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Mask Facts

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Introduction

COVID-19 is as politically-charged as it is infectious. Early in the COVID-19 pandemic, the WHO, the CDC and NIH's Dr. Anthony Fauci discouraged wearing masks as not useful for non-health care workers. Now they recommend wearing cloth face coverings in public settings where other social distancing measures are hard to do (e.g., grocery stores and pharmacies). The recommendation was published without a single scientific paper or other information provided to support that cloth masks actually provide any respiratory protection. Let's look at the data.

The theory behind mask wearing:

- Source control: Cloth mask can trap droplets that come out of a person's mouth when they cough or sneeze.
- Protection: Personal Protective Equipment (PPE) – only N95 masks

Transmission of SARS-CoV-2

Note: A COVID-19 (SARS-CoV-2) particle is 0.125 micrometers/microns (μm); influenza virus size is 0.08 – 0.12 μm ; a human hair is about 150 μm .

*1 nm = 0.001 micron; 1000 nm = 1 micron; Micrometer (μm) is the preferred name for micron

*1 meter is = 1,000,000,000 [trillion] nm or 1,000,000 [million] microns

*For a complete dissection and explanation of aerosols and airborne particles, please see *Understanding Particle Size and Aerosol-based Transmission* by Steve Probst. <https://www.4conference.com/wp-content/uploads/2020/07/Understanding-Particle-Size-and-Aerosol-Based-Transmission.pdf>

Droplets

- Virus is transmitted through respiratory droplets produced when an infected person coughs, sneezes, or talks.
 - Larger respiratory droplets ($>5\ \mu\text{m}$) remain in the air for only a short time and travel only short distances, generally <1 meter. They fall to the ground quickly. [https://www.thelancet.com/journals/lanres/article/PIIS2213-2600\(20\)30245-9/fulltext](https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(20)30245-9/fulltext)
 - This idea guides the CDC's advice to maintain at least a 6-foot distance.
- Small ($<5\ \mu\text{m}$) aerosolized droplets can remain in the air for at least 3 hours and travel long distances (up to 27 ft.).
 - <https://www.nejm.org/doi/pdf/10.1056/NEJMc2004973?articleTools=true>;
 - <https://www.cidrap.umn.edu/covid-19/podcasts-webinars/special-ep-masks>;
 - <https://www.nap.edu/catalog/25769/rapid-expert-consultation-on-the-possibility-of-bioaerosol-spread-of-sars-cov-2-for-the-covid-19-pandemic-april-1-2020>

Air currents

- In an air conditioned environment these large droplets may travel farther.
- Ventilation. Even the opening of an entrance door and a small window can dilute the number of small droplets to one half after 30 seconds. (*This study looked at droplets from uninfected persons*). This is clinically relevant because poorly ventilated and populated spaces, like public transport and nursing homes, have high SARS-CoV-2 disease transmission despite physical distancing.
 - [https://www.thelancet.com/journals/lanres/article/PIIS2213-2600\(20\)30245-9/fulltext](https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(20)30245-9/fulltext)

Humidity

- Since 1961, experiments showed that viral-pathogen-carrying droplets were inactivated within shorter and shorter times as ambient humidity was increased. Dryness drives the small aerosol particles. See e.g., review of studies, <https://aaqr.org/articles/aaqr-20-06-covid-0302>

Conclusions

The preponderance of scientific evidence supports that aerosols play a critical role in the transmission of SARS-CoV-2. Years of dose response studies indicate that if anything gets through, you will become infected.

- Thus, any respiratory protection respirator or mask must provide a high level of filtration and fit to be highly effective in preventing the transmission of SARS-CoV-2. (Works for *Mycobacterium tuberculosis* ($3\ \mu\text{m}$))
 - Public health authorities define a significant exposure to COVID-19 as face-to-face contact within 6 feet with a patient with symptomatic COVID-19 that is sustained for at least a few minutes (and some say more than 10 minutes or even 30 minutes).
 - The chance of catching COVID-19 from a passing interaction in a public space is therefore minimal.
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MASKS

Filter Efficiency and Fit

Data from a University of Illinois at Chicago review <https://www.cidrap.umn.edu/news-perspective/2020/04/commentary-masks-all-covid-19-not-based-sound-data>

- HEPA (high efficiency particulate air) filters are 99.97 to 100% efficient. HEPA filters are tested with particles that are 0.125 μm (the size of SARS-CoV-2).
 - Masks and respirators work by collecting particles through several physical mechanisms, including diffusion (small particles) and interception and impaction (large particles).
 - Surgical masks are loose-fitting devices that were designed to be worn by medical personnel to protect accidental contamination of patient wounds, and to protect the wearer against splashes or sprays of bodily fluids. They aren't effective at blocking particles smaller than 100 μm . <https://multimedia.3m.com/mws/media/9577300/respirators-and-surgical-masks-contrast-technical-bulletin.pdf>
 - OSHA/CDC: A surgical mask is not a respirator. It cannot be used to protect workers who perform or assist with aerosol-generating procedures, which may create very fine aerosol sprays. **A surgical mask can only be used to protect workers from contact with the large droplets made by patients when they cough, sneeze, talk or breathe.** <https://www.osha.gov/dts/guidance/flu/healthcare.html>
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Laboratory Studies

- N95 filtering facepiece respirators (FFRs) are constructed from electret (a dielectric material that has a quasi-permanent electric charge.) *An electret generates internal and external electric fields so the filter material has electrostatic attraction for additional collection of all particle sizes. As flow increases, particles will be collected less efficiently.*
- A properly fitted N95 will block 95% of tiny air particles down to 0.3 μm from reaching the wearer's face.
 - <https://www.honeywell.com/en-us/newsroom/news/2020/03/n95-masks-explained>.
 - Problem: no source control. An N95 does not filter exhaled air passing through the exhaust/exhalation valve (for easier breathing and less moisture inside the mask).
- Study measuring filter efficiency (2010)
 - <https://academic.oup.com/annweh/article/54/7/789/202744>; <https://www.cidrap.umn.edu/news-perspective/2020/04/commentary-masks-all-covid-19-not-based-sound-data>; <https://academic.oup.com/annweh/article/54/7/789/202744>
 - Filter efficiency was measured across a wide range of small particle sizes (0.02 to 1 μm) at 33 and 99 L/min.
 - All the cloth masks and materials had near zero efficiency at 0.3 μm , a particle size that easily penetrates into the lung (SARS-CoV-2 is 0.125 μm)
 - Efficiency for the entire range of particles
 - T-shirts — 10%
 - Scarves — 10% to 20%
 - Cloth masks — 10% to 30%
 - Sweatshirts — 20% to 40%
 - Towels — 40%
- Study measuring filter efficiency (2014, Korea)
 - <https://aaqr.org/articles/aaqr-13-06-0a-0201>
 - Evaluated 44 masks, respirators, and other materials with similar methods and small aerosols (0.08 and 0.22 μm)
 - N95 FFR filter — >95% efficiency
 - Medical masks — 55% efficiency
 - General (cloth) masks — 38% efficiency
 - Handkerchiefs — 2% (one layer) to 13% (four layers) efficiency.

- **Conclusion:** Wearing masks (other than N95) will not be effective at preventing SARS-CoV-2 transmission, whether worn as source control or as PPE.
 - N95s protect health care workers, but are not recommended for source control transmission.
 - Surgical masks are better than cloth but not very efficient at preventing emissions from infected patients. Cloth masks must be 3 layers, plus adding static electricity by rubbing with rubber glove.
 - The cloth that serves as the filtration for the mask is meant to trap particles being breathed in and out. But it also serves as a barrier to air movement because it forces the air to take the path of least resistance, resulting in the aerosols going in and out at the sides of the mask.
 - An August 2020 UCSF study suggested that the mask would decrease the absolute volume of the inoculum. (The concentrations of bacteria upstream and downstream of the test devices were measured with an aerodynamic size spectrometer)

<https://ucsf.app.box.com/s/blvolkp5z0mydzd82rjks4wyleagt036>
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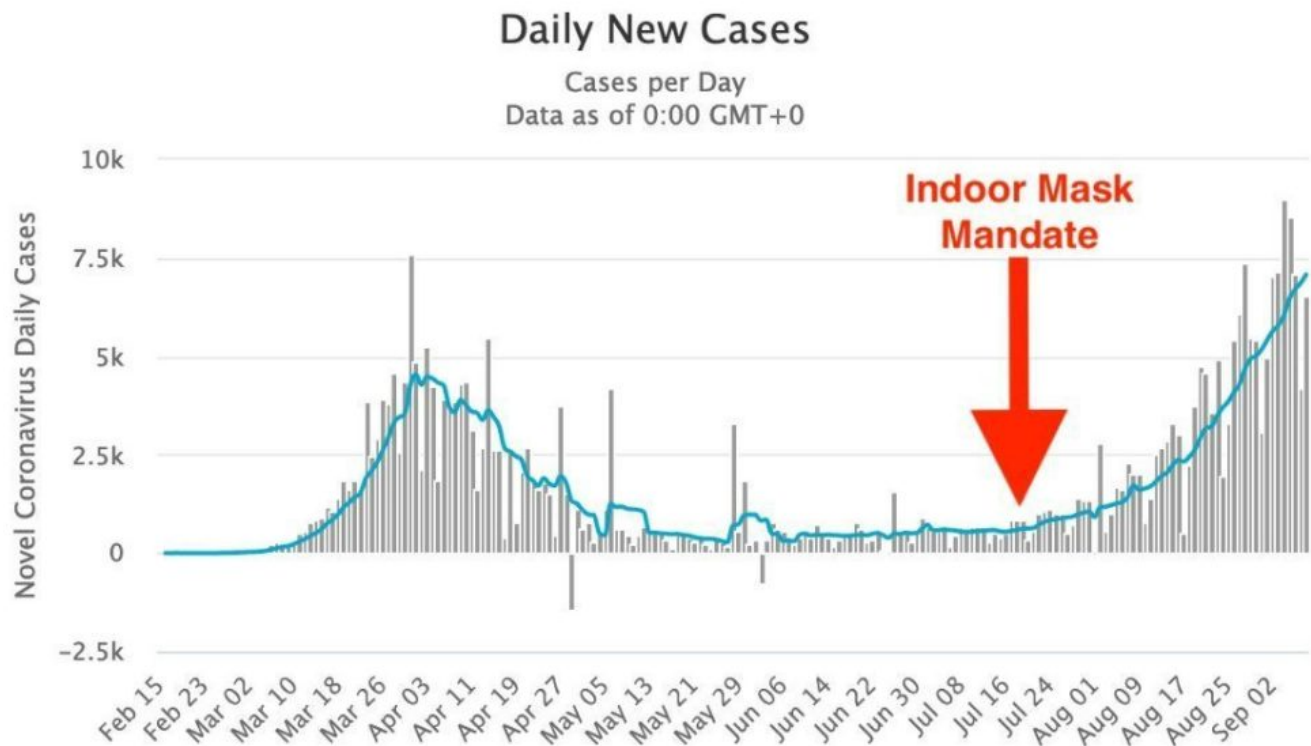
Human Studies

- Study of correct use of masks (2020, Singapore).
 - <https://www.medpagetoday.com/infectiousdisease/publichealth/86601>
 - Overall, data were collected from 714 men and women. Of all ages, only 90 participants (12.6%) passed the visual mask fit test. About 75% performed strap placement incorrectly, 61% left a “visible gap between the mask and skin,” and about 60% didn’t tighten the nose-clip.
- Study of surgical face mask use in health care workers (2009, Japan).
 - <https://pubmed.ncbi.nlm.nih.gov/19216002/>
 - Masks did not provide benefit in terms of cold symptoms or getting cold.
- Randomized clinical trial of standard medical/surgical masks in health care workers (2010, Australia).
 - https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1750-2659.2011.00198.x?fbclid=IwAR3kRYVYDKb0aR-su9_me9_vY6a8KVR4HZ17J2A_80f_fXUABRQdhQlc8Wo.
 - Study was spurred by the H1N1 flu. While N95 masks offered protection against respiratory illness, medical mask wearers and control group numbers were similar.
- Review of influenza virus and face masks in health care workers (HCWs) (2010, Hong Kong).
 - <https://www.cambridge.org/core/journals/epidemiology-and-infection/article/face-masks-to-prevent-transmission-of-influenza-virus-a-systematic-review/64D368496EBDE0AFCC6639CCC9D8BC05>
 - 6 studies of face mask use, both surgical masks and N-95 respirators in HCWs and community settings. The effectiveness of face masks is probably impacted by compliance issues in both the healthcare and community setting. Various studies show a lower level of compliance with face masks or find lower reported acceptability of face masks compared to hand hygiene behaviors and other non-pharmaceutical interventions.
- Review of masks against influenza (2012, Europe).
 - <https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1750-2659.2011.00307.x>
 - 17 eligible studies. One study had improvement with mask plus hand sanitizer. None of the studies established a conclusive relationship between mask/respirator use and protection against influenza infection.
- *The first randomized controlled trial of cloth masks in health care workers (2015, Australia).
 - <https://bmjopen.bmj.com/content/5/4/e006577>; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4420971/pdf/bmjopen-2014-006577.pdf>
 - Penetration of:
 - Cloth masks by particles — 97%
 - Medical masks — 44%,
 - 3M Vflex 9105 N95 — 0.1%
 - 3M 9320 N95 — <0.01%

- Cloth masks resulted in significantly higher rates of infection than medical masks, and also performed worse than the control arm some of whom may have worn masks.
- The virus may survive on the surface of the face masks
- Self-contamination through repeated use and improper doffing is possible. A contaminated cloth mask may transfer pathogen from the mask to the bare hands of the wearer.
- Moisture retention, reuse of cloth masks, and poor filtration may result in increased risk of infection.
- Cloth masks should not be recommended for health care workers, particularly in high-risk situations.
- Review of N95 and surgical masks against respiratory infection (2016). <https://www.cmaj.ca/content/cmaj/188/8/567.full.pdf>
 - From January 1990 to December 2014. 6 clinical studies: 3 randomized controlled trials (RCTs), 1 cohort study and 2 case-control studies, and 23 surrogate exposure studies.
 - In the meta-analysis of the clinical studies, "no significant difference between N95 respirators and surgical masks in associated risk of (a) laboratory-confirmed respiratory infection, (b) influenza-like illness, or (c) reported work-place absenteeism."
- Review of masks and N95s against respiratory infection (2017, Singapore).
 - <https://doi.org/10.1093/cid/cix681>
 - Separate meta-analyses of 6 randomized controlled trials (RCTs) and 23 observational studies conducted during the 2003 SARS pandemic.
 - Compared to medical masks, N95 respirators provided greater protection against clinical respiratory illness (CRI) and bacterial respiratory illness (BRI). These 2 outcomes were common in these trials (average risks of 8.7% and 7.3%, respectively).
 - Compared to masks, N95 respirators conferred superior protection against clinical respiratory illness and laboratory-confirmed bacterial, but not viral infections or influenza like illness (ILI).
 - Self-reported assessment of clinical outcomes was prone to bias.
 - Evidence of a protective effect of masks or respirators against verified respiratory infection was not statistically significant (compared to no mask)
- Randomized Controlled Trial: N95s vs medical masks in health care workers (HCWs) against influenza (2019).
 - <https://jamanetwork.com/journals/jama/fullarticle/2749214>
 - 2862 randomized participants, 2371 completed the study and accounted for 5180 HCW-seasons.
 - Among outpatient health care personnel, N95 respirators (8.2%) vs medical masks (7.2%) resulted in no significant difference in the incidence of laboratory-confirmed influenza. 90% said they wore the mask all the time.
- Review of N95 respirators versus surgical masks against influenza (March 2020, China).
 - <https://doi.org/10.1111/jebm.12381>
 - 6 randomized controlled trials (RCTs) involving 9,171 participants were included (2015-2020). There were no statistically significant differences in preventing laboratory-confirmed influenza, laboratory-confirmed respiratory viral infections, laboratory-confirmed respiratory infection and influenza-like illness using N95 respirators and surgical masks.
 - Meta-analysis indicated a protective effect of N95 respirators against laboratory-confirmed bacterial colonization.
- CDC Review since 1946 of masks and influenza (May 2020)
 - Nonpharmaceutical Measures for Pandemic Influenza in Nonhealthcare Settings—Personal Protective and Environmental Measures. https://wwwnc.cdc.gov/eid/article/26/5/19-0994_article
 - Systematic review. 10 RCTs that reported estimates of the effectiveness of face masks in reducing laboratory-confirmed influenza virus infections in the community from literature published during 1946–July 27, 2018.
 - There is limited evidence for face masks' effectiveness in preventing laboratory-confirmed influenza virus transmission either when worn by the infected person for source control or when worn by uninfected persons to reduce exposure.
 - "Proper use of face masks is essential because improper use might increase the risk for transmission."
- A study of 4 patients (July 2020, South Korea).
 - <https://www.acpjournals.org/doi/10.7326/M20-1342>
 - Known patients infected with SARS-CoV-2 wore masks and coughed into a Petrie dish. "Both surgical and cotton masks seem to be ineffective in preventing the dissemination of SARS-CoV-2 from the coughs of patients with COVID-19 to the environment and external mask surface."

- Studied different types of face coverings in non-clinical setting (August 2020).
 - <https://advances.sciencemag.org/content/early/2020/08/07/sciadv.abd3083>
 - *They used a black box, a laser, and a camera.* A person wears a face mask and speaks into the direction of an expanded laser beam inside a dark enclosure. Droplets that propagate through the laser beam scatter light, which is recorded with a camera. A simple computer algorithm then counts the droplets seen in the video.
 - The N95 led to a droplet transmission of below 0.1%.
 - Cotton and polypropylene masks, some of which were made from apron material showed a droplet transmission ranging from 10% to 40%.
 - Knitted mask had up to 60% droplet transmission.
 - Neck fleece had 110% droplet transmission (10% higher than not wearing a mask).
 - Speaking through some masks (particularly the neck fleece, bandanas) seemed to disperse the largest droplets into a multitude of smaller droplets ... which explains the apparent increase in droplet count relative to no mask in that case.
- See "Positive Effects of Masks" below. A recent study suggested that the mask would decrease the absolute volume of the inoculum. (The concentrations of bacteria upstream and downstream of the test devices were measured with an aerodynamic size spectrometer) <https://ucsf.app.box.com/s/blvolkp5z0mydzd82rjks4wyleagt036>
- Austrian observation (August 2020)
 - <https://corona-transition.org/maskenpflicht-brachte-in-osterreich-keinerlei-messbaren-nutzen> (in German)
 - The introduction, retraction and re-introduction of mandatory face masks in Austria had no influence at all on the infection rate.
- News report (August 13, 2020)
 - <https://sentinelksmo.org/more-deception-kdhe-hid-data-to-justify-mask-mandate/>
 - In Kansas, the 90 counties without mask mandates had lower coronavirus infection rates than the 15 counties with mask mandates. To hide this fact, the Kansas health department tried to manipulate the official statistics and data presentation.

Study from France:



<https://swprs.org/face-masks-evidence/> (Swiss Policy Research)

New Confirmed COVID-19 Cases per Day, normalized by population



<https://twitter.com/Covid19Crusher/status/1308013900546428928>

Negative Effects of Masks

Air inside the mask is definitely stale. In filtering particles, the mask makes it harder to breathe.

Decreased PaO₂

- A 2004 observational study of end stage renal disease patients during dialysis for 4 hours (2004, Taiwan).
 - <https://pubmed.ncbi.nlm.nih.gov/15340662/>;
 - https://www.researchgate.net/publication/18371248_The_physiological_impact_of_wearing_an_N95_mask_during_hemodialysis_as_a_precaution_against_SARS_in_patients_with_end-stage_renal_disease
- 39 patients, mean age, 57 years. 70% had decreased PaO₂ (from 100 to 92); 19% had hypoxemia (PaO₂ <70); all patients had increased respiratory rate 16 to 18; chest discomfort (3 baseline patients to 11 patients); respiratory distress (1 baseline patient to 17 patients)
- Stanford engineers estimated that N95 masks cause a 5% to 20% reduction in O₂ intake. This can cause dizziness and lightheadedness. This can be life-threatening for someone with lung disease or with respiratory distress.
 - <https://engineering.stanford.edu/magazine/article/covid-19-prompts-team-engineers-rethink-humble-face-mask>
- Study of surgeons in the OR (2008, Turkey).
 - <http://scielo.isciii.es/pdf/neuro/v19n2/3.pdf>
 - Scientists looked at O₂ levels of surgeons wearing masks while performing surgery. Found a decrease in the oxygen saturation of arterial pulsations (peripheral capillary O₂ saturation/SpO₂) fell from 98% to 96% and a slight increase in pulse rates compared to preoperative values in all surgeon groups.

Increased CO₂

- This may be merely theoretical. Carbon dioxide molecules freely diffuse through the masks, allowing normal gas exchange while breathing.
- CO₂ is present in the atmosphere at a level of about 0.04% (400ppm). According to the U.S. Department of Agriculture / OSHA, carbon dioxide becomes toxic at concentrations above 4 percent (40,000ppm); symptoms at 5,000-10,000 ppm. 10,000 ppm has been measured behind mask.
- Experiment (July 2020).
 - <https://www.wthr.com/article/news/health/coronavirus/verify-do-face-masks-reduce-oxygen-intake-carbon-dioxide-experiment-multiple-maskss/531-c00c96cb-9273-4947-949c-0807f94454a7>
 - Pulse oximeter and exhaled CO₂ (via tube in mask) No change with mask. (End-tidal capnography or end-tidal CO₂ (EtCO₂) monitoring is a non-invasive technique that measures the partial pressure or maximal concentration of carbon dioxide (CO₂) at the end of an exhaled breath. The normal values are 5-6% CO₂, which is equivalent to 35-45 mmHg.)
- Health care worker study (2005, Scandinavia)
 - <https://pubmed.ncbi.nlm.nih.gov/16441251/>
 - 37.3% reported face-mask-associated headaches, 32.9% reported headache frequency >6 times per month. 7.6% had taken sick leave from March 2003 to June 2004 (mean 2 days; range 1-4 days) and 59.5% required use of abortive analgesics because of headache.
- Health care worker study (2009, Japan) with similar headache results as Scandinavian study (above).
 - <https://pubmed.ncbi.nlm.nih.gov/19216002/>
- While there are some articles reporting OSHA tests, it is not clear they were proper tests.
- Some people have mistakenly claimed that OSHA standards (e.g., the Respiratory Protection standard, 29 CFR 1910.134; the Permit-Required Confined Space standard 29 CFR 1910.146; and the Air Contaminants standard, 29 CFR 1910.1000) apply to the issue of oxygen or carbon dioxide levels resulting from the use of medical masks or cloth face coverings in work settings with normal ambient air (e.g. healthcare settings, offices, retail settings, construction). These standards do not apply to the wearing of medical masks or cloth face coverings in work settings with normal ambient air. These standards would only apply to work settings where there are known or suspected sources of chemicals (e.g., manufacturing facilities) or workers are required to enter a potentially dangerous location (e.g., a large tank or vessel). <https://www.osha.gov/SLTC/covid-19/covid-19-faq.html>
- It is hard to tell if the headaches experienced by HCWs with N95s is CO₂ or having a strap around the head.
- But when asked should we be worried about CO₂, mask proponents say, “No” because you can exhale around the sides of the mask. This defeats the purpose. (2006) <https://pubmed.ncbi.nlm.nih.gov/16441251/>

Moisture retention

- Reuse of cloth masks, frequency and effectiveness of cleaning, and poor filtration may result in increased risk of infection.
- Observations during SARS suggested double-masking and other practices increased the risk of infection because of moisture, liquid diffusion.
 - <https://bmjopen.bmj.com/content/5/4/e006577>; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4420971/pdf/bmjopen-2014-006577.pdf>
- Recent study (in German) cultured 82 bacterial colonies & 4 mold (fungoid) colonies from a child's masks after 8 hours of wear.
 - <https://twitter.com/MMaccruiskeen/status/1307266527662669825?s=20>

Self-contamination

- Contamination through repeated use and improper doffing is possible. The virus may survive on the surface of the mask. The pathogen goes from mask to bare hands.

“Mask mouth”

- Reported by dentists. <https://nypost.com/2020/08/05/mask-mouth-is-a-seriously-stinky-side-effect-of-wearing-masks/>
- Wearing masks increases dryness, which leads to decrease in saliva. It is the saliva that fights bacteria. Result is decaying teeth, receding gum lines and seriously sour breath. Gum disease — or periodontal disease — will eventually lead to strokes and an increased risk of heart attacks.”

World Health Organization (WHO), June 2020

- https://apps.who.int/iris/bitstream/handle/10665/332293/WHO-2019-nCov-IPC_Masks-2020.4-eng.pdf?sequence=1&isAllowed=y
- “The likely disadvantages of the use of mask by healthy people in the general public include:
 - potential increased risk of self-contamination due to the manipulation of a face mask and subsequently touching eyes with contaminated hands;
 - potential self-contamination that can occur if non- medical masks are not changed when wet or soiled. This can create favourable conditions for microorganism to amplify;
 - potential headache and/or breathing difficulties, depending on type of mask used;
 - potential development of facial skin lesions, irritant dermatitis or worsening acne, when used frequently for long hours;
 - difficulty with communicating clearly;
 - potential discomfort;
 - a false sense of security, leading to potentially lower adherence to other critical preventive measures such as physical distancing and hand hygiene;
 - poor compliance with mask wearing, in particular by young children;
 - waste management issues; improper mask disposal leading to increased litter in public places, risk of contamination to street cleaners and environment hazard;
 - difficulty communicating for deaf persons who rely on lip reading;
 - disadvantages for or difficulty wearing them, especially for children, developmentally challenged persons, those with mental illness, elderly persons with cognitive impairment, those with asthma or chronic respiratory or breathing problems, those who have had facial trauma or recent oral maxillofacial surgery, and those living in hot and humid environments.

The Hamburg Environmental Institute (July 2020) warned of the inhalation of chlorine compounds in polyester masks as well as problems in connection with face mask disposal. <https://swprs.org/face-masks-evidence/>; <https://corona-transition.org/maskentragen-noch-ungesunder-als-gedacht> (in German)

Psychological Damage in Children (September 11, 2020).

<https://www.world-today-news.com/70-doctors-in-open-letter-to-ben-weyts-abolish-mandatory-mouth-mask-at-school-belgium/>

- 70 Belgian doctors begged for cancellation of mask mandate at school. “In recent months, the general well-being of children and young people has come under severe pressure. We see in our practices an increasing number of children and young people with complaints due to the rules of conduct that have been imposed on them. We diagnose anxiety and sleep problems, behavioral disorders and fear of contamination. We are seeing an increase in domestic violence, isolation and deprivation. Many lack physical and emotional contact; attachment problems and addiction are obvious. **‘The mandatory mouth mask in schools is a major threat to their development. It ignores the essential needs of the growing child. The well-being of children and young people is highly dependent on the emotional connection with others. (...)** The aim of education is to create an optimal context so that a maximum development of young people is possible. The school environment must be a safe practice field. **The mouth mask obligation, on the other hand, makes the school a threatening and unsafe environment, where emotional connection becomes difficult. ‘In addition, there is no large-scale evidence that wearing face masks in a non-professional environment has any positive effect on the spread of viruses, let alone on general health.’**

Unanswered questions

- Can virions escape an evaporating droplet stuck to a mask fiber?
- What are long-term health effects on HCW, such as headaches, arising from impeded breathing?
- Are there negative social consequences to a masked society?
- Are there negative psychological consequences to wearing a mask, as a fear-based behavioral modification?

- What are the environmental consequences of mask manufacturing and disposal?

Positive Mask Studies

- Some cite a September 2019 study mentioned above (<https://jamanetwork.com/journals/jama/fullarticle/2749214>) comparing N95s and surgical masks in preventing flu. BUT there was no control wearing no mask. The point of the study found that both types had similar incidence of flu. (N95-8.2% vs 7.2%).
- The main study used is the Missouri hairdressers who were SARS-CoV-2 infected but asymptomatic and wore a mask; clients did not get infected.(July 2020)
 - <https://www.livescience.com/hair-stylists-infected-covid19-face-masks.html>;
 - <https://www.cdc.gov/mmwr/volumes/69/wr/mm6928e2.htm>
 - But there is a Chinese report (May [August] 2020) of a COVID infected asymptomatic person who did not infect 455 persons with whom he was in contact. <https://pubmed.ncbi.nlm.nih.gov/32513410/>
 - Asymptomatic people do not cough and sneeze. But one study showed they shed just as many viruses as symptomatic. (August 2020, Korea)
 - <https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2769235>
- Review of mask use (March 2020, multi-country)
 - <https://www.sciencedirect.com/science/article/pii/S1477893920302301?via%3Dihub>
 - 21 studies; 8,686 participants. Mask use by health care workers (HCWs) and non-HCWs. HCWs had 80% reduction of viral infections. Non-HCW had 56%. Asian better than Western. Study stressed that masks were an adjunct to other measures.
 - Other factors:
 - Older age of the population, urbanization, obesity, and longer duration of the outbreak in a country were independently associated with higher country-wide per-capita coronavirus mortality.
 - International travel restrictions were associated with lower per-capita mortality.
 - Other containment measures, testing and tracing policies, and the amount of viral testing were not statistically significant predictors of country-wide coronavirus mortality, after controlling for other predictors.
 - Societal norms and government policies supporting mask-wearing by the public were independently associated with lower per-capita mortality from COVID-19.
- Review of 8 pre-COVID-19 studies (June 2020, Australia).
 - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7323223/?fbclid=IwAR2Ukyt8GCrK-qoc-bgCJhHknW5pqytBFOfe6txHWL_7eUs9p8vsrQ26KIM
 - Surgical masks reduced influenza like illnesses (ILI) by 41% and N95 by 66% (difference was not statistically significant). Save N95 for aerosols.
 - No good evidence face masks protect the public against viral respiratory illnesses
 - "Australia and New Zealand currently, the questionable benefits arguably do not justify health-care staff wearing surgical masks when treating low-risk patients and may impede the normal caring relationship between patients, parents and staff."
- Review of masks, physical distancing, eye protection (June 2020, WHO).
 - [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)31142-9/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)31142-9/fulltext)
 - 172 observational studies across 16 countries and six continents; MERS, SARS, betacoronavirus, SARS-CoV-2 in health care and non-healthcare settings. N95s better than surgical or 12 layer cotton. Authors did not rate the certainty of effect as high. Findings were in accord with those of a cluster randomized trial showing a potential benefit of continuous N95 respirator use over medical masks against seasonal viral infections.
- Review of face mask efficacy (July 2020, China).
 - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7253999>;
 - <https://www.sciencedirect.com/science/article/pii/S1477893920302301?via%3Dihub>
 - 21 studies, 8,686 participants: 13 case-control studies, 6 cluster randomized trials, and 2 cohort studies. 12 studies of health care workers (HCWs); 8 studies of non-healthcare professional populations; 1 study of HCWs and relatives of patients. SARS, H1N1, influenza lab confirmed.

- Masks (N95 and surgical) were generally effective in preventing the spread of respiratory viruses. After wearing a mask, the risk of contracting RVIs was significantly reduced. Use of masks by HCWs and non-HCWs can reduce the risk of respiratory virus infection by 80% and 47% respectively.
- The study they reference regarding “social” masks is footnoted to a model that assumes complete compliance and universality.
- CDC review of masks and antibody presence in health care workers (HCWs) (September 2020).
 - https://www.cdc.gov/mmwr/volumes/69/wr/mm6935e2.htm?s_cid=mm6935e2_w
 - 3,248 HCWs observed. 6% had antibodies to SARS-CoV-2; 29% were asymptomatic; 69% had not had a diagnosis of SARS-CoV-2 infection. Prevalence of antibodies was lower (6%) in HCWs who wore masks than those who did not (9%).
- *Experiment (human) measuring surgical mask efficacy in reducing virus transmission (April 2020, Hong Kong).
 - <https://www.nature.com/articles/s41591-020-0843-2>
 - 246 participants. Infection measured by PCR. Bioaerosol collecting device, to capture exhaled breath particles. Two size fractions: < and >5 microns. Surgical masks can efficaciously reduce the emission of influenza virus particles into the environment in respiratory droplets, but not in aerosols. Surgical face masks could be used by ill people to reduce onward transmission.
- Summer 2020 study with laboratory coughs (Summer 2020)
 - <https://www.vumedi.com/video/airborne-transmission-face-masks-how-do-different-types-of-masks-protect-against-various-ranges-of-t/>

Forward motion distance:

 - Handkerchief — 4 feet
 - 3 layer cloth -- 1 foot
 - 2 layers sewn cloth -- 2-3 inches
 - Problems:
 - But drops go around the nose and sides of mask.
 - Shields only work for large droplets.
 - Exhalation ports reduce humidity but defeat the purpose of using the mask.
- A U.S. study of airborne transmission (May 2020)
 - <https://www.pnas.org/content/117/26/14857>
 - Study claimed that masks had led to a decrease in infections in three global hotspots (including New York City). This did not take into account the natural decrease in infections and other measures. The study was so flawed that over 40 scientists recommended that the study be withdrawn.
- A U.S. study comparing states with mask mandates (June 2020).
 - <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2020.00818>
 - Study concluded that mandatory masks had led to a decrease in infections in 15 states. The study did not take into account that the incidence of infection was already declining in most states at that time. A comparison with other states was not made.
- A U.S. study comparing masks, lockdowns in various countries (June 2020).
 - <https://www.medrxiv.org/content/10.1101/2020.05.22.20109231v3.full.pdf>
 - Study concluded that countries with mandatory masks had fewer deaths than countries without mandatory masks. But the study compared African, Latin American, Asian and Eastern European countries with very different infection rates and population structures.
- *July-August 2020– UCSF – Mask can be a crude “vaccine.”
 - <https://link.springer.com/article/10.1007/s11606-020-06067-8>;
 - <https://ucsf.app.box.com/s/blvolkp5z0mydzd82rjks4wyleagt036>;
 - <https://www.nejm.org/doi/full/10.1056/NEJMp2026913>;
 - <https://epibiostat.ucsf.edu/news/new-theory-asks-could-mask-be-crude-‘vaccine’>;
 - <https://www.vumedi.com/video/covid-19-mortality-update-does-masking-reduce-viral-inoculum-to-which-wearer-is-exposed/>
 - Universal masking reduces the “inoculum” or dose of the virus for the mask-wearer, leading to more mild and asymptomatic

infection manifestations similar to variolation with small pox. CDC estimates 40% asymptomatic. But masked cruise ship folks had 81% asymptomatic, 95% masked prison folks, food processing plants. (The concentrations of bacteria upstream and downstream of the test devices were measured with an aerodynamic size spectrometer.)

- Many studies ignore the effect of other measures, the natural development of infection numbers, changes in test activity, or they compare countries with very different conditions.

Conclusions from Organizations

- The World Health Organization (WHO): (April 6, 2020)
 - https://apps.who.int/iris/bitstream/handle/10665/331693/WHO-2019-nCov-IPC_Masks-2020.3-eng.pdf?sequence=1&isAllowed=y
 - **“Advice to decision makers on the use of masks for healthy people in community settings:**
 - The wide use of masks by healthy people in the community setting is not supported by current evidence and carries uncertainties and critical risks.”
 - **“Medical masks should be reserved for health care workers.** The use of medical masks in the community may create a false sense of security, with neglect of other essential measures, such as hand hygiene practices and physical distancing, and may lead to touching the face under the masks and under the eyes, result in unnecessary costs, and take masks away from those in health care who need them most, especially when masks are in short supply.”
 - **“Masks are effective only when used in combination with frequent hand-cleaning with alcohol-based hand rub or soap and water.” WHO acknowledges that most people do not use masks properly.**
- But in June 8, 2020
 - https://apps.who.int/iris/bitstream/handle/10665/332293/WHO-2019-nCov-IPC_Masks-2020.4-eng.pdf?sequence=1&isAllowed=y
 - The World Health Organization has changed its stance on wearing face masks during the COVID-19 pandemic. People over 60 and people with underlying medical conditions should wear a medical-grade mask when they're in public and cannot socially distance. The general public should wear a three-layer fabric mask in those situations. Admitting that this was despite evidence with randomized controlled trials. “The use of a mask alone is insufficient to provide an adequate level of protection or source control, and other personal and community level measures should also be adopted to suppress transmission of respiratory viruses.”
 - The reasons for recommending masks has little to do with effectiveness. “The likely advantages of the use of masks by healthy people in the general public include:
 - reduced potential exposure risk from infected persons before they develop symptoms;
 - reduced potential stigmatization of individuals wearing masks to prevent infecting others (source control) or of people caring for COVID-19 patients in non-clinical settings;
 - making people feel they can play a role in contributing to stopping spread of the virus;
 - reminding people to be compliant with other measures (e.g., hand hygiene, not touching nose and mouth).
 - potential social and economic benefits.
 - Amidst the global shortage of surgical masks and PPE, encouraging the public to create their own fabric masks may promote individual enterprise and community integration.
 - the production of non-medical masks may offer a source of income for those able to manufacture masks within their communities.
 - Fabric masks can also be a form of cultural expression, encouraging public acceptance of protection measures in general.
 - The safe re-use of fabric masks will also reduce costs and waste and contribute to sustainability.”
- Dr. Nancy Messonnier, director of the Center for the National Center for Immunization and Respiratory Diseases (January 31, 2020):
 - <https://www.cdc.gov/media/releases/2020/t0131-2019-novel-coronavirus.html>
 - “We don’t routinely recommend the use of face masks by the public to prevent respiratory illness.... And we certainly are not recommending that at this time for this new virus.”
- The Centers for Disease Control and Prevention (CDC)
 - <https://www.cdc.gov/flu/professionals/infectioncontrol/maskguidance.htm>

- In March 5, 2019 regarding the flu: "Masks are not usually recommended in non-healthcare settings; however, this guidance provides other strategies for limiting the spread of influenza viruses in the community":
 - *Cover their nose and mouth when coughing or sneezing,
 - *Use tissues to contain respiratory secretions and, after use, to dispose of them in the nearest waste receptacle, and
 - *Perform hand hygiene (e.g., handwashing with non-antimicrobial soap and water, and alcohol-based hand rub if soap and water are not available) after having contact with respiratory secretions and contaminated objects/materials.
- On August 7, 2020
 - Masks are recommended as a simple barrier to help prevent respiratory droplets from traveling into the air and onto other people when the person wearing the mask coughs, sneezes, talks, or raises their voice. This is called source control.
 - CDC recommends that people wear masks in public settings and when around people who don't live in your household, especially when other social distancing measures are difficult to maintain.
 - Masks may help prevent people who have COVID-19 from spreading the virus to others.
 - Masks are most likely to reduce the spread of COVID-19 when they are widely used by people in public settings.
 - Masks should NOT be worn by children under the age of 2 or anyone who has trouble breathing, is unconscious, incapacitated, or otherwise unable to remove the mask without assistance.
 - Masks with exhalation valves or vents should NOT be worn to help prevent the person wearing the mask from spreading COVID-19 to others (source control).
- From the New England Journal of Medicine, Universal Masking in the Covid-19 Era, July 9, 2020;
 - <https://www.nejm.org/doi/full/10.1056/NEJMp2006372>
 - "We know that wearing a mask outside health care facilities offers little, if any, protection from infection. Public health authorities define a significant exposure to Covid-19 as face-to-face contact within 6 feet with a patient with symptomatic Covid-19 that is sustained for at least a few minutes (and some say more than 10 minutes or even 30 minutes). The chance of catching Covid-19 from a passing interaction in a public space is therefore minimal. In many cases, the desire for widespread masking is a reflexive reaction to anxiety over the pandemic." It is also clear that masks serve symbolic roles. **Masks are not only tools, they are also talismans that may help increase health care workers' perceived sense of safety**, well-being, and trust in their hospitals. Although such reactions may not be strictly logical, we are all subject to fear and anxiety, especially during times of crisis. One might argue that fear and anxiety are better countered with data and education than with a marginally beneficial mask.
 - But later authors said, "A growing body of research shows that the risk of SARS-CoV-2 transmission is strongly correlated with the duration and intensity of contact: the risk of transmission among household members can be as high as 40%, whereas the risk of transmission from less intense and less sustained encounters is below 5%. This finding is also borne out by recent research associating mask wearing with less transmission of SARS-CoV-2, particularly in closed settings." <https://www.nejm.org/doi/full/10.1056/NEJMc2020836>
- Holland's Medical Care Minister Tamara van Ark
 - <https://www.thesun.co.uk/news/uknews/12292821/face-masks-not-necessary-say-holland-scientists/>
 - "Despite a global stampede of mask-wearing, data show that 80-90 percent of people in Finland and Holland say they "never" wear masks when they go out, a sharp contrast to the 80-90 percent of people in Spain and Italy who say they "always" wear masks when they go out. "From a medical point of view, there is no evidence of a medical effect of wearing face masks, so we decided not to impose a national obligation."
- Panel, Rational use of face masks in the COVID-19 pandemic (March 2020)
 - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7118603/>
 - Recommendations on face mask use in community settings
 - WHO
 - If you are healthy, you only need to wear a mask if you are taking care of a person with suspected SARS-CoV-2 infection.
 - China
 - People at moderate risk* of infection: surgical or disposable mask for medical use.
 - People at low risk† of infection: disposable mask for medical use.
 - People at very low risk‡ of infection: do not have to wear a mask or can wear non-medical mask (such as cloth mask).
 - Hong Kong

- Surgical masks can prevent transmission of respiratory viruses from people who are ill. It is essential for people who are symptomatic (even if they have mild symptoms) to wear a surgical mask.
- Wear a surgical mask when taking public transport or staying in crowded places. It is important to wear a mask properly and practice good hand hygiene before wearing and after removing a mask.
- Singapore
 - Wear a mask if you have respiratory symptoms, such as a cough or runny nose.
- Japan
 - The effectiveness of wearing a face mask to protect yourself from contracting viruses is thought to be limited. If you wear a face mask in confined, badly ventilated spaces, it might help avoid catching droplets emitted from others but if you are in an open-air environment, the use of face mask is not very efficient.
- USA
 - Centers for Disease Control and Prevention does not recommend that people who are well wear a face mask (including respirators) to protect themselves from respiratory diseases, including COVID-19.
 - US Surgeon General urged people on Twitter to stop buying face masks
- UK
 - Face masks play a very important role in places such as hospitals, but there is very little evidence of widespread benefit for members of the public.
- Germany
 - There is not enough evidence to prove that wearing a surgical mask significantly reduces a healthy person's risk of becoming infected while wearing it. According to WHO, wearing a mask in situations where it is not recommended to do so can create a false sense of security because it might lead to neglecting fundamental hygiene measures, such as proper hand hygiene.

Final Thoughts

- Surgical masks are loose fitting. They are designed to protect the patient from the doctors' respiratory droplets. The wearer is not protected from others' airborne particles.
- People do not wear masks properly. Many people have the mask under the nose. The wearer does not have glasses on and the eyes are a portal of entry. If the virus lands on the conjunctiva, tears will wash it into the nasopharynx.
- Most studies cannot separate out hand hygiene.
- The designer masks and scarves offer minimal protection. They give a false sense of security to both the wearer and those around the wearer.
 - **Not to mention they add a perverse lightheartedness to the situation.
- If you are walking alone, no need for a mask. Avoid other folks; use common sense.
- Remember: children under 2 years should not wear masks because of accidental suffocation and difficulty breathing in some.
- Even if a universal mask mandate were imposed, several studies noted that folks do not use the mask properly and over-report their wearing. Additionally, how would the mandate be enforced??
- The positive studies are models that assume universality and full compliance.
- If wearing a mask makes people go out and get Vitamin D – go for it. In the 1918 flu pandemic people who went outside did better. Early reports are showing people with COVID-19 with low Vitamin D do worse than those with normal levels. Perhaps that is why shut-ins do so poorly. <https://www.medrxiv.org/content/10.1101/2020.04.08.20058578v4>

Wash your hands ——— If you are sick, stay home!

Objects and surfaces

- Person to person touching
- The CDC's most recent statement regarding contracting COVID-19 from touching surfaces: "Based on data from lab studies on Covid-19 and what we know about similar respiratory diseases, it may be possible that a person can get Covid-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose or possibly their eyes," the agency wrote. "But this isn't thought to be the main way the virus spreads. <https://www.cdc.gov/media/releases/2020/s0522-cdc-updates-covid-transmission.html>.

- Chinese study with data taken from swabs on surfaces around the hospital (July 2020)
 - https://wwwnc.cdc.gov/eid/article/26/7/20-0885_article?deliveryName=USCDC_333-DM25707
- The surfaces where tested with the PCR (polymerase chain reaction) test, which greatly amplifies the viral genetic material if it is present. That material is detectable when a person is actively infected. At the time of the study, it was thought to be the most reliable test. Because of the amplification of the viral material, there are many false positives. It is not clear that the mere presence of virus means it is infectious.
 - Computer mouse (ICU 6/8, 75%; General ward (GW) 1/5, 20%)
 - Trash cans (ICU 3/5, 60%; GW 0/8)
 - Sickbed handrails (ICU 6/14, 42.9%; GW 0/12)
 - Doorknobs (GW 1/12, 8.3%)
 - 81.3% of the miscellaneous personal items were positive:
 - Exercise equipment
 - Medical equipment (spirometer, pulse oximeter, nasal cannula)
 - PC and iPads
 - Reading glasses
 - Cellular phones (83.3% positive for viral RNA)
 - Remote controls for in-room TVs (64.7% percent positive)
 - Toilets (81.0% positive)
 - Room surfaces (80.4% of all sampled)
 - Bedside tables and bed rails (75.0%)
 - Window ledges (81.8%)
 - Plastic: up to 2-3 days
 - Stainless Steel: up to 2-3 days
 - Cardboard: up to 1 day
 - Copper: up to 4 hours
 - Floor – gravity causes droplets to fall to the floor. Half of ICU workers all had virus on the bottoms of their shoes

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