

Damian Guerra, PhD

Town of Longmeadow
60 Center Square
East Longmeadow, MA 01028.

Dear Town Council and Town Manager of East Longmeadow:

I am writing to summarize and provide context for our study on mask mandates and mask use in relation to COVID-19 containment.

Our study titled “Mask mandate and use efficacy for COVID-19 containment in US States” was published in *International Research Journal of Public Health* and can be found [here](#). We found no association between either reported mask use or US state mandatory mask policies and COVID-19 case growth. Early in the pandemic (Summer 2020), there was an apparent association between mask use and lower infection rates. However, this association weakened and disappeared when transmission levels rose—despite general mask use increasing during Fall 2020. Critically, cases rose and fell in locations with and without mask mandates, and the magnitude and duration of surges were approximately equal. Early association between mask policies and case growth was an apparent artifact of lower total cases begetting larger fold-increases. Even accounting for population density and testing differences (suggested to us by reviewers), we still did not obtain an association.

There can be no doubt that precautionary measures are warranted during a serious pandemic disease such as COVID-19. Measures should be supported by evidence, checked against effectiveness of other measures, and balanced with potential harms. To date, there is very little evidence that general civilian mask mandates are useful. In the attached annotated bibliography, I address significant limitations of articles that supposedly demonstrate mask benefits. On the other hand, vaccination, improved ventilation, and vitamin D repletion are proven strategies for COVID-19 mitigation. While we did not evaluate harms in our study, others have shown that mask wearing is not without risk. Facial processing is critical for social communication, and prolonged mask use is associated with physical and psychological deficits in adults and children. It is likely that universal masking would interfere with social learning in younger populations, which may irreversibly harm neurodevelopment in children. Due to the novelty of mask mandates, consequences of chronic mask use have not been evaluated.

If you have any questions, please feel free to email me at magistervitalis@gmail.com.

Sincerely,



-Damian Guerra

About me: Until recently, I was Assistant Professor of Biology at the University of Louisville, where I taught Biostatistics and directed research in Redox Biology. My son’s medical and schooling needs could not be met in Louisville, Kentucky. For the good of my family, it was necessary to leave my position and seek employment in a community replete in resources my son requires. I make these disclosures to clarify that I was neither forced from nor voluntarily left UofL for any professional reason and that I maintain the utmost respect for my former colleagues.

Annotated Bibliography

Summary

- COVID-19 is a serious pandemic disease that warrants precautionary measures.
- The best protections against COVID-19 are vaccination, ventilation, and generally good health (e.g., vitamin D repletion).
- General civilian mask use and mask mandates likely do not reduce rates of COVID-19 transmission.
- Studies purportedly demonstrating mask efficacy have used small sample sizes, have lacked comparison groups, or have omitted key information.
- Among masks, only properly fitted KN95 (or related N/R/P95 type) respirators have demonstrated protection against viral infection.
- Enhanced building ventilation is more effective than mask wearing at aerosol dispersion.

COVID-19 and Mask Use or Mandates

1. **Bundgaard, H., et al. *Ann Intern Med*, 2021. 174(3): p. 335-343.** <https://pubmed.ncbi.nlm.nih.gov/33205991/>. Compared with social distancing alone, surgical masks offered no protection against COVID-19 infection. 'N' were ~3000 in each group. They did not assess source control, but infection rates were similar among subsets of the masked cohort who adhered to face masks some, most, and all of the time.
2. **Xi, J., X.A. Si, and R. Nagarajan. *Phys Fluids* (1994), 2020. 32(12): p. 123312.** <https://pubmed.ncbi.nlm.nih.gov/33362401/>. Surgical masks block droplets but do not efficiently block particles smaller than 5µm in diameter. SARS-CoV2 aerosols are smaller than 5µm.
3. **Shah, Y., et al. *Phys Fluids* (1994), 2021. 33(7): p. 073315.** <https://pubmed.ncbi.nlm.nih.gov/34335009/>. Under typical respiration rates, ~89% of aerosols penetrate cloth and surgical masks, suggesting little efficacy in long-term congregant settings like schools. N-95 type masks (KN95, R95) were far more effective. Strikingly, increased room ventilation was found to have the greatest effect—increasing air circulation ~2-fold led to a ~50% reduction in particles (an effect greater than any mask compared with no mask).
4. **Gettings, J., et al. *MMWR Morb Mortal Wkly Rep*, 2021. 70: p. 779–784.** <http://dx.doi.org/10.15585/mmwr.mm7021e1> Among ~90k K-12 students in the US state of Georgia, the effect of requiring vs. not requiring masks for students was a small (20%) and statistically non-significant reduction in COVID-19 cases (the 95% confidence interval for risk rate crosses 1.0). There was no deconvolution of mask mandate status from other mitigation strategies associated with mandatory masking (e.g., social distancing and capacity restrictions). Thus, 20% likely represents an upper limit of effectiveness that may be due entirely to other mitigation strategies that segregate with masking.
5. **Ludvigsson, J.F., et al. *N Engl J Med*, 2021. 384(7): p. 669-671.** <https://pubmed.ncbi.nlm.nih.gov/33406327/>. Sweden did not mandate masks or close

schools during the first COVID-19 wave, but they did encourage social distancing. From March 1st-June 30th 2020, 69 Swedish children (0-18 years old) died of natural causes (compared with 65 in March-June 2019). In the same period, 15 Swedish children and 31 preschool or school teachers were admitted to ICUs for COVID-19 (0.9 and 19 per 100,000, respectively). ICU admission risk was not significantly different from other professions, nor was child mortality significantly greater than in previous years.

6. **Guerra DD and Guerra DJ. International Research Journal of Public Health, 2021; 5:55.** <https://escipub.com/irjph-2021-08-1005/>. We found no association between either reported mask use or US state mandatory mask policies and COVID-19 case growth. Early in the pandemic (Summer 2020), there was an apparent association between mask use and lower infection rates. However, this association weakened and disappeared when transmission levels rose—despite general mask use increasing over the Fall. Critically, cases rose and fell in locations with and without mask mandates, and the magnitude and duration of surges was approximately equal. Early association between mask policies and case growth was an apparent artifact of lower total cases begetting larger fold-increases. Even accounting for population density and testing differences (suggested to us by peer reviewers), we still did not obtain an association.

7. **CDC COVID-19 Dashboard.** <https://covid.cdc.gov/covid-data-tracker/#demographics>. COVID-19 deaths for those 18 and younger comprise ~0.1% of all COVID deaths. Simply put, the risk of serious COVID illness—while not zero—is lower than the risk of serious flu illness if you are younger than 18.

Mask Use and Transmission of Respiratory Viruses before COVID-19

8. **MacIntyre, C.R., et al. Prev Med, 2014. 62: p. 1-7.** <https://pubmed.ncbi.nlm.nih.gov/24472436/>. This was a pre-COVID randomized controlled trial (RCT) of 1441 healthcare workers (HCW) who wore N95s, surgical masks, or no mask in the winter. HCWs were instructed on proper mask etiquette, including hand washing and hygienic mask removal for eating and restroom breaks. Participants were provided daily with 2 fresh N95s or 3 fresh surgical masks. While N95s decreased bacterial and viral infection of HCW upper respiratory tracts, surgical masks had no effect ($p = 0.66$). Thus, in a healthcare setting with trained professionals, only N95s (not masking in general) was able to reduce HCW infection rates with viruses or bacteria.

9. **MacIntyre, C.R., et al. BMJ Open, 2015. 5(4): p. e006577.** <https://pubmed.ncbi.nlm.nih.gov/25903751/>. 1607 Vietnamese HCWs were randomly assigned to medical masks, cloth masks, or control (~20% voluntary mask use) for 4 weeks in March 2011. Compliance was ~50% for medical and cloth masks. Compared with medical masks, cloth masks were associated with 6-fold higher influenza-like illness and 1.7-fold higher laboratory confirmed virus. Cloth masks offered no benefit compared with the control arm. Medical masks alone were not associated with lower influenza-like illness than controls. Inefficacy of medical masks mirrors a subsequent RCT by [MacIntyre et al. 2016 BMJ Open 6\(12\):e012330](#), with relative risk 95% CIs crossing 1.0.

10. **Fong, M.W., et al. Emerg Infect Dis, 2020. 26(5): p. 976-984.** https://wwwnc.cdc.gov/eid/article/26/5/19-0994_article. This policy review summarizes 10 RCTs and found that community face masks (i.e., outside of medical settings) had no effect on influenza transmission. Influenzae and SARS-CoV-2 are both respiratory viruses. If masks do not work against the flu, how could they work against COVID-19? As an aside, recent CDC data suggest that the delta variant is as transmissible as chickenpox. If this is true, then masking in the absence of other measures (i.e. social distancing and enhanced building ventilation) is unlikely to have an appreciable effect on case growth even if masks were effective.

Problems with Studies Suggesting Mask Use Reduces Respiratory Virus Transmission (including SARS-CoV-2)

11. **Fong, M.W., et al. Emerg Infect Dis, 2021. 27(5).** <https://pubmed.ncbi.nlm.nih.gov/33596168/>. Retrospective on upper respiratory tract infections (URIs) among school-age children and teachers in Hong Kong, Fall of 2020. Compared with 2017-2019, when there were 3-6 large URI outbreaks, there were 81 large outbreaks in the Fall of 2020 when all students and teachers were masked. All individuals were negative for SARS-CoV-2. Infections were due primarily to rhinoviruses. Reduced contact among children early in the pandemic could have de-habituated immune familiarity. While causality is unclear, there was a strong association between prior pandemic restrictions and subsequently higher URI rates regardless of mask use.

12. **Hendrix, M.J., et al. MMWR Morb Mortal Wkly Rep, 2020. 69(28): p. 930-932.** <https://pubmed.ncbi.nlm.nih.gov/32673300/> There was a reported absence of SARS-CoV-2 transmission from two hair stylists with a universal face covering policy in Missouri. However, we do not know what occurred in the half of participants who did not want to be tested. We must rely on the faithful memory of patrons (83% of whom claim no respiratory symptoms within the last 90 days). This seems doubtfully high, as respiratory illnesses are common in winter. There is too much ambiguity here for a policy recommendation.

13. **Szablewski, C.M., et al. MMWR Morb Mortal Wkly Rep, 2020. 69(31): p. 1023-1025.** <https://pubmed.ncbi.nlm.nih.gov/32759921/>. SARS-CoV-2 transmission was high among unmasked attendees of a camp in Georgia. Assuming that all symptoms were due to COVID-19, it is notable that no one required hospitalization (260 confirmed positives out of 597 total attendees, with an unknown number of asymptomatic carriers). This is a hospitalization rate of 0% with a sample size of nearly 600. For this group of mostly children (7 people aged 22-59), the absence of masks was not a significant harm.

14. **Lyu, W. and G.L. Wehby. Health Aff (Millwood), 2020. 39(8): p. 1419-1425.** <https://pubmed.ncbi.nlm.nih.gov/32543923/>. This was framed as a natural experiment of US state mask mandates. The primary problem with this study is the lack of a control group. As others noted, issue and effective dates of mask mandates are separated by 1-5 days, and significance diminishes if one uses effective rather than issue dates. The effect size is small, and there are numerous factors beside mask mandate issuance that could explain a decline in case growth. Notably, control (“no mandate”) data from then and the Fall of 2020 supersede these findings and demonstrate equivalent trends among US States regardless of statewide mask mandates.

15. **Chan, J.F., et al. Clin Infect Dis, 2020. 71(16): p. 2139-2149.** <https://pubmed.ncbi.nlm.nih.gov/32472679/>. For hamsters, cage masks significantly altered viral loads in lung but not in nose or trachea, which are more susceptible to SARS-CoV2 infection. It is not clear that this would make a difference epidemiologically, as a viral infection in one part of the respiratory tract can migrate to other respiratory organs. For static exposures, the study would seem to suggest that masks reduce infection probability by 50-67%. However, this protection is predicted to wane with time and exposure events, even if masks are effective in a single exposure context. Community spread would be predicted to occur at comparable rates, [as we demonstrated recently](#).

16. **Cheng, Y., et al. (2021). Science. May 20. doi: 10.1126/science.abg6296.** <https://pubmed.ncbi.nlm.nih.gov/34016743/>. This theoretical study used models to demonstrate how surgical masks should work to reduce transmission of SARS-CoV2. As stated elsewhere, real-world data suggest that surgical masks are not effective. Hidden variables and differing initial conditions (caveats that the authors admit) are likely explanations for these discrepancies. Increased viral circulation and the greater contagiousness of the delta variant would both work to undermine surgical mask effectiveness by increasing the effective value of $\log(N/ID_{50})$ —the ratio of viral particles to median infectious dose—and could explain why masks appeared less effective in Fall-Winter 2020-21 than in Summer 2020.

17. [Press release](#) states that quarantines in a Kentucky county declined since implementation of mask mandates. This finding is misleading because of the lack of control group.

18. [Preprint](#) of a large RCT in Bangladesh suggests that masks are 9-12% effective at reducing COVID-19 case growth. The effect size is small, and the statistical significance is marginal. However, even if the effect were very significant, it is striking that the mask intervention arm under 50 exhibited indistinguishable case growth from the control arm under 50. This suggests the lower case growth among those older than 50 resulted from some other effect apart from masking.

Actual and Potential Harms of Mask Use

19. **Atcherson, S.R., et al. Audiology Today, 2020. Nov/Dec. [Link](#).** Face coverings reduce the sound quality of verbal speech. This team examined several common mask types (surgical, N95, and transparent face shields). These masks decreased the sound intensity by 5, 10.9, and 12-13 dB, respectively. While not explicated in the discussion, these data indicate that all masks reduce auditory access, which is restrictive for the deaf and hard of hearing.

20. **Hua, W., et al. Contact Dermatitis, 2020. 83(2): p. 115-121.** <https://pubmed.ncbi.nlm.nih.gov/32406064/>. Study subjects wore N95 or surgical masks for 2 hours, removed masks for 1 hour, and then wore the masks again for 4 hours. Measurements were made on mask-covered skin after the 2 hour bloc and after the 4-hr block. As a control, non-covered parts of the face were measured. Regardless of mask type, trans-epidermal water loss (TEWL) and pH increased ~40% and 0.4 pH units, respectively.

These pH and hydration changes are associated with acne, inflammation, barrier breakdown, and infection with pathogenic bacteria. These findings mirror those of [Damiani et al. 2021 Dermatol Ther e14848](#).

21. **Larvin, H., et al. Front Med (Lausanne), 2020. 7: p. 604980.** <https://pubmed.ncbi.nlm.nih.gov/33330570/>. Mask use indirectly encourages reduced water intake, which is associated with periodontal disease. This study examined the association between periodontal disease and dying from COVID-19. Among those with COVID-19, periodontal disease increased the risk of death ~1.7 fold.

22. **Davey, S.L., et al. J Hosp Infect, 2021. 108: p. 185-188.** <https://pubmed.ncbi.nlm.nih.gov/33301841/>. In a survey of UK healthcare workers, pandemic-associated personal protective equipment, most notably masks, were found to increase heat stress with concomitant physical and cognitive stress. These results mirror those of [Swaminathan et al. Postgrad Med J 2020-139150](#), who reported increased headaches, breathlessness, and exhaustion. Survey bias notwithstanding, these stresses are associated with increased medical errors (<https://pubmed.ncbi.nlm.nih.gov/25742336/>).

23. **Meinhardt-Injac, B., et al. Front Hum Neurosci, 2018. 12: p. 25.** <https://pubmed.ncbi.nlm.nih.gov/29445336/> Facial expression is a critical mediator of social information. It is unknown but a viable hypothesis that diminished facial recognition through continuous and chronic mask use could have long-term and potentially irreversible damage on social learning in children.