Health Services Research and Managerial Epidemiology
Volume 8: 1-7

DOI: 10.1177/23333928211058023
journals.sagepub.com/home/hme
SAGE

# Efficacy of Generalized Face Masking Mandates

**Alberto Boretti**[1]

**Abstract**

This commentary discusses if targeted uses of face masks may provide better results than generalized face masks mandates to limit the spread of Covid-19. The study is based on a literature review, as well as the analysis of cases and fatalities of different countries adopting different mask mandates. Before the Covid-19 emergency, the literature was consistently against generalized masking for cold and flu viruses. The latest literature for Covid-19 infection is opposite mostly supportive for generalized masking, even if contrarian works exist. The Covid-19 recommendations are not based on randomized controlled trials of healthy individuals wearing or not masks, differentiating in between closed or open spaces. Countries that did not mandate face masks have not performed worse for the number of cases and fatalities than countries that adopted generalized face masking policies during the Covid-19 emergency. Face masks help against Covid-19 infection but also have downfalls. Their benefits are overestimated, while their risks are underestimated. Masks can block the larger droplets exhaled by an infected wearer, protecting the healthy from viral exposure, but their ability to filter out viruses is variable and generally poor especially in reused cloth masks worn by the public. New surgical masks should be used in crowded spaces especially indoors, preferring distancing without masks outdoor. There are serious unintended consequences from wearing face masks improperly and for too long that must be accounted for. There could be more advantages from targeted rather than generalized uses of only surgical face masks.

**Keywords**

influenza, face mask, coronavirus, epidemic

There is an open debate about the efficacy of generalized face masking mandates against the spread of Covid-19 infection, with arguments being brought forward in favor and against the mandates. The debate is strongly politically polarized, with the specific literature being biased accordingly. This paper aims to understand whether the best approach could be an intermediate solution, that is, if a targeted use of face masks may provide better results than generalized face masks mandates to limit the spread of Covid-19. The proposed method is based on the analysis of the literature regarding the use of face masks to prevent the spread of the cold and flu viruses before the Covid-19 emergency, and regarding the use of face masks to prevent the spread of Covid-19. Then, an environmental study is performed by comparing the number of cases and fatalities of countries that adopted or not generalized face-covering mandates during the Covid-19 emergency.

Before the Covid-19 emergency, there was no doubt healthy people should not wear surgical or dust face masks or respirators to protect themselves from the viruses of cold and flu. Certainly, nobody could have supposed face masks would have been made compulsory also walking outdoor far from every other human, forced to be worn over the many hours spent out of private spaces. Although the new science is now in favor of masking humanity to prevent the spreading of the virus, some doubts remain. Targeted rather than generalized uses of face masks could deliver better results.

Previously, universal masking of all the members of the population was not needed and considered generally counterproductive, as face masks and respirators did not prevent viral transmission.[1–17] As they were never shown to prevent viral transmission, they were never recommended in policies for seasonal flu outbreaks.

[1] Prince Mohammad Bin Fahd University, Al Khobar, Kingdom of Saudi Arabia

**Corresponding Author:**
Alberto Boretti, Deanship of Research, Prince Mohammad Bin Fahd University, P.O. Box 1664, Al Khobar 31952, Kingdom of Saudi Arabia.
Emails: a.a.boretti@gmail.com; deanshipofresearch@pmu.edu.sa

Evidence from randomized controlled trials never suggested face masks had a substantial effect on the transmission of influenza.[1–11] There is extensive literature establishing that wearing surgical and dust masks or respirators does not reduce the risk of being infected by viruses not that different from Covid-19.

All the reviews, such as Long et al, Cowling et al, bin-Reza et al, Smith et al, Offeddu et al, Radonovich et al,[12–17] consistently report as no study showed a benefit from wearing a mask against influenza infection, with N95 respirators also making no difference. No randomized controlled trial study conducted in not suspicious times shows a benefit for wearing a mask or respirator, for influenza, or cold coronaviruses.

The opposite opinion is now popular, and many concerned scientists about this opinion are very cautious regarding speaking out. Thus, past studies, such as Suess et al, Barasheed et al, Aiello et al, Aiello et al, MacIntyre et al, MacIntyre et al, Cowling et al, Cowling et al, Larson et al, Simmerman et al, Jacobs et al, Long et al, Cowling et al, bin-Reza et al, Smith et al, Offeddu et al, Radonovich et al,[1–17] have been mostly forgotten. To be precise, also some latest analyses such as Vainshelboim[18] or Xiao et al[19] confirm that face masks do not prevent transmission of Covid-19, same as they do not prevent transmission of influenza and common cold coronaviruses. However, these analyses are downplayed.

From a purely mechanical perspective, the filtration material of N95 respirators has an average pore size of ~0.3 to 0.5 μm. Worse is the material of surgical masks, of average pore size 0.3 to 10 μm,[20] and even larger pore sizes may be found in low-cost cloth face masks.[21] These materials do not block the penetration of much smaller virions. The covid-19 virus has a size of 50 to 140 nm, about the same as common cold coronaviruses, and the influenza A virus has a size of 80 to 120 nm.

Although the minimal infective dose (MID) of Covid-19 is not known with certainty, likely the viruses carried in a single aerosol particle avoiding mask-capture are larger than the MID. This would make the mask mostly, even if not completely, useless.[22–25]

If masks may capture most of the large droplets generated by infected individuals sneezing or coughing wearing a mask,[26,27] this does not seem a good reason to force the vast majority of healthy individuals to wear a mask not protecting them every hour of their life they spend in public spaces every far from other humans. It would be enough to make sure those who are unwell isolate themselves at home for much better results.

Worn always, and not only in the more critical conditions face masks also have many downfalls. Used for long times, surgical and dust face masks have negative effects, from lowering oxygen and rebreathing carbon dioxide.[19] Moisture build-up and reusing masks increase negative effects such as contamination.[19] The concentration and distribution of pathogens on used masks may harm. Improper use may increase the risk of transmission.[19] Masks have many issues. Mask wearing increased aerosol production due to the humidity build up on the mask and then with mild exercise the moisture gets pushed out into aerosols. Looser masks people tend to mostly breathe around than through.

Although there is certainly a growing literature supporting the role of face masks in reducing the Covid-19 transmission in the community, also in the form of cloth mask-wearing,[28] some doubt persists. If evidence from a randomized controlled trial in the past was not supporting any use of face masks to prevent seasonal flu and colds, it must be made clear that current prevailing recommendations are not based on randomized controlled trials of healthy individuals wearing or not wearing masks in time of Covid-19.

Comparison of Covid-19 cases and fatalities of countries adopting different face mask mandates also do not support generalized face mask mandates.

If we compare the countries of West Europe which did not mandate face masks, for example, Sweden, Finland, Norway, Denmark, Iceland, to other countries such as the United Kingdom, Ireland, Belgium, Germany, or the Netherlands, that adopted generalized face masking policies, there is no increase in the number of cases or the number of fatalities (Figure 1).

Although wearing face masks indoors may have benefits, especially face mask-wearing outdoors in uncrowded areas is senseless. There is no evidence of a super-spreader event outdoors. Although the selective use of face masks on public transport, in shops, and offices may have advantages, wearing masks far from every other human has more cons than pros.

As recently discussed in Kisielinski et al,[29] there are adverse effects of face masks. Covers of the mouth and nose are not free from undesirable side effects in everyday use and present several potential hazards. Face masks have adverse effects on psychological, social, and physical levels. Regarding the physical level alone, evidence suggests face masking produces changes in respiratory physiology with the correlation of $O_2$ drop and fatigue, a clustered co-occurrence of respiratory impairment and $O_2$ drop, N95 mask and $CO_2$ rise, N95 mask and $O_2$ drop, N95 mask, and headache, respiratory impairment and temperature rise, and temperature rise and moisture under the masks.[29]

Finally, as noticed in Bar-Yam,[30] an infected individual wearing a standard face mask may be subjected to rebreathing of viral particles. Rebreathing of Covid-19 viral particles may contribute to the build-up of a significant viral load and therefore increase the severity of Covid-19 infection. Thus, wearing face masks should be limited to the minimum indispensable for everyone, infected symptomatic or asymptomatic, and not infected.

Several works performed during the Covid-19 emergency do not support the view of major benefits from face masking. As previously noticed, the use of face masks either by infected persons or by uninfected persons does not have a substantial effect on influenza transmission.[18] Scientific evidence supporting face masks' efficacy is lacking,[19] while their adverse physiological, psychological, and health effects are established.[19]

Transmission probability is more driven by indoor air quality, followed by patient infectiousness, and the least by respiratory protection from medical face mask use.[31] There is limited evidence that the use of masks might reduce the risk

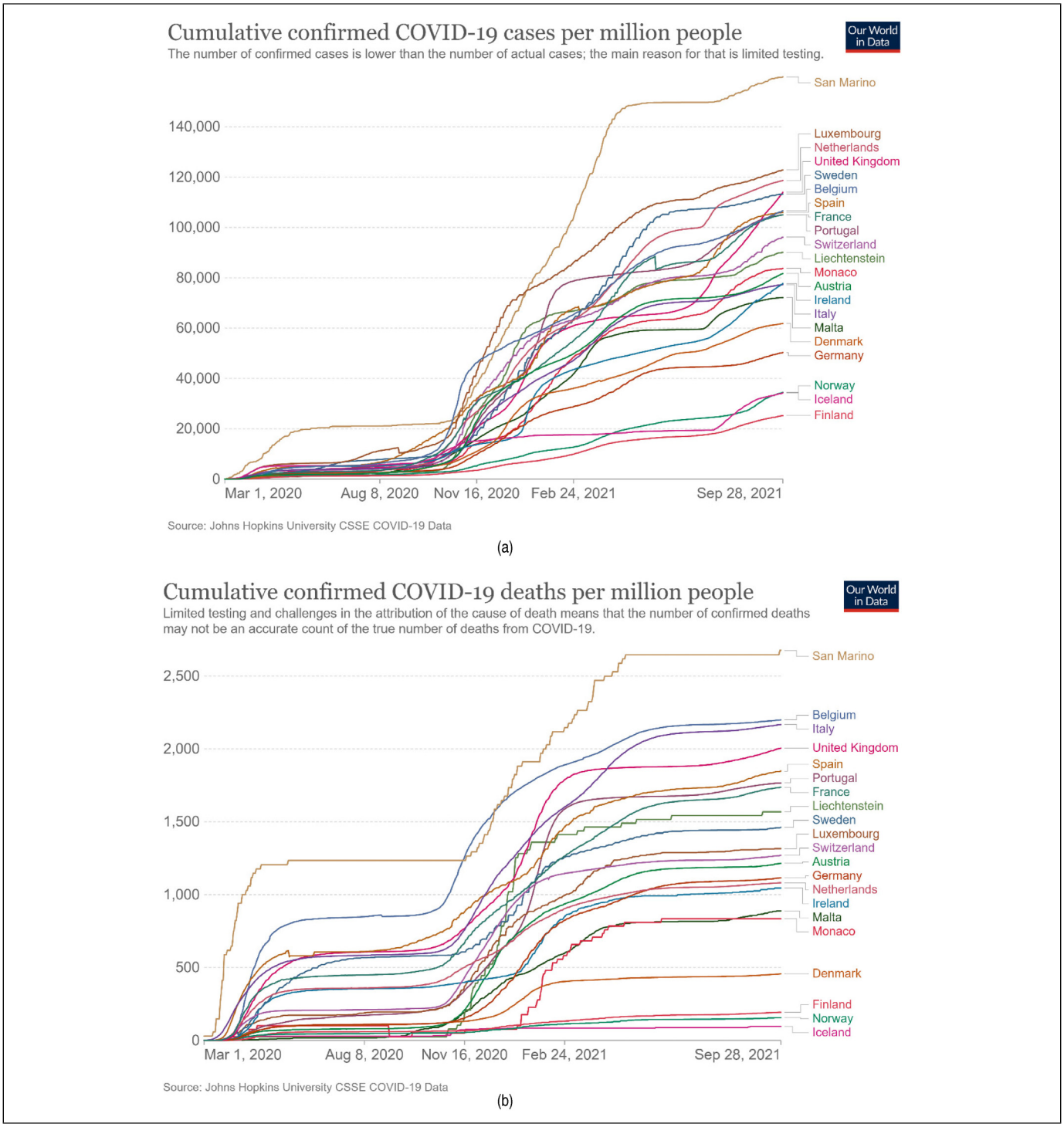


**Figure 1.** Cumulative number of Covid-9 cases (A) and fatalities (B) per million people across West Europe. Images from ourworldindata.org. CC BY.

of viral respiratory infections.[32] According to MacIntyre et al,[33] there was a higher risk of coronavirus infection in health care workers who wore a mask compared to a respirator. No evidence exists to claim the face masks during exercise offer additional protection from the droplet transfer of the virus.[34] Over-reliance on masks has more downfalls than benefits.

The Australian case is a clear example of overreaction to the Covid-19 treat and over-reliance on masks. Australian citizens even if fully vaccinated are permitted to enter Australia only in limited numbers and are subject to 14 days hotel quarantine detention, in hotel rooms without any window opening and centralized air-conditioning system. Sharing of air-conditioning in

hotel quarantine detention has been responsible for almost all the cases leaked to the community, as few travelers have been tested positive while in quarantine, more have been infected during quarantine testing positive after leaving quarantine. Air-conditioning-sickness is very well known.[35–39] Hotels are not designed to accommodate travelers locked into a room for 14 days. Headaches and feeling dizzy are commonly associated with increased cold conditions and reduced humidity. Dry skin is associated with low humidity levels. Air conditioning accelerates the spread of viruses such as those of cold and Covid-19. The cold conditions further dehydrate the linen in the nose making it more susceptible to infection. Although air conditioners may remove particulate matter (10 μm and above), they do not remove mold, bacteria, dander, fungi, and other microorganisms. Air conditioners do not remove viruses such as those of cold and Covid-19 that are 40 to 60 nm in size. This creates a sore throat and difficulty breathing. The health conditions of returning travelers are placed even more at risk if they tested positive for Covid-19 during the quarantine. It is the recommendation of the Australian Government to "*put on a surgical mask*" for those who "*get sick while in quarantine in Australia*," even for single occupancy of one hotel room. Confinement in an air-conditioned hotel room dressing a surgical mask is a driver for viral load build-up that may then become difficult to control.

Poorly ventilated indoor areas are among the highest risk venues for spreading the Covid-19 disease.[40] The best way to control exposure to fine aerosol particles in an indoor environment is ventilation.[41,42] The UK government campaign[43] recommended the opening of windows fully for short, sharp bursts of 10 to 15 min regularly, or leave them open a small amount continuously, to reduce the risk of infection from particles by more than 70%. The Japanese government alerted against closed spaces from the very beginning.[44] In the early 20th century, hospitals treated Spanish flu patients outdoors. In 2021, the Australian government still keeps infected and not infected Covid-19 travelers in nearby sealed rooms of air-conditioned hotels, with no option to open a window, and no opportunity to relocate those infected in a more appropriate setting, just asking those infected to wear face masks. Face masks in a closed environment without ventilation limits the ability to get rid naturally of the virus without preventing spreading to nearby travelers. The fact that most of the travelers arriving with a negative polymerase chain reaction then are tested as infected later, sometimes after having left quarantine, is not acknowledged as a problem of the improper organization of the quarantine system.

The Australian anomaly is not limited to overreliance on face masks (or border closure to own citizens, now ongoing since 20 months, or lockdowns going up for very few new daily cases per million). As another example, practically none of the antiviral therapies adopted in better jurisdictions is permitted in Australia.[45–49] This explains why the case fatality rate of Victoria is 4%, the average case fatality rate of Australia is 3%, no other country of similar gross domestic product (GDP) per capita has done so badly in treating Covid-19 infected patients, with countries that understand the issue of a consistent approach made of vaccinations, therapies, and effective but sustainable nonpharmaceutical measure such as the United Arab Emirates have a case fatality rate more than 10 times smaller at 0.25%.

Other factors influence the COVID-19 infection rates, including cultural, environmental, genetic, other than just public policy, and certainly not only masks use. However, taking a look back and forward, it is important to figure out which policies supported in the literature could work that is less disruptive to human interaction and are these. At the beginning of the pandemic, many other adjunctive remedies were proposed to limit the spread of the virus in closed spaces, from virucidal lamps[50–52] to active virucidal air filters,[53–55] to the simple overventilation and periodic cleaning of surfaces and change of air. For example, in the Australian state of Victoria, returning travelers are forced to spend 14 days in hotel quarantine detention in a centralized air-conditioned room, and if infected, always wear a mask. At the time of the Spanish flu, the opening of windows was always recommended, with some cases of hospitals set up in open spaces.[56] Not a surprise if the hotel quarantine system of Australia has been much less effective than thought.

The development of new viral killing technology in air and surfaces within closed spaces in principle more effective has not been supported at all. All these adjunctive remedies have been completely neglected. The same is true for using gloves in grocery stores, which only a few have implemented, with, for example, the Australian state of Victoria completely ignoring the danger from touching surfaces and objects in common spaces. Prevention of spreading has mostly been confined to mask mandates, often requiring mask-wearing also by children in outdoor playgrounds, when also this activity has not been banned, as it has occurred for example in the Australian state of Victoria. Masking in younger, healthy people, such as children should have been avoided, and to some extent, this population will be the most negatively impacted by universal masking policies.

Guidance and regulations about mask-wearing have become very politicized and it is important to provide information about what the scientific literature said and is saying on the matter, as well as what data from real-world experiences tell us (not all the countries adopted the same policies).

Weighing costs and benefits of generalized mask mandates are impossible from an analysis of the scientific literature. There are no such studies, and the studies proposed to cover other aspects are controversial.

The monetary costs of all those masks and the environmental costs of disposal are unaccounted for. The societal costs of being masked when in touch with other individuals are unaccounted for. Masking as virtue signaling in a political debate is truly unscientific.

Ultimately, all the health expenditures should be allocated efficiently so that a dollar worth of spending yields a much better result in COVID-19 intervention. This is, however, a subject quite controversial and open to arbitration, which is

certainly not within the scope of this paper to discuss. If we measure the efficacy of the COVID-19 intervention as inversely proportional to the product of the specific number of COVID-19 fatalities by GDP per capita of a country, the worse countries across the world are the United States, the European Union, and the United Kingdom. This important fact has never been stressed so far in the scientific literature, even if the numbers of specific fatalities and GDP per capita are publicly available.

A recent study[57,58] has evidenced as wearing masks reduces the spread of COVID-19 and that surgical masks work even better than cloth ones. The work shows some protective effects that varied with the quality of mask in the high dense living conditions of Bangladesh, which are more extreme than in the United States or the European Union, or the United Kingdom. We mention a possible conflict of interest in this work, as many other works proposed so far which are dealing with the pandemic. We note as despite being strongly publicized, the reference work is an Innovations for Poverty Action (IPA) preprint not yet peer-reviewed,[59] which has surprisingly made the headlines without having been published into a scientific journal. IPA is a 501(c)(3) nonprofit organization funded through tax-deductible contributions.

We note as similar emphasis has not been given to the experience made in Uttar Pradesh, India's most populous state, where a program sponsored by the local government and the World Health Organization[60] had a significant positive impact on their recent COVID-19 outbreak, as also commented in the peer review.[61,62] In this test and treat program, those infected were isolated and given a kit of 2.63$ cost containing paracetamol tablets, vitamin C, multivitamin, zinc, vitamin D3, ivermectin, and doxycycline. Ivermectin was intended as the primary antiviral treatment. Many countries, for example, Australia, still refuse to treat COVID-19 infected patients with antivirals, not only those successfully used in low case fatality rates countries such as the United Arab Emirates[46–49] but also the Uttar Pradesh program ivermectin. The scientific literature is quite positive for what concerns the ivermectin. The summary[63] mentions a total of 121 Ivermectin COVID-19 studies, showing an average improvement in the prophylaxis of 86% and an average improvement in the early treatment of 66%. Although most nonprofit organizations and some governments are unconditionally supportive of generalized mask mandates, they disregard other opportunities such as treatments with motivations difficult to be understood from a purely epidemiologic argumentation that is however not the goal of this contribution to address.

Face masks certainly help against Covid-19 infection. However, their benefits are presently overestimated, while their risks are unnoticed. Generalized mask-wearing policies for Covid-19 applying to anyone in public spaces no matter the specific circumstances ignore the scientific evidence gathered before the Covid-19 emergence and during the pandemic. No randomized controlled trial has been conducted to prove the current face mask policies are effective for Covid-19. There could be more benefits from targeted rather than generalized uses of face masks.

It is the conclusion of this letter based on a survey of literature and COVID-19 cases and fatalities of different countries that generalized mask mandates are excessive and inefficient, and targeted uses of masks could deliver much better results.

## Authors' Note

Single author contributed equally to this work. We further confirm that no aspect of the work covered in this manuscript has involved human patients requiring ethical approval of all relevant bodies.

## Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author received no financial support for the research, authorship, and/or publication of this article.

## ORCID iD

Alberto Boretti https://orcid.org/0000-0002-3374-0238

## References

1. Suess T, Remschmidt C, Schink SB, et al. The role of facemasks and hand hygiene in the prevention of influenza transmission in households: results from a cluster randomised trial; Berlin, Germany, 2009-2011. *BMC Infect Dis*. 2012;12(1):1-16.
2. Barasheed O, Almasri N, Badahdah AM, et al. Booy on behalf of the Hajj Research Team. Pilot randomised controlled trial to test effectiveness of facemasks in preventing influenza-like illness transmission among Australian Hajj pilgrims in 2011. *Infect Disord Drug Targets*. 2014;14(2):110-116.
3. Aiello AE, Murray GF, Perez V, et al. Mask use, hand hygiene, and seasonal influenza-like illness among young adults: a randomized intervention trial. *J Infect Dis*. 2010;201(4):491-498.
4. Aiello AE, Perez V, Coulborn RM, Davis BM, Uddin M, Monto AS. Facemasks, hand hygiene, and influenza among young adults: a randomized intervention trial. *PLoS One*. 2012;7(1):e29744.
5. MacIntyre CR, Cauchemez S, Dwyer DE, et al. Face mask use and control of respiratory virus transmission in households. *Emerg Infect Dis*. 2009;15(2):233.
6. MacIntyre CR, Zhang Y, Chughtai AA, et al. Cluster randomised controlled trial to examine medical mask use as source control for people with respiratory illness. *BMJ Open*. 2016;6(12).
7. Cowling BJ, Chan KH, Fang VJ, et al. Facemasks and hand hygiene to prevent influenza transmission in households: a cluster randomized trial. *Ann Intern Med*. 2009;151(7):437-446.
8. Cowling BJ, Fung RO, Cheng CK, et al. Preliminary findings of a randomized trial of non-pharmaceutical interventions to prevent influenza transmission in households. *PLoS One*. 2008;3(5):e2101.
9. Larson EL, Ferng YH, Wong-McLoughlin J, Wang S, Haber M, Morse SS. Impact of non-pharmaceutical interventions on URIs and influenza in crowded, urban households. *Public Health Rep*. 2010;125(2):178-191.

10. Simmerman JM, Suntarattiwong P, Levy J, et al. Findings from a household randomized controlled trial of hand washing and face masks to reduce influenza transmission in Bangkok, Thailand. *Influenza Other Respir Viruses*. 2011;5(4):256-267.
11. Jacobs JL, Ohde S, Takahashi O, Tokuda Y, Omata F, Fukui T. Use of surgical face masks to reduce the incidence of the common cold among health care workers in Japan: a randomized controlled trial. *Am J Infect Control*. 2009;37(5):417-419.
12. Long Y, Hu T, Liu L, et al. Effectiveness of N95 respirators versus surgical masks against influenza: a systematic review and meta-analysis. *J Evid Based Med*. 2020;13(2):93-101.
13. Cowling BJ, Zhou YDKM, Ip DKM, Leung GM, Aiello AE. Face masks to prevent transmission of influenza virus: a systematic review. *Epidemiol Infect*. 2010;138(4):449-456.
14. bin-Reza F, Lopez Chavarrias V, Nicoll A, Chamberland ME. The use of masks and respirators to prevent transmission of influenza: a systematic review of the scientific evidence. *Influenza Other Respir Viruses*. 2012;6(4):257-267.
15. Smith JD, MacDougall CC, Johnstone J, Copes RA, Schwartz B, Garber GE. Effectiveness of N95 respirators versus surgical masks in protecting health care workers from acute respiratory infection: a systematic review and meta-analysis. *CMAJ*. 2016;188(8):567-574.
16. Offeddu V, Yung CF, Low MSF, Tam CC. Effectiveness of masks and respirators against respiratory infections in healthcare workers: a systematic review and meta-analysis. *Clin Infect Dis*. 2017;65(11):1934-1942.
17. Radonovich LJ, Simberkoff MS, Bessesen MT, et al. N95 respirators vs medical masks for preventing influenza among health care personnel: a randomized clinical trial. *JAMA*. 2019;322(9):824-833.
18. Vainshelboim B. Facemasks in the COVID-19 era: a health hypothesis. *Med Hypotheses*. 2021;146:110411.
19. Xiao J, Shiu EY, Gao H, et al. Nonpharmaceutical measures for pandemic influenza in nonhealthcare settings—personal protective and environmental measures. *Emerg Infect Dis*. 2020;26(5):967.
20. Liu Y, Leachman SA, Bar A. Proposed approach for reusing surgical masks in COVID-19 pandemic. *J Am Acad Dermatol*. 2020;83(1):e53-e54.
21. Neupane BB, Mainali S, Sharma A, Giri B. Optical microscopic study of surface morphology and filtering efficiency of face masks. *Peer J*. 2019;7:e7142.
22. Bałazy A, Toivola M, Adhikari A, Sivasubramani SK, Reponen T, Grinshpun SA. Do N95 respirators provide 95% protection level against airborne viruses, and how adequate are surgical masks? *Am J Infect Control*. 2006;34(2):51-57.
23. Yezli S, Otter JA. Minimum infective dose of the major human respiratory and enteric viruses transmitted through food and the environment. *Food Environ Virol*. 2011;3(1):1-30.
24. Baccam P, Beauchemin C, Macken CA, Hayden FG, Perelson AS. Kinetics of influenza A virus infection in humans. *J Virol*. 2006;80(15):7590-7599.
25. Brooke CB, Ince WL, Wrammert J, et al. Most influenza a virions fail to express at least one essential viral protein. *J Virol*. 2013;87(6):3155-3162.
26. Leung NH, Chu DK, Shiu EY, et al. Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nat Med*. 2020;26(5):676-680.
27. Lai ACK, Poon CKM, Cheung ACT. Effectiveness of facemasks to reduce exposure hazards for airborne infections among general populations. *J R Soc Interface*. 2012;9(70):938-948.
28. Howard J, Huang A, Li Z, et al. An evidence review of face masks against COVID-19. *Proc Natl Acad Sci*. 2021;118(4).
29. Kisielinski K, Giboni P, Prescher A, et al. Is a mask that covers the mouth and nose free from undesirable side effects in everyday use and free of potential hazards? *Int J Environ Res Public Health*. 2021;18(8):4344.
30. Bar-Yam Y. Don't rebreath the coronavirus: New mask designs. New England Complex Systems Institute. 2020. Accessed May 18, 2021. https://necsi.edu/dont-rebreath-the-coronavirus-new-mask-designs
31. Zemouri C, Awad SF, Volgenant CMC, Crielaard W, Laheij AMGA, De Soet JJ. Modeling of the transmission of coronaviruses, measles virus, influenza virus, *Mycobacterium tuberculosis*, and *Legionella pneumophila* in dental clinics. *J Dent Res*. 2020;99(10):1192-1198.
32. Dugré N, Ton J, Perry D, et al. Masks for prevention of viral respiratory infections among health care workers and the public: PEER umbrella systematic review. *Can Fam Physician*. 2020;66(7):509-517.
33. MacIntyre CR, Chughtai AA, Seale H, Dwyer DE, Quanyi W. Human coronavirus data from four clinical trials of masks and respirators. *Int J Infect Dis*. 2020;96:631-633.
34. Chandrasekaran B, Fernandes S. "Exercise with facemask; Are we handling a devil's sword?"-A physiological hypothesis. *Med Hypotheses*. 2020;144:110002.
35. Preziosi P, Czernichow S, Gehanno P, Hercberg S. Workplace air-conditioning and health services attendance among French middle-aged women: a prospective cohort study. *Int J Epidemiol*. 2004;33(5):1120-1123.
36. Robertson AS, McInnes M, Glass D, Dalton G, Burge PS. Building sickness, are symptoms related to the office lighting? *Ann Occup Hyg*. 1989;33(1):47-59.
37. Bain P, Baldry C. Sickness and control in the office—the sick building syndrome. *New Technol Work Employ*. 1995;10(1):19-31.
38. Mendell MJ. Commentary: Air conditioning as a risk for increased use of health services. *Int J Epidemiol*. 2004;33(5):1123-1126.
39. Taylor P, Baldry C, Bain P, Ellis V. A unique working environment': health, sickness and absence management in UK call centres. *Work Employ Soc*. 2003;17(3):435-458.
40. Morawska L, Tang JW, Bahnfleth W, et al. How can airborne transmission of COVID-19 indoors be minimised? *Environ Int*. 2020;142:105832.
41. SAGE. Evidence of environmental dispersion for different mechanisms, and the risks and potential mitigations/measures of control within different environments from what we know about COVID19: A brief evidence summary for SAGE. 2020, April 14, 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/887556/SAGE_paper_Apr_2020_Final-redacted.pdf
42. SAGE. Environmental Influence on Transmission. SAGE – Environmental and Modelling Group. 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/887618/EMG_Environmental_transmission-_02052020__1_pdf
43. UK Government. Every Action count protecting against Covid19. 2020. https://youtu.be/qYZMOG2kUWg

44. Prime Minister of Japan. How to avoid the 3Cs. 2020. https://japan.kantei.go.jp/ongoingtopics/COVID19CASFlyer/PROffice3CGuide_en.pdf
45. New South Wales Health. NSW Health interim guidance on use of antiviral and immunomodulation therapy in COVID-19. 2021. Update March 01, 2021. www.health.nsw.gov.au/Infectious/covid-19/communities-of-practice/Pages/guide-antiviral-therapy.aspx
46. Abu Dhabi Public Health Center. COVID-19 Guideline for Healthcare Professionals Abu Dhabi. Accessed January 28, 2021. https://doh.gov.ae/-/media/7BD7B077D8F846B48A70C5872902DD1C.ashx
47. United Arab Emirates Ministry of Health and Prevention. National Guidelines for Clinical Management and Treatment of COVID-19 1st June, 2020. Accessed January 28, 2021. www.dha.gov.ae/en/HealthRegulation/Documents/National_Guidelines_of_COVID_19_1st_June_2020.pdf
48. Boretti A. Analysis of the performances of the covid-19 therapeutic approaches in the United Arab Emirates. *Signa Vitae*. 2021;17-(3):256-263. doi.org/10.22514/sv.2021.041
49. Boretti A. Consequences of restrictions, therapies and vaccines for covid-19 infection. *Asian J Org Med Chem*. 2021;6(1):310. doi.org/10.14233/ajomc.2021.AJOMC-P310
50. Buonanno M, Welch D, Shuryak I, Brenner DJ. Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses. *Sci Rep*. 2020;10(1):1-8.
51. Kitagawa H, Nomura T, Nazmul T, et al. Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination. *Am J Infect Control*. 2021;49(3):299-301.
52. Heilingloh CS, Aufderhorst UW, Schipper L, et al. Susceptibility of SARS-CoV-2 to UV irradiation. *Am J Infect Control*. 2020;48(10):1273-1275.
53. Zhao B, An N, Chen C. Using an air purifier as a supplementary protective measure in dental clinics during the coronavirus disease 2019 (COVID-19) pandemic. *Inf Control Hosp Epidemiol*. 2021;42(4):493-493.
54. Christopherson DA, Yao WC, Lu M, Vijayakumar R, Sedaghat AR. High-efficiency particulate air filters in the era of COVID-19: function and efficacy. *Otolaryngol Head Neck Surg*. 2020;163(6):1153-1155.
55. Agarwal N, Meena CS, Raj BP, et al. Indoor air quality improvement in COVID-19 pandemic. *Sustain Cities Soc*. 2021;70:102942.
56. Hobday RA, Cason JW. The open-air treatment of pandemic influenza. *Am J Public Health*. 2009;99(S2):S236-S242.
57. www.nature.com/articles/d41586-021-02415-8
58. www.nbcnews.com/science/science-news/largest-mask-study-yet-details-importance-fighting-covid-19-rcna1858
59. www.poverty-action.org/sites/default/files/publications/Mask_RCT____Symptomatic_Seropositivity_083121.pdf
60. www.who.int/india/news/feature-stories/detail/uttar-pradesh-going-the-last-mile-to-stop-covid-19
61. Bryant A, Lawrie TA, Dowswell T, et al. Ivermectin for prevention and treatment of COVID-19 infection: a systematic review, meta-analysis and trial sequential analysis to inform clinical guidelines. *Am J Ther*. 2021;28(4):e434-e460. doi:10.1097/MJT.0000000000001402
62. Kory P, Meduri GU, Varon J, Iglesias J, Marik PE. Review of the emerging evidence demonstrating the efficacy of ivermectin in the prophylaxis and treatment of COVID-19. *Am J Ther*. 2021;28(3):e299. doi:10.1097/MJT.0000000000001377
63. c19ivermectin.com/