Infection Control & Hospital Epidemiology (2021), 1–2
doi:10.1017/ice.2021.155

Letter to the Editor

Double masking: Does science coincide with common sense?

Jeffrey T. Mueller MD[1], Soroor Karimi PhD[2], Karl A. Poterack MD[1], Maria Teresa A. Seville MD[3] and Steven M. Tipton PhD[2]

[1]Department of Anesthesiology, Mayo Clinic College of Medicine and Science, Phoenix, Arizona, [2]Department of Mechanical Engineering, University of Tulsa, Tulsa, Oklahoma and [3]Division of Infectious Diseases, Mayo Clinic College of Medicine and Science, Phoenix, Arizona

To the Editor—The importance of nonpharmaceutical interventions in preventing the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is clearly established, and their ongoing improvement must include all available expertise within science, medicine, and engineering. The nonpharmaceutical intervention of masking, specifically the potential incremental benefit of wearing 2 or more masks, is currently receiving considerable attention.[1] When asked about the possible benefit of wearing 2 masks during a January 25, 2021, *Today Show* interview, Dr Anthony Fauci responded, "So, if you have a physical covering with one layer, you put another layer on, it just makes common sense that it likely would be more effective." Subsequent news stories have provided further perspectives on this concept; most create a sense of probable benefit and no potential harm.[2] In addition, a recent limited study suggested the benefit of improving mask fit and decreasing leakage by wearing a cloth mask over a poorly fitting surgical mask based upon controlled bench tests.[3] More fully understanding the potential risks and benefits of double masking is very relevant for both the general public and for providers practicing in current and future clinical environments subject to personal protective equipment scarcity.

Although the overall benefit of simple public masking is well accepted, the degree of individual benefit is determined by several variables including mask materials, design, cleanliness, fit, and the technique used for placement and removal. All cloth, surgical, and medical masks (referred to as surgical masks in this letter) are filters through which some, but not all, of a user's respiratory airflow passes. Grinshpun et al[4] demonstrated that 5–6 times more contaminants reach users through leakage around surgical masks versus those which pass through the mask's filter media. Drewnick et al[5] have reported additional results emphasizing the importance of leakage. The ratio of airflow leaking around versus passing through the mask is determined in part by the mask's resistance to airflow and the related pressure difference across the mask: the higher the resistance and associated pressure difference for a given inhalational airflow, the greater the amount of air that will leak or be shunted around the mask and into the airway. The same problem could occur during exhalation and thus impair the mask's protection of others. We recently presented a mathematical analysis of a similar potential problem when surgical masks are worn over N95 filtering facepiece respirators.[6] Unlike N95 filtering facepiece respirators, surgical masks have no intended true seal between the mask edge and the face, making shunting or leakage around the mask edges an expected design characteristic.

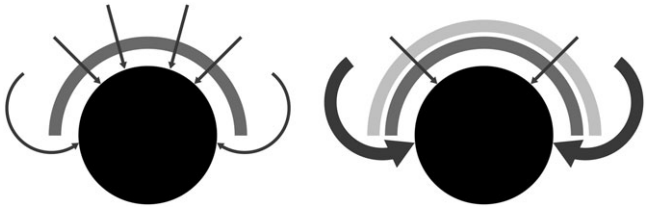

Fig. 1. Schematic diagram of single and double masking, displaying the possible scenario of increased respiratory airflow leakage due to increased mask resistance.

The incremental benefit of the increased filtration efficiency created by using multiple masks could be negated or even exceeded by the incremental harm of increased leakage around the masks. That is, additional masks might provide better filtration of a reduced fraction and cause an increase in the unfiltered fraction of total airflow (Fig. 1). Accurately determining the net protective effect of beneficial versus harmful factors in a 2-mask scenario is a significant engineering and fluid mechanics problem. Attempts to understand SARS-CoV-2 transmission problems such as this one must recognize the complex and nonintuitive nature of aerosol and airflow physics.[7] The net effect could vary with individual mask designs, minute ventilation, airway pressures, facial anatomy, and facial movement. It is also important that empirical and analytical models recognize the cyclical, time-variable nature of respiratory airflow, and that peak impulses of pressure and flow will create the intervals of maximum leakage. These variables and possibly others will determine the concerning fraction of respiratory airflow that passes between the edges of a surgical mask and the face. Additional experimental and analytical investigations are necessary to produce an evidence-based assessment of the risks and benefits of double masking.

Acknowledgment.

Financial support. No financial support was provided relevant to this article.

Conflicts of interest. All authors report no conflicts of interest relevant to this article.

References

1. Wu KJ. One mask is good. Would two be better? *New York Times* website. https://www.nytimes.com/2021/01/12/health/coronavirus-masks-transmission.html. Published 2021. Accessed February 24, 2021.

Author for correspondence: Jeffrey T. Mueller, E-mail: mueller.jeff@mayo.edu
Cite this article: Mueller JT, *et al.* (2021). Double masking: Does science coincide with common sense?. *Infection Control & Hospital Epidemiology*, https://doi.org/10.1017/ice.2021.155

2. Godoy M. Five hacks and tips to make your face mask more protective. Shots: health news from NPR. National Public Radio website. https://www.npr.org/sections/health-shots/2021/02/03/962197192/5-hacks-to-make-your-face-mask-more-protective. Published 2021. Accessed February 24, 2021.
3. Brooks JT, Beezhold DH, Noti JD, *et al.* Maximizing fit for cloth and medical procedure masks to improve performance and reduce SARS-CoV-2 transmission and exposure, 2021. *Morb Mortal Wkly Rep* 2021;70:254–257.
4. Grinshpun SA, Haruta H, Eninger RM, Reponen T, McKay RT, Lee SA. Performance of an N95 filtering facepiece particulate respirator and a surgical mask during human breathing: two pathways for particle penetration. *J Occup Environ Hyg* 2009;6:593–603.
5. Drewnick F, Pikmann J, Fachinger F, Moormann L, Sprang F, Borrmann S. Aerosol filtration efficiency of household materials for homemade face masks: Influence of material properties, particle size, particle electrical charge, face velocity, and leaks. *Aerosol Sci Tech* 2021;55:63–79.
6. Mueller JT, Karimi S, Poterack KA, Seville MTA, Tipton SM. Surgical mask covering of N95 filtering facepiece respirators: the risk of increased leakage. *Infect Control Hosp Epidemiol* 2021. doi: 10.1017/ice.2021.50.
7. Mittal R, Ni R, Seo JH. The flow physics of COVID-19. *J Fluid Mech* 2020;894: F2 1–11.