanish Flu (1918–1919)	20–50 mill	CMR ~2.5% *	2.11–2.5
Asian Flu (1957)	700,000–1.5 mil	0.02–0.05%	1.8
Hong Kong Flu (1968)	500,000–2.0 mil	0.67%	1.28–1.58
Swine Flu (2009)	2185–284,000	1.09%	1.33–1.38
SARS (2003)	774	9.6%	2.4
MERS (2012)	858	34.4%	1.1–1.2
COVID-19 (2020)	1,385,000	2–3%	1.5–3.5

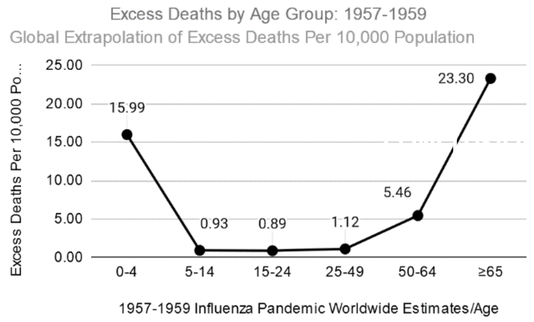
Table 1. * Crude mortality rate (CMR) of ~2.5% calculated based on excess mortality observations

METHODS

- Obtained epidemiological data on coronaviruses and influenza viruses from the U.S. Public Health Service, World Health Organization (WHO), and peer-reviewed publications.
- Analyzed the relationship between peak pandemic death rates, time of the year, and population characteristics ("biosocial" drivers of pandemic spread).
- Assessed various non-pharmacologic interventions (NPIs), the timing of their implementation, and the regional impact these had on subsequent pandemic waves.

RESULTS





Virus Pandemic Years	Waves (Duration)	Timing
H3N8 - Russian Flu 1889–1890	3 (3 years)	W1: 1889–1890 / W2: 1890–1891 / W3: 1892–1893
H1N1 - Spanish Flu 1918–1919	3 (9 months)	W1: Jun–Jul 1918 / W2: Oct–Nov 1918 / W3: Feb–Mar 1919
H2N2 - Asian Flu 1957–1959	3 (15–18 months)	W1: Sep–Dec 1957 / W2: Dec–Mar 1958 / W3: Dec 58–Apr 59
H3N2 - Hong Kong 1968–1970	2 (12–18 months)	Based on global circ. / W1: Jul 68 to Aug 69 / W2: Sept 69–Sept 70
H1N1 - Swine Flu 2009–2010	1 Epidemic, 2 Pandemics (12 months)	E1: Jan–Mar 2009 / W1: Mar–Aug 2009 / W2: Aug 09–Jan 10

Table 2. Comparison of duration and wave seasonality of influenza pandemics from late 19th to 21st century

CONCLUSIONS

- In the past 100 years, the majority of pandemics have been caused by respiratory viruses that emerged during the winter in the Northern Hemisphere, during the second half of the typical flu season.
- All pandemics have originated from a non-human source. Most have exhibited the ability to cross from humans back into certain animal populations, thus serving as a site for additional antigenic shifts or genetic recombination events. Given that SARS-CoV-2 is capable of infecting animal hosts, similar events could result in viral mutations that impact herd immunity.
- The first 2–3 waves of a pandemic are most likely to occur within 12–15 months of the virus originating. That being said, the speed at which pandemics spread has increased significantly given the rise in population density, globalization, and ease of travel. Pandemics are becoming more common and more difficult to control.
- School-age children have been major drivers of household transmission and pandemic spread. Early institution of mitigation interventions such as school closures, interruption of mass gathering, travel restrictions, and community quarantine is critical to achieving at least a 50% reduction in transmission, which correlates with a basic reproductive number lower or equal to one (R_0 ≤1). These have historically had the largest, most cost-effective impacts on incidence and mortality.
- Pandemics disproportionately impact socially disadvantaged populations. They do not produce inequalities but reveal issues we have failed to address as mandates of public health.

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