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The Evidence Behind Social Distancing

Introduction

At the time of writing, there are 52,145 confirmed COVID-19 cases in the United States, with 677 attributable deaths. Worldwide, 415,876 cases have been reported, with 18,574 deaths.[1] The terms "social distancing" and "flattening the curve" have been popularized by social media and are quickly becoming part of the American vernacular.

Pandemic response involves both containment and mitigation strategies. Containment strategies seek to prevent pandemic spread through quarantine measures, while mitigation strategies aim to lessen the negative effects, once community spread is apparent. Social distancing is an important tool of mitigation.

Governors in several states have issued state-wide "sheltering in place" orders mandating closure of all non-essential business, and ordering all non-essential personnel to stay in their homes. Almost all state and local governments have promoted other social distancing measures in concordance with the most recent Centers for Disease Control and Prevention (CDC) pandemic guidelines.[2]

This DICON newsletter will define social distancing, and review the literature supporting such measures.

What is Social Distancing?

Social distancing means deliberately increasing the physical space between people to avoid spreading illness. This includes changing personal behaviors to maintain a distance of six feet from others. Examples include avoiding handshakes and close contact, mass gatherings, working from home if possible, closing schools, communicating electronically instead of in person and canceling or postponing conferences or meetings.

The goals of social distancing are three-fold[2]:

1. Gain time to better assess the dynamics and prevalence of symptomatic and asymptomatic transmission of SARS-CoV-2
2. Slow the spread of infection to allow health systems to cope with increased demand for hospital care
3. Allow time for development of antiviral therapies and vaccine production

While social distancing makes intuitive sense, scientific evidence supporting its use is limited to historical analyses and mathematical modeling studies, addressed in the next sections.

What is "flattening the curve?"

Flattening the curve refers to using protective practices to slow the rate of COVID-19 infection so hospitals have room, supplies and doctors for all of the patients who need care.

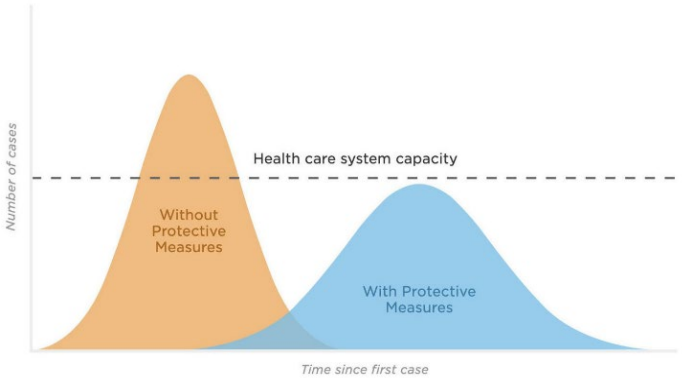

Figure 1. Flattening the Curve. Source: www.npr.og

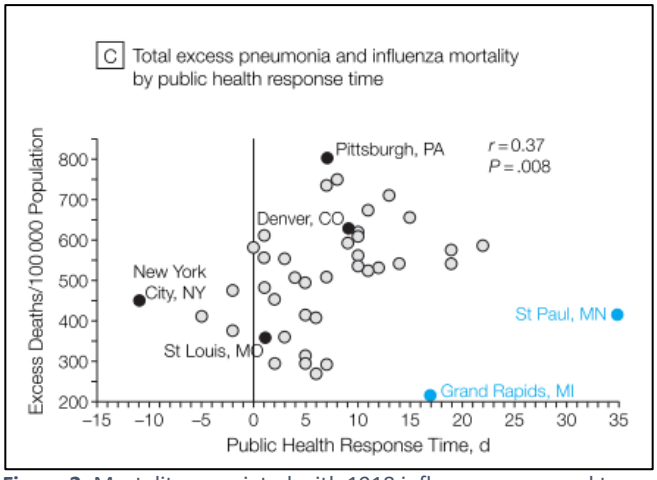

Figure 2. Mortality associated with 1918 influenza compared to time to public health intervention. Cities in blue represent outliers.

Lessons from the 1918 Influenza Epidemic

The 1918 influenza outbreak was the deadliest pandemic in history, killing an estimated 40 to 100 million persons worldwide. Nonpharmaceutical interventions, including social distancing, were the only methods available to confront the pandemic, as a vaccine was not available until 1938. Decades later, several investigators examined historical records to evaluate the efficacy of local responses throughout the United States.

Markel and colleagues[3] reviewed three interventions—school closures, cancellations of public events (including closures of bars and restaurants), and quarantines—carried out at 43 cities (pop. 23 million) in the United States from September 1918 through February 1918. Excess death rates from pandemic influenza during this 5-month interval were compared to average monthly deaths from influenza and pneumonia from 1910 to 1916. Decisions to implement social distancing measures were the responsibility of local governments. In many instances, social distancing measures were implemented **after** excess mortality or morbidity had occurred in specific cities.

Several conclusions can be drawn from Merkel et al.'s retrospective analysis.

1. Delayed interventions were associated with higher excessive death rates. (Fig. 2).
2. Cities that acted in a timely and comprehensive manner observed lower excess death rates.
3. Cessation of social distancing measures often resulted in subsequent increases in excess death rates.

The Concept of R_0

R_0 is a composite measure of infectivity that is dependent upon intrinsic factors of viral transmissibility and control measures taken to counteract spread. R_0 is roughly equivalent to the number of non-immune persons who become infected from contact with one infected individual. An epidemic will ultimately terminate spontaneously when R_0 is <1.

Mathematical Modeling

More recent mathematical models provide findings consistent with the conclusions of the study by Merkel et. al. discussed above. For example, during the 2009 H1N1 influenza epidemic, researchers created a model to simulate the expected effects of social distancing on pandemics with variable R_0 values.[4]

These investigators simulated 4 interventions:

- School closures
- Self-isolation of 90% of cases,
- Workplace nonattendance/absenteeism, and
- Avoidance of mass gatherings

All four interventions needed to be introduced within two weeks of a community index case to arrest viral spread and decrease peak attack rates in an epidemic caused by a pathogen with an R_0 value of 2.5 (similar to what has been estimated for SARS-CoV-2).

The investigators concluded implementation of any one single measure would decrease attack rates but would not prevent epidemic spread. The authors estimated that all four of the evaluated social distancing measures would need to remain in place for 5 months to be effective. Subsequent analysis of data obtained from the 1918 pandemic corroborates this estimate.[5]

Attitudes Regarding Social Distancing

Eastwood and coworkers[6] surveyed the Australian public regarding their willingness to comply with recommended public health interventions during the 2009 H1N1

pandemic. Eighty-three percent of respondents stated they would avoid public places for up to one month, while only 62.7% agreed to avoid all social gatherings. Individuals were more likely to follow measures if they were over 60 years of age, or if they had previously suffered from an influenza-like illness (ILI).

Mitchell conducted a survey of university students and faculty affected by an H1N1 outbreak at the University of Delaware.[7] A total of 423 students with acute respiratory illness were queried; 94 % admitted that they left their household before completion of the recommended self-quarantine. When asked to provide a reason, 44.4% responded they simply "*wanted to go out*." Similarly, only 43.1% of faculty suffering from influenza-like illness missed any days of work. Level of concern regarding the H1N1 outbreak correlated strongly with willingness to take social distancing measures.

Baum convened focus groups in 2008, prior to the H1N1 pandemic, to assess public perceptions of social distancing.[8] Most participants felt a "need to know that threat of disease was imminent and severe" before complying with social distancing. Others voiced distrust in government or fear of losing employment as strong reasons for straying from public health interventions.

Social distancing measures may mitigate pandemics and lessen burdens placed on health care systems, but at the cost of political and economic consequences. While economic analysis of a simulated influenza pandemic suggests a combination of personal social distancing measures (discussed above), school closures and antiviral therapy to be cost-effective, this finding is strongly influenced by population compliance.[9]

Social distancing may have other unintended consequences. Chronic social isolation increases the risk of mortality by 29%. There's a correlation between perceived social connectedness and stress responses.[10]

COVID-19

The success that social distancing measures have in mitigating the SARS-CoV-2 pandemic depend upon the public response. Without early and aggressive implementation, and without broad public support, these measures will be ineffective.

Key Points

- **Social distancing consists of personal and public health interventions, including school closures, workplace avoidance, cancellation of mass gatherings and self-isolation.**
- **Evidence for social distancing is based primarily on historical analyses of previous outbreaks and inferential mathematical modeling. Controlled studies during an ongoing outbreak would be impossible to undertake and unethical.**
- **Implementation of measures prior to or shortly after local community spread may be effective in preventing a local epidemic. The same measures may modestly reduce attack rates if they are deployed too late.**
- **Social distancing can have negative effects on the economic, political and mental health of the community. Efforts to promote public understanding of the need for such measures are paramount.**

Further Information

Readers with further interest in mathematical modeling of SARS-CoV-2 may find the following site of interest:

https://penn-chime.phl.io/ : Allows users to input data according to local statistics to predict rates of admission, ICU admission and mechanical ventilation for individual hospitals.

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