Summary of Recent Evidence Relevant to the COVID-19 Response
March 2, 2020

This list was compiled by Kayoko Shioda, Mary Petrone, and Hanna Ehrlich, PhD candidates at Yale School of Public Health and Rita Gilles, JD candidate at Yale Law School. We have compiled much of the relevant and representative literature pertaining to the impacts of travel restrictions, quarantines and isolation, and social distancing on the spread of SARS-CoV-2, the etiologic agent of COVID-19. We also include some key research on the impacts of the same movement restriction measures on SARS, pandemic influenza, and infectious disease more broadly. The list is not intended to be a thorough systematic review. The most recent literature search was conducted on March 1, 2020.

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1. **Effectiveness of travel restrictions**
    - *Assessing the impact of reduced travel on exportation dynamics of novel coronavirus infection (COVID-19)* [*(Anzai et al. medRxiv 2020)*](#)
        - "From 28 January to 7 February 2020, we estimated that 226 exported cases (95% confidence interval: 86, 449) were prevented, corresponding to a 70.4% reduction in incidence compared to the counterfactual scenario. The reduced probability of a major epidemic ranged from 7% to 20% in Japan, which resulted in a median time delay to a major epidemic of two days."
    - *The effect of travel restrictions on the spread of the 2019 novel coronavirus (2019-nCoV) outbreak* [*(Chinazzi et al. medRxiv 2020)*](#)
        - "The model shows that as of January 23, most Chinese cities had already received a considerable number of infected cases, and the travel quarantine delays the overall epidemic progression by only 3 to 5 days."
    - *Early evaluation of transmission control measures in response to the 2019 novel coronavirus outbreak in China* [*(Tian et al. medRxiv 2020)*](#)
        - "The Wuhan city travel ban slowed the dispersal of infection to other cities by an estimated 2.91 days (95% CI: 2.54-3.29) on average."
    - *Evaluating the impact of international airline suspensions on COVID-19 direct importation risk* [*(Adiga et al. medRxiv 2020)*](#)

- ○ "It is observed that for countries like Singapore, Thailand, United States, etc. which typically have large flow of traffic during normal operations, the change in effective distance after reduced connectivity is small."
  - *Nonpharmaceutical Measures for Pandemic Influenza in Nonhealthcare Settings-International Travel-Related Measures.* *(Ryu et al. EID 2020)*
    - ○ "Some studies reported that travel restrictions could delay the start of local transmission and slow international spread."

2. **Effectiveness of quarantine and isolation**
   - *Risk for Transportation of 2019 Novel Coronavirus Disease from Wuhan to Other Cities in China* *(Du et al. EID 2020)*
     - ○ "We estimated the probability of transportation of COVID-19 from Wuhan to 369 other cities in China before the quarantine. Expected COVID-19 risk is >50% in 130 (95% CI 89–190) cities and >99% in the 4 largest metropolitan areas."
   - *Serial interval of novel coronavirus (2019-nCoV) infections* *(Nishiura et al. medRxiv 2020)*
     - ○ "The serial interval of COVID-19 is shorter than its median incubation period. This suggests that a substantial proportion of secondary transmission may occur prior to illness onset." … "Thus, containment via case isolation alone is likely to be very challenging."
   - *Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak* *(Wilder-Smith et al. J Travel Med. 2020)*
     - ○ "Whether these rigorous measures will result in the same victory as for SARS depends on the following questions that currently remain unanswered: (i) what is the proportion of subclinical disease (asymptomatic or mildly symptomatic) that would be missed by the case definition, hence not be identified and immediately isolated, and therefore contribute to community transmission? (ii) On what day of illness is peak viral shedding, and how much viral shedding occurs before onset of symptoms? (iii) Does viral shedding occur also beyond respiratory droplets, e.g. via fomites? (iv) What is the true case fatality rate if the denominator also takes milder cases into account?"
   - *Fear, Politics, and Ebola: How Quarantines Hurt the Fight Against Ebola and Violate the Constitution* (Abdo et al., *ACLU and GHJP* 2015)
     - ○
   - *Quarantine, isolation and the duty of easy rescue in public health.* *(Giubilini et al. Dev World Bioeth 2017)*
     - ○ "We argue that the benefits of quarantine and isolation justify some level of coercion or compulsion by the state, but that the state should be able to provide the strongest justification possible for implementing such measures."

- *When is quarantine a useful control strategy for emerging infectious diseases? (Day et al. AJE 2006)*
  - "Results demonstrate that the number of infections averted (per initially infected individual) through the use of quarantine is expected to be very low provided that isolation is effective, but it increases abruptly and at an accelerating rate as the effectiveness of isolation diminishes."
- *Was mandatory quarantine necessary in China for controlling the 2009 H1N1 pandemic? (Li et al. Int J Environ Res Public Health. 2013)*
  - "mandatory quarantine served to postpone the spread of the 2009 H1N1 pandemic in Beijing by one and a half months." ... "When the cost of quarantine is taken into account, mandatory quarantine was not an economically effective intervention approach against the 2009 H1N1 pandemic."
- *Impact of quarantine on the 2003 SARS outbreak: a retrospective modeling study. (Hsieh et al. J Theor Biol 2007)*
  - "Level A quarantine prevented approximately 461 additional SARS cases and 62 additional deaths, while the effect of Level B quarantine was comparatively minor, yielding only around 5% reduction of cases and deaths."
- *Severe acute respiratory syndrome: Did quarantine help? (Schabas. Can J Infect Dis Med Microbiol. 2004)*
  - "SARS quarantine in Toronto was both inefficient and ineffective."
- *Quantifying the impact of community quarantine on SARS transmission in Ontario: estimation of secondary case count difference and number needed to quarantine. (Bondy et al. BMC Public Health. 2009)*
  - "This analysis suggests quarantine can be an effective preventive measure for SARS, although these estimates lack statistical precision."
- *The economic impact of quarantine: SARS in Toronto as a case study. (Gupta et al. J Infect. 2005)*
  - "Our results indicate that quarantine is effective in containing newly emerging infectious diseases, and also cost saving when compared to not implementing a widespread containment mechanism."
- *Is There a Case for Quarantine? Perspectives from SARS to Ebola. (Barbisch et al. Disaster Med Public Health Prep. 2015)*
  - "we provide a quarantine and isolation decision tree to assist policy makers and public health officials in applying medically defensible, outcomes-based data and legal authorities to optimize management of emerging infectious diseases."
- *SARS control and psychological effects of quarantine, Toronto, Canada. (Hawryluck et al. EID 2004)*
  - "PTSD and depression were observed in 28.9% and 31.2% of respondents, respectively."

3. **Effectiveness of any non-pharmaceutical interventions (NPIs)**
   - *Community Mitigation Guidelines to Prevent Pandemic Influenza — United States, 2017 (Qualls et al. MMWR Recomm Rep 2017)*
     - It has a summary of systematic literature reviews, meta-analyses, and empirical, laboratory, and modeling studies (published in peer reviewed journals in 1990-2016) for NPIs, such as voluntary home isolation and voluntary home quarantine, school closures and dismissals, social distancing and measures for schools, workplaces, and mass gatherings
       - Chapter 3: NPI Toolbox: Evidence Base, Implementation Issues, and Research Gaps
       - Appendix 5: NPI "Body of Evidence" Summary Table
   - *Early evaluation of transmission control measures in response to the 2019 novel coronavirus outbreak in China (Tian et al. medRxiv 2020)*
     - "Among individual control measures investigated, the most effective were suspending intra-city public transport, and closing entertainment venues and banning public gatherings."

4. **Adjusted mortality rate**
   - *2019-novel Coronavirus (2019-nCoV): estimating the case fatality rate - a word of caution. (Manuel et al. Swiss Med Wkly 2020)*
     - "At present, it is tempting to estimate the case fatality rate by dividing the number of known deaths by the number of confirmed cases. The resulting number, however, does not represent the true case fatality rate and might be off by orders of magnitude."
   - *Estimating the case fatality ratio of the COVID-19 epidemic in China (Wang et al. medRxiv 2020)*
     - "The CFR of COVID-19 were estimated to be 7.24% (95% CI: 6.61%-8.01%) in Hubei province, including Wuhan, the epicenter, and 1.00% (95% CI: 0.87%-1.18%) in other areas of China, respectively."
   - *Real-Time Estimation of the Risk of Death from Novel Coronavirus (COVID-19) Infection: Inference Using Exported Cases (Jung et al. medRxiv 2020)*
     - "The latest estimated values of the cCFR (confirmed case fatality risk) were 5.3% (95% CI: 3.5%, 7.5%) for Scenario 1 and 8.4% (95% CI: 5.3%, 12.3%) for Scenario 2." ... "Considering that about 9% of all infected individuals are ascertained and reported, the infection fatality risk (IFR), i.e., the risk of death among all infected individuals, would be on the order of 0.5% to 0.8%."