



## A More Fitting Approach to Mask Policy

Throughout the COVID-19 pandemic, one of the central public policy debates has revolved around masking requirements as a mitigation technique to impede the spread of transmission. Controversy arose over masking mandates that were implemented across American society at various levels, some at the behest of individual businesses and others via the edict of municipal or state governments. At the federal level, Executive Orders issued during the first week of the Biden administration made masking a requirement on federal property (including National Parks) and on commercial transportation such as trains, ferries, buses, and airplanes. Another core area of focus was education, with public schools in many states operating under mask mandates as late as Spring 2022. Internationally, other nations' policies on the issue varied, with countries such as Italy and South Korea implementing strong mask mandates both indoors and outdoors and others such as Sweden never required masking at all.

Although the topic of masking was a subject of heated debate for over 2 full years as various officials scrambled to flatten the curve of the pandemic, these discussions were all too frequently lamentably reductive. By treating the issue as a binary choice between masking and not masking, important nuance was lost about environmental context and the relative efficacy of different types of masks. Although public health policy eventually came to reflect environmental considerations—for example, the US Centers for Disease Control and Prevention relaxing its guidance and stating that fully vaccinated individuals no longer needed to wear masks outdoors in April 2021—domestic policy continually failed to delineate between various types of masks, some of which have been found to be wildly more protective than others.<sup>1</sup>

Popular mask types utilized throughout the pandemic included cloth masks made from cotton or nylon, polypropylene surgical masks, bandanas, gaiters, and high-grade respirators such as N95 and KN95 models. Although some mandates prohibited the use of masks with exhalation valves or vents, public policy in the United States otherwise

did extremely little to distinguish between the various types of masks, with mandates issued in blanket terms that treated all of the above as interchangeable. In the absence of any such specifications, most Americans defaulted to wearing the cheapest and most comfortable masks available. Polling taken in January 2022 (during the highest peak in viral cases throughout the entire pandemic) revealed that 43% of adults opted for cloth masks, 27% wore surgical masks, and only 20% wore N95 or KN95 respirators.<sup>2</sup> This was reported during the Omicron variant wave, where it was already apparent that cloth masks offered insufficient protection to prevent transmission.<sup>3</sup>

N95 respirators have consistently demonstrated far superior protection from COVID compared with cloth or surgical masks throughout the pandemic.<sup>4</sup> This is in large part due to the fact that N95s are fitted snugly across the face; respiratory protective equipment is most effective when an adequate seal forms between the mask and the wearer to ensure that all inhaled air is properly filtered.<sup>5</sup> With the popular cloth and surgical masks, a large amount of airflow goes around the mask, bypassing any potential for filtering entirely. Despite the fact that N95 respirators offer significantly more benefit to wearers than the loose-fitting types of masks more commonly worn, all domestic policies have elided the distinction between these types of personal and protective equipment and none have required fitted respirators specifically.

However, more selective—and more effective—masking requirements are possible in future pandemics. In 2021, Bavaria, Germany issued mandates specifying that FFP2 respirators must be worn in shops and public transport; Austria adopted this policy nationwide, as well.<sup>6</sup> The core restraint against the United States embracing these types of policies is the cost and availability of suitable masks. Even late into the pandemic, the US Centers for Disease Control and Prevention was advising that N95s should be prioritized for healthcare workers over the general population.

Fortunately, advances in technology offer solutions to the issues of both cost and scarcity. Using standard consumer 3D-printers, my team and I were able to generate and assemble 1000 durable, re-wearable, high-filtration respirators with a cost in materials of only approximately \$1–2 each, we distributed the 3d printed respirators to the homeless in Miami. Citation: <https://www.abc27.com/news/health/coronavirus/coronavirus-pennsylvania/>

---

**Funding:** None.

**Conflict of Interest:** None.

**Authorship:** The author is solely responsible for the content of this manuscript.

Requests for reprints should be addressed to Marc Levine, 700 HMC Crescent Rd, Hershey, PA 17033.

E-mail address: [mlevine2@pennstatehealth.psu.edu](mailto:mlevine2@pennstatehealth.psu.edu)

[penn-state-college-of-medicine-student-creates-masks-for-the-homeless-using-3-d-printer/](#). Printed out of cheap polylactic acid or thermoplastic polyurethane and secured firmly with elastic straps fastened with a proprietary plastic backplate, these respirators used high-efficiency particulate air filters comparable to those used in N95s. In recently published research in *The American Journal of Medicine*, we established via fit testing trials employing a particle counter that these masks offered a superior fit factor to even N95s and were more likely to fit a large variety of face shapes and sizes.<sup>7</sup>

The schematics for these masks are publicly available, and they are able to be easily, quickly, and inexpensively assembled en masse by anyone with even hobbyist-grade 3D-printers. Unlike N95s, these durable and reusable respirators can be worn over the course of long periods without the need for replacement. Innovations like this can help ameliorate issues regarding cost and scarcity of respirators during future pandemics. With these practical considerations resolved, future public policy can focus on implementing mandates nuanced enough to specify the most effective personal and protective equipment practices and ensure that masking requirements reflect the established best practices in maintaining public health.

Marc Levine, BS

*Pennsylvania State University College of Medicine, Hershey, PA*

## References

1. U.S. Centers for Disease Control and Prevention. CDC lifts outdoor masking restrictions for fully vaccinated individuals, updates infection prevention and control recommendations for health care personnel. Available at: <https://www.aha.org/news/headline/2021-04-27-cdc-lifts-outdoor-masking-restrictions-fully-vaccinated-individuals>. Accessed June 11, 2022.
2. Morning Consult. CDC says N95 masks offer the best protection against COVID-19. Few Americans are wearing them. Available at: <https://morningconsult.com/2022/01/27/public-mask-wearing-habits-poll/>. Accessed June 11, 2022.
3. Cleveland Clinic. Are cloth masks enough to protect against Omicron? Available at: <https://health.clevelandclinic.org/are-cloth-masks-enough-against-omicron/>. Accessed June 11, 2022.
4. Mayo Clinic. How well do face masks protect against COVID-19? Available at: <https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/coronavirus-mask/art-20485449>. Accessed June 11, 2022.
5. O'Kelly E, Arora A, Pirog S, Ward J, Clarkson PJ. Comparing the fit of N95, KN95, surgical, and cloth face masks and assessing the accuracy of fit checking. *PLoS One*. 2021;16(1):e0245688.
6. Euronews. Bavaria makes FFP2 masks mandatory in shops and public transport. Available at: <https://www.euronews.com/2021/01/18/bavaria-makes-ffp2-masks-mandatory-in-shops-and-public-transport>. Accessed June 11, 2022.
7. Levine M, Levine L, Xun H, et al. Face off: 3D printed masks as a cost-effective and reusable alternative to N95 respirators: a feasibility study [e-pub ahead of print]. *Am J Med*. doi: 10.1016/j.amjmed.2022.04.026. Accessed June 11, 2022.