

THE COVID TEXTBOOK

By Kamps, Hoffmann et al.

TOP 10: AUGUST 24

INTERNATIONAL | **DAILY TOP 10** | **TOP 10 BOOK (PDF)**

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Top 20 on Face Masks

Almost all organizations recommend masks for the general public. Unfortunately, earlier in the pandemic, many did exactly the opposite – due to limited data but also due to concerns about diminished mask supply for healthcare workers and out of fear that masked individuals might be tempted to ignore rules of social distancing. In addition, conflicting national guidelines have led to variable public compliance. A few physicians, in line with some COVIDiots, still argue against face masks. Even in late April, for example, Frank Ulrich Montgomery, a radiologist (!) and chairperson of the “World Medical Association”, declared with superb ignorance that masks were nonsense. Sadly, he attracted less attention when he later declared that his statement was a mistake

(and it was a gruesome mistake); doubts are always difficult to dispel once they are raised.

Do you need some arguments to convince your patients to wear a face mask? Here we present the Top 20 studies on their effectiveness and/or efficacy.

Human experiments

Leung NH, Chu Dk, Shiu EY. **Respiratory virus shedding in exhaled breath and efficacy of face masks.** Nature Med 2020, April 3. Full-text: <https://doi.org/10.1038/s41591-020-0843-2>

This study from Hong Kong quantified virus in respiratory droplets and aerosols in exhaled breath. In total, 111 participants (infected with seasonal coronavirus, influenza or rhinovirus) were randomized to wear or not to wear a simple surgical face mask. Results suggested that masks could be used by ill people to reduce onward transmission. In respiratory droplets, seasonal coronavirus was detected in 3/10 (aerosols: 4/10) samples collected without face masks, but in 0/11 (aerosols: 0/11) from participants wearing face masks. Influenza viruses were detected in 6/23 (aerosols: 8/23) without masks, compared to 1/27 (aerosols: 6/27!) with masks. For rhinovirus, there were no significant differences. Of note, the authors also identified virus in some participants who did not cough at all during the 30 min exhaled breath collection, suggesting droplet and aerosol routes of transmission from individuals with no obvious signs or symptoms.

Ho KF, Lin LY, Weng SP, Chuang KJ. **Medical mask versus cotton mask for preventing respiratory droplet transmission in micro environments.** Sci Total Environ. 2020 Sep 15;735:139510. PubMed: <https://pubmed.gov/32480154> . Full-text: <https://doi.org/10.1016/j.scitotenv.2020.139510>

This heroic study from Taiwan recruited 211 (!) adult volunteers with 208 confirmed

cases of influenza and 6 suspected cases of COVID-19. Volunteers had to wear medical masks and self-designed triple-layer cotton masks in a regular bedroom and a car (a Toyota) with air conditioning. Four 1-hour repeated measurements of particles with a size range of 20-1000 nm, temperature and relative humidity, and cough/sneeze counts per hour were conducted for each volunteer. There was no significant difference in NC0.02-1 or cough/sneeze counts between volunteers with medical masks and cotton masks in a bedroom or a car.

Animal experiments

Chan JF, Yuan S, Zhang AJ, et al. **Surgical mask partition reduces the risk of non-contact transmission in a golden Syrian hamster model for Coronavirus Disease 2019 (COVID-19)**. Clin Infect Dis. 2020 May 30:ciaa644. PubMed: <https://pubmed.gov/32472679> . Full-text: <https://doi.org/10.1093/cid/ciaa644>

Surgical mask use for COVID-19-challenged hamsters vs naïve hamsters significantly reduced transmission in those with the virus.

Lab experiments

Anfinrud P, Stadnytskyi V, Bax CE, Bax A. **Visualizing Speech-Generated Oral Fluid Droplets with Laser Light Scattering**. N Engl J Med. 2020 May 21;382(21):2061-2063. PubMed: <https://pubmed.gov/32294341>. Full-text: <https://doi.org/10.1056/NEJMc2007800>

Illustration of how liquid droplets exhaled during speech can linger in the air.

Rodriguez-Palacios A, Cominelli F, Basson AR, Pizarro TT, Ilic S. **Textile Masks and Surface Covers-A Spray Simulation Method and a “Universal Droplet Reduction Model” Against Respiratory Pandemics.** Front Med (Lausanne). 2020 May 27;7:260. PubMed: <https://pubmed.gov/32574342> . Full-text: <https://doi.org/10.3389/fmed.2020.00260>

First, a rapid spray-simulation model of droplets (mimicking a sneeze) was validated, using a bacterial suspension to quantify the extent by which widely available household textiles reduced the ejection of long-distance flights of droplets. To facilitate the enumeration of macro-droplets and invisible micro-droplets, spray simulations were conducted over nutritious-media agar surfaces and incubated for 24 h to enable colony-forming-droplet-unit formation. The study demonstrated that two-layer household textiles produced a profound reduction of environmental droplet contamination as effectively as medical-grade materials.

Observational studies

Wang Y, Tian H, Zhang L, et al. **Reduction of secondary transmission of SARS-CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China.** BMJ Glob Health. 2020;5. Full-text: <https://doi.org/10.1136/bmjgh-2020-002794>

A retrospective cohort study of 124 households with an index SARS-CoV-2 case and 355 uninfected household contacts. Households in which masks were used by at least 1 family member (including the index case) before the development of symptoms by the index case were associated with decreased risk for incident infections, after adjustment for other hygiene and infection control practices, physical distance to index case, environmental factors, and presence of diarrhea in the index case (adjusted odds ratio, 0.21, 95% CI, 0.06 to 0.79).

Hendrix MJ, Walde C, Findley K, Trotman R. **Absence of Apparent Transmission of SARS-CoV-2 from Two Stylists After Exposure at a Hair Salon with a Universal Face Covering Policy – Springfield, Missouri, May 2020.** MMWR Morb Mortal Wkly Rep. 2020 Jul 17;69(28):930-932. PubMed: <https://pubmed.gov/32673300> . Full-text: <https://doi.org/10.15585/mmwr.mm6928e2>

Among 139 clients exposed to two symptomatic hair stylists with confirmed COVID-19 while both the stylists and the clients wore face masks, not a single symptomatic secondary case was observed; among 67 clients tested for SARS-CoV-2, all tests were negative. At least one hair stylist was infectious: all four close household contacts became ill.

Wang X, Ferro EG, Zhou G, Hashimoto D, Bhatt DL. **Association Between Universal Masking in a Health Care System and SARS-CoV-2 Positivity Among Health Care Workers.** JAMA. 2020 Jul 14. PubMed: <https://pubmed.gov/32663246> . Full-text: <https://doi.org/10.1001/jama.2020.12897>

In March 2020, a large health care system in Massachusetts (12 hospitals, > 75,000 employees), implemented universal masking of all HCWs and patients with surgical masks. During the pre-intervention period, the SARS-CoV-2 positivity rate increased exponentially, with a case doubling time of 3.6 days. During the intervention period, the positivity rate decreased linearly from 14.65% to 11.46%, with a weighted mean decline of 0.49% per day and a net slope change of 1.65% more decline per day compared with the pre-intervention period.

Bielecki M, Züst R, Siegrist D, et al. **Social distancing alters the clinical course of COVID-19 in young adults: A comparative cohort study.** Clinical Infectious Diseases, 29 June 2020. Full-text: <https://doi.org/10.1093/cid/ciaa889>

Viral inoculum during infection or mode of transmission may be key factors determining the clinical course of COVID-19. Masks may reduce this inoculum. After an outbreak at a Swiss Army base, soldiers had to keep a distance of at least 2 m from each other at all

times, and in situations where this could not be avoided (e.g., military training), they had to wear a surgical face mask. Of the 354 soldiers infected prior to the implementation of social distancing, 30% fell ill from COVID-19. None of the soldiers in a group of 154, where infections occurred after implementation of social distancing, developed COVID-19.

Chen Y, Qin G, Chen J, et al. **Comparison of Face-Touching Behaviors Before and During the Coronavirus Disease 2019 Pandemic.** JAMA Netw Open 2020;3(7):e2016924. <https://doi.org/10.1001/jamanetworkopen.2020.16924>

Is wearing face masks really associated with reduced face-touching behaviors? Using videos recorded in public transportation stations, streets, and parks among the general population in several countries, this study found that mask wearing was associated with reduced face-touching behavior, especially touching of the eyes, nose, and mouth. Authors conclude that the reduction of face-touching behaviors by mask wearing could contribute to curbing the COVID-19 pandemic.

Nir-Paz R, Grotto I, Strolov I, et al. **Absence of in-flight transmission of SARS-CoV-2 likely due to use of face masks on board.** J Travel Med. 2020 Jul 14:taaa117. PubMed: <https://pubmed.gov/32662832> . Full-text: <https://doi.org/10.1093/jtm/taaa117>

During a 14-hour flight of 11 passengers and 4 crew members in which 2 positive SARS-CoV-2 were on board, no new viral acquisitions were found, probably due to the use of masks.

Epidemiological studies

Lyu W, Wehby GL. **Community Use Of Face Masks And COVID-19: Evidence From A Natural Experiment Of State Mandates In The US.** Health Aff (Millwood). 2020 Jun 16.

PubMed: <https://pubmed.gov/32543923> . Full-text: <https://doi.org/10.1377/hlthaff.2020.00818>

This study provides evidence from a natural experiment on the effects of state government mandates in the US for face mask use in public issued by 15 states plus Washington DC between April 8 and May 15. Mandating face mask use in public was associated with a decline in the daily COVID-19 growth rate by 0.9, 1.1, 1.4, 1.7, and 2.0 percentage points in 1–5, 6–10, 11–15, 16–20, and 21+ days after implementation, respectively. Estimates suggest as many as 230,000–450,000 COVID-19 cases were possibly averted by May 22, 2020 due to these mandates.

Zhang R, Li Y, Zhang AL, Wang Y, Molina MJ. **Identifying airborne transmission as the dominant route for the spread of COVID-19**. Proc Natl Acad Sci U S A. 2020 Jun 30;117(26):14857-14863. PubMed: <https://pubmed.gov/32527856> . Full-text: <https://doi.org/10.1073/pnas.2009637117>

By analyzing the trend and mitigation measures in Wuhan, Italy, and New York City, this work illustrates that the difference with and without mandated face covering represents the determinant in shaping the pandemic trends in the three epicenters. This protective measure alone significantly reduced the number of infections, that is, by over 78,000 in Italy from April 6 to May 9 and over 66,000 in New York City from April 17 to May 9.

Mathematical modelling studies

Worby CJ, Chang HH. **Face mask use in the general population and optimal resource allocation during the COVID-19 pandemic**. Nat Commun. 2020 Aug 13;11(1):4049. PubMed: <https://pubmed.gov/32792562> . Full-text: <https://doi.org/10.1038/s41467-020-17922-x>

The use of face masks among the general public is an effective strategy in mitigating transmission of SARS-CoV-2 under a range of scenarios. Even with a limited protective effect, face masks can reduce total infections and deaths, and can delay the peak time of the epidemic.

Fisman DN, Greer AL, Tuite AR. **Bidirectional impact of imperfect mask use on reproduction number of COVID-19: A next generation matrix approach.** Infect Dis Model. 2020 Jul 4;5:405-408. PubMed: <https://pubmed.gov/32691014>. Full-text: <https://doi.org/10.1016/j.idm.2020.06.004>

Same direction: Even modest mask effectiveness for reduction of transmission of COVID-19 could have important effects on epidemic dynamics, especially with regard to pre-symptomatic transmission (40%).

Systematic reviews and meta-analyses

Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ. **COVID-19 Systematic Urgent Review Group Effort (SURGE) study authors. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis.** Lancet. 2020 Jun 1. PubMed: <https://pubmed.gov/32497510> . Full-text: [https://doi.org/10.1016/S0140-6736\(20\)31142-9](https://doi.org/10.1016/S0140-6736(20)31142-9)

This systematic review identified 172 observational studies across 16 countries and 44 relevant comparative studies in healthcare and non-healthcare settings. Face mask use could result in a large reduction in risk of infection ($n = 2,647$; adjusted OR 0.15, 95% CI 0.07 to 0.34) SARS-CoV-2, SARS-CoV, and MERS-CoV. The association with protection from infection was more pronounced with N95 or similar respirators (aOR 0.04, 95% CI 0.004 to 0.30) compared to other masks (aOR 0.33, 95% CI 0.17 to 0.61). However, the latter were better than wearing no mask (see below, mathematical modelling).

Liang M, Gao L, Cheng C, et al. **Efficacy of face mask in preventing respiratory virus transmission: A systematic review and meta-analysis.** *Travel Med Infect Dis.* 2020 May 28;101751. PubMed: <https://pubmed.gov/32473312> . Full-text: <https://doi.org/10.1016/j.tmaid.2020.101751>

This meta-analysis of 21 studies suggests that mask use provided a significant protective effect. Use of masks by healthcare workers and non-healthcare workers can reduce the risk of respiratory virus infection by 80% (OR = 0.20, 95% CI = 0.11-0.37) and 47% (OR = 0.53, 95% CI = 0.36-0.79).

Cloth masks

Zangmeister CD, Radney JG, Vicenzi EP, Weaver JL. **Filtration Efficiencies of Nanoscale Aerosol by Cloth Mask Materials Used to Slow the Spread of SARS-CoV-2.** *ACS Nano.* 2020 Jul 28;14(7):9188-9200. PubMed: <https://pubmed.gov/32584542> . Full-text: <https://doi.org/10.1021/acsnano.0c05025>

A detailed study, evaluating cloth materials. Results indicate that there is a complex interplay between fabric type, weave, and yarn count and the filtration of nanometer-sized aerosol particles. No measured cloth masks performed as well as an N95. However, the best performing cloth materials had moderate yarn counts with visible raised fibers.

Konda A, Prakash A, Moss GA, Schmoltdt M, Grant GD, Guha S. **Aerosol Filtration Efficiency of Common Fabrics Used in Respiratory Cloth Masks.** *ACS Nano.* 2020 May 26;14(5):6339-6347. PubMed: <https://pubmed.gov/32329337> . Full-text: <https://doi.org/10.1021/acsnano.0c03252>

The aerosol filtering efficiency of different materials, thicknesses, and layers used in

properly fitted homemade masks was found to be similar to that of the medical masks that were tested.

Mueller AV, Eden MJ, Oakes JM, et al. **Quantitative Method for Comparative Assessment of Particle Removal Efficiency of Fabric Masks as Alternatives to Standard Surgical Masks for PPE.** Matter July 09, 2020. Full-text: <https://doi.org/10.1016/j.matt.2020.07.006>

Cloth masks tested had widely varying mean particle removal efficiencies (< 30% to near 90%), with some cloth masks achieving similar particle removal efficiencies as commercial surgical masks.

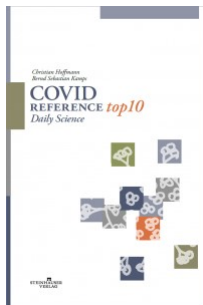
Conclusions

Yes, each of the above studies can be criticized. And yes, seasonal coronaviruses may differ from SARS-CoV-2, hamsters are not (yet) humans, there may be other things leading to the incidental decline of new infections paralleling the introduction of face masks, and cloth masks are less effective than surgical masks. Agreed. You will find many issues in each study that you can do better (if so, then do so!). However, decisions in the current pandemic have to be made on the basis of best available information, even if that information is imperfect. This crisis is an emergency. We need risk reduction rather than absolute prevention. Imagine you make an emergency call to the fire brigade, whereupon they refuse to come, because they need “more information”...

The self-proclaimed experts, who never tire of doubting the sense of masks, should ask themselves why they are actually doing this. Have they ever called for perfect data on the seatbelt obligation, helmets, smoking bans, speed limits in road traffic? Why does a piece of cloth covering their noses rile them up so much, what is the problem?

The prayer wheel-like demand for better studies or more data is redundant. We know

enough.



COVID Reference Top 10 (January-August) | We dedicate this book to our students. May this selection of approx. 1,000 fine articles and full-text links deepen their understanding of the new coronavirus and prepare them for the challenges ahead ([Update 22 August: PDF, 502 pages](#)).

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