ADDENDUM MATERIAL

DATE 12·21·21 ITEM NO. ADD4

Katrina Martinez

From:	Melissa Manriquez
Sent:	Monday, December 27, 2021 9:36 AM
To:	COB_mail
Cc:	Katrina Martinez
Subject:	FW: Mask Mandate
Attachments:	face-mask-plastic-microfibers-pdf.pdf; Mask_Risks_Part4.pdf; Mask_Risks_Part1.pdf; Mask_Risks_Part3.pdf; Mask_Risks_Part2.pdf

From: Sal Balakrishnan [redacted]
Sent: Saturday, December 25, 2021 1:35 PM
To: Melissa Manriquez <Melissa.Manriquez@pima.gov>
Subject: Mask Mandate

CAUTION: This message and sender come from outside Pima County. If you did not expect this message, proceed with caution. Verify the sender's identity before performing any action, such as clicking on a link or opening an attachment.

Hello, we have been in communication in the past regarding public input on a past proposal to require vaccinations for healthcare providers. I spoke at the meeting among others and forwarded a letter based on scientific and legal objections in the matter. This letter is regarding imposition of a mask mandate.

Please be advised there are dozens of peer reviewed scientific studies on the dangers of casual wearing of masks from potential lung, brain, physiological damage to one's health. Not one paper exists extolling the benefits of masking. Dentists are reporting mask mouth disease, rotting gums and teeth from inhaling your exhalation products including bacterial and viral components back into the respiratory tract.

I'm attaching one such study, a four part peer reviewed study and a paper on dangers of masks for your reference. In fact, disclaimers are printed on virtually every box of masks by manufacturers clearly stating they are not intended for prevention of pathogen exposure. Masks were only intended for surgical use to prevent expulsion of droplets from surgeons while operating.

If you are imposing requirements such as this please provide a valid scientific basis backed by credible data . I have not found one such paper that validates your mandate; rather the opposite.

Sincerely,

Sal Balakrishnan, D.C.

MERCOLA
Take Control of Your Health

Masks Are a Ticking Time Bomb

Analysis by Dr. Joseph Mercola   Fact Checked

STORY AT-A-GLANCE -

- It's estimated that 129 billion face masks are used worldwide each month, which works out to about 3 million masks a minute
- Not only are masks not being recycled, but their materials make them likely to persist and accumulate in the environment
- Because masks may be directly made from microsized plastic fibers with a thickness of 1 mm to 10 mm, they may release microsized particles into the environment more readily — and faster — than larger plastic items, like plastic bags
- Microbes from your mouth, known as oral commensals, frequently enter your lungs, where they've been linked to advanced stage lung cancer; wearing a mask could potentially accelerate this process
- The "new normal" of widespread masking is affecting not only the environment but also the mental and physical health of humans

This article was previously published on April 7, 2021 and has been updated with new information.

The planet may be facing a new plastic crisis, similar to the one brought on by bottled water, but this time involving discarded face masks. "Mass masking" continues to be recommended by most public health groups during the COVID-19 pandemic, despite research showing masks do not significantly reduce the incidence of infection.[1]

As a result, it's estimated that 129 billion face masks are used worldwide each month, which works out to about 3 million masks a minute. Most of these are the disposable variety, made from plastic microfibers.[2]

Ranging in size from five millimeters (mm) to microscopic lengths, microplastics, which include microfibers, are being ingested by fish, plankton and other marine life, as well as the creatures on land that consume them (including humans[3]).

More than 300 million tons of plastic are produced globally annually — and that was before mask-wearing became a daily habit. Most of it ends up as waste in the environment, leading researchers from the University of Southern Denmark and Princeton University to warn that masks could quickly become "the next plastic problem."[4]

Why Disposable Masks May Be Even Worse Than Plastic Bottles

The bottled water crisis is now well-known as a leading source of environmental plastic pollution, but it's slated to be outpaced by a new mask crisis. While about 25% of plastic bottles are recycled, "there is no official guidance on mask recycle, making it more likely to be disposed of as solid waste," the researchers stated. "With increasing reports on inappropriate disposal of masks, it is urgent to recognize this potential environmental threat."[5]

Not only are masks not being recycled, but their materials make them likely to persist and accumulate in the environment. Most disposable face masks contain three layers — a polyester outer layer, a polypropylene or polystyrene middle layer and an inner layer made of absorbent material such as cotton.

Polypropylene is already one of the most problematic plastics, as it's widely produced and responsible for large waste accumulation in the environment, as well as being a known asthma trigger.[6] Further, the researchers noted:[7]

> *"Once in the environment, the mask is subjected to solar radiation and heat, but the degradation of polypropylene is retarded due to its high hydrophobicity, high*

molecular weight, lacking an active functional group, and continuous chain of repetitive methylene units. These recalcitrant properties lead to the persistence and accumulation in the environment."

They also stated that when the masks become weathered in the environment, they can generate a large number of microsized polypropylene particles in a matter of weeks, then break down further into nanoplastics that are less than 1 mm in size.

Because masks may be directly made from microsized plastic fibers with a thickness of 1 mm to 10 mm, they may release microsized particles into the environment more readily — and faster — than larger plastic items, like plastic bags.

Further, "Such impacts can be worsened by a new-generation mask, nanomasks, which directly use nanosized plastic fibers (e.g., diameter <1 mm) and add a new source of nanoplastic pollution."[8] A report by OceansAsia further estimated that 1.56 billion face masks may have entered the world's oceans in 2020, based on a global production estimate of 52 billion masks manufactured that year, and a loss rate of 3%, which is conservative.

Based on this data, and an average weight of 3 to 4 grams for a single-use polypropylene surgical mask, the masks would add 4,680 to 6,240 additional metric tons of plastic pollution to the marine environment, which, they note, "will take as long as 450 years to break down, slowly turning into microplastics while negatively impacting marine wildlife and ecosystems."[9]

Masks Entering Marine Environments Pose Additional Risks

Plastic particles are known to travel great distances, posing immense risks to virtually every part of the globe. Small, weathered pieces of plastic — suggesting they'd been on a long journey — have been found at the top of the Pyrénées mountains in southern France[10] and "in the northernmost and easternmost areas of the Greenland and Barents seas."[11]

Calling the Greenland and Barents seas area a "dead end" for the plastic debris, researchers hypothesized that the seafloor below would be a catch-all for accumulating plastic debris.[12] In separate research, it was also revealed that plastic pollution has reached the Southern Ocean surrounding Antarctica — an area believed to be mostly free of contamination.[13] According to the featured study:[14]

> *"When not properly collected and managed, masks can be transported from land into freshwater and marine environments by surface run-off, river flows, oceanic currents, wind, and animals (via entanglement or ingestion). The occurrence of waste masks has been increasingly reported in different environments and social media have shared of wildlife tangled in elastic straps of masks."*

Such plastics also contain contaminants, such as polycyclic hydrocarbons (PAHs), which may be genotoxic (i.e., causing DNA damage that could lead to cancer), along with dyes, plasticizers and other additives linked to additional toxic effects, including reproductive toxicity, carcinogenicity and mutagenicity.[15]

Aside from the chemical toxicity, ingestion of microplastics from degraded masks and other plastic waste is also toxic due to the particles themselves as well as the potential that they could carry pathogenic microorganisms.

Another issue that's rarely talked about is the fact that when you wear a mask, tiny microfibers are released, which can cause health problems when inhaled. The risk is increased when masks are reused. This hazard was highlighted in a performance study in the June 2021 issue of Journal of Hazardous Materials.[16]

Researchers from Xi'an Jiaotong University also said scientists, manufacturers and regulators need to assess the inhalation of microplastic and nanoplastic debris shed from masks — both disposable and cloth — noting:[17]

> *"… [C]omplaints of throat irritation or discomfort in the respiratory tract by children, the elderly, or other sensitive individuals after wearing these may be alerting signs of excessive amounts of respirable debris inhaled from self-made masks and respirators."*

In the featured study researchers also called on the environmental research community to "move fast to understand and mitigate these risks," suggesting that reusable cloth masks be promoted in lieu of disposable options and that mask-only trash cans be set up to assist in proper disposal.[18] However, another option would be to loosen or eliminate mask mandates, which may turn out to cause more harm than good.

Mask Use May Pose a Risk for Advanced Stage Lung Cancer

While it's well-known that gut microbiota affect your immune system and risk of chronic diseases, it was long thought that lungs were sterile. Now it's known that microbes from your mouth, known as oral commensals, frequently enter your lungs.[19] Not only that, researchers from New York University Grossman School of Medicine revealed that when these oral commensals are "enriched" in the lungs, it's associated with cancer.[20]

Specifically, in a study of 83 adults with lung cancer, those with advanced-stage cancer had more oral commensals in their lungs than those with early-stage cancer. Those with an enrichment of oral commensals in their lungs also had decreased survival and worsened tumor progression.

While the study didn't look into how mask usage could affect oral commensals in your lungs, they did note, "The lower airway microbiota, whether in health or disease state, are mostly affected by aspiration of oral secretions, and the lower airway microbial products are in constant interaction with the host immune system."[21]

It seems highly likely that wearing a mask would accelerate the accumulation of oral microbes in your lungs, thereby raising the question of whether mask usage could be linked to advanced stage lung cancer. The National Institutes of Health even conducted a study[22] that confirmed when you wear a mask most of the water vapor you would normally exhale remains in the mask, becomes condensed and is reinhaled.[23]

They went so far as to suggest that wearing a moist mask and inhaling the humid air of your own breath was a good thing, because it would hydrate your respiratory tract. But given the finding that inhaling the microbes from your mouth may increase advanced cancer risk, this hardly sounds like a benefit.

Not to mention, the humidity inside the mask will allow pathogenic bacteria to rapidly grow and multiply and, since the mask makes it more difficult to breathe, you're likely to breathe heavier, thereby risking inhaling the microbes even deeper inside your lungs.

Masks Are Harming Children and Adults

The "new normal" of widespread masking is affecting not only the environment but also the mental and physical health of humans, including children. It's largely assumed that face masks are "safe" for children to wear for long periods, such as during school, but no risk assessment has been carried out.[24] Further proof that they cause harm to children is evidenced by Germany's first registry recording the experience of children wearing masks.[25]

Using data on 25,930 children, 24 health issues were reported that were associated with wearing masks that fell into the categories of physical, psychological and behavioral issues.[26] They recorded symptoms that:[27]

> *"… included irritability (60%), headache (53%), difficulty concentrating (50%), less happiness (49%), reluctance to go to school/kindergarten (44%), malaise (42%), impaired learning (38%) and drowsiness or fatigue (37%)."*

They also found 29.7% reported feeling short of breath, 26.4% being dizzy and 17.9% were unwilling to move or play.[28] Hundreds more experienced "accelerated respiration, tightness in chest, weakness and short-term impairment of consciousness."

It's also known that microplastics exist in human placentas,[29] and animal studies show that inhaled plastic particles pass through the placenta and into the heart and brains of fetuses.[30] The fetuses exposed to the microplastics also gained less weight in the later part of the pregnancy.[31]

"We found the plastic nanoparticles everywhere we looked — in the maternal tissues, in the placenta and in the fetal tissues. We found them in the fetal heart, brain, lungs, liver and kidney," lead research Phoebe Stapleton of Rutgers University told The Guardian.[32]

Dr. Jim Meehan, an ophthalmologist and preventive medicine specialist who has performed more than 10,000 surgical procedures and is also a former editor of the medical journal Ocular Immunology and Inflammation, also conducted an evidence-based scientific analysis on masks, which shows that not only should healthy people not be wearing masks but they could be harmed as a result.[33]

Meehan suggests that the notion of mask-wearing defies common sense and reason, considering that most of the population is at very low or almost no risk of becoming severely ill from COVID-19. He also compiled 17 ways that masks can cause harm:[34]

Medical masks adversely affect respiratory physiology and function	Medical masks lower oxygen levels in the blood
Medical masks raise carbon dioxide levels in the blood	SARS-CoV-2 has a "furin cleavage" site that makes it more pathogenic, and the virus enters cells more easily when arterial oxygen levels decline, which means wearing a mask could increase COVID-19 severity
Medical masks trap exhaled virus in the mouth/mask, increasing viral/infectious load and increasing disease severity	SARS-CoV-2 becomes more dangerous when blood oxygen levels decline
The furin cleavage site of SARS-CoV-2 increases cellular invasion, especially during low blood oxygen levels	Cloth masks may increase the risk of contracting COVID-19 and other respiratory infections
Wearing a face mask may give a false sense of security	Masks compromise communications and reduce social distancing
Untrained and inappropriate management of face masks is common	Masks worn imperfectly are dangerous

Masks collect and colonize viruses, bacteria and mold	Wearing a face mask makes the exhaled air go into the eyes
Contact tracing studies show that asymptomatic carrier transmission is very rare	Face masks and stay at home orders prevent the development of herd immunity
Face masks are dangerous and contraindicated for a large number of people with preexisting medical conditions and disabilities	

Adding insult to injury, the first randomized controlled trial of more than 6,000 individuals to assess the effectiveness of surgical face masks against SARS-CoV-2 infection found masks did not statistically significantly reduce the incidence of infection.[35]

Considering the lack of evidence for their use, and the potential harms to human health and the environment, it's no wonder that calls for peaceful civil disobedience against mandatory masking are growing. The U.S. nonprofit **Stand for Health Freedom** has a widget you can use to contact your government representatives to let them know wearing a mask must be a personal choice.

Sources and References

- [1, 35] Annals of Internal Medicine November 18, 2020 DOI: 10.7326/M20-6817
- [2, 4, 5, 7, 8, 14, 18] Front. Environ. Sci. Eng. 2021, 15(6): 125
- [3] PLOS One April 11, 2018
- [6] The Lung Association Ontario 2009
- [9] OceansAsia December 7, 2020
- [10] WWF Analysis, No Plastic in Nature: Assessing Plastic Ingestion From Nature To People 2019
- [11] Science Advances April 19, 2017
- [12] Reuters April 19, 2017
- [13] Science of the Total Environment November 15, 2017
- [15] Current Opinion in Environmental Science & Health February 2018, Volume 1, Pages 1-5
- [16] Journal of Hazardous Materials June 5, 2021; 411: 124955

- [17] Environ Pollut. 2021 Jan 1; 268: 115728
- [19] Geopolitic News February 4, 2021
- [20, 21] Cancer Discov. 2021 Feb;11(2):293-307. doi: 10.1158/2159-8290.CD-20-0263. Epub 2020 Nov 11
- [22] Biophysical Journal February 11, 2021 DOI: 10.1016/j/bpj.2021.02.002
- [23] Healthing.ca February 16, 2021
- [24] The Telegraph March 18, 2021
- [25, 27] Research Square, 2021; doi.org/10.21203/rs.3.rs-124394/v2
- [26, 28] Montana Daily Gazette, January 25, 2021
- [29] Environmental International January 2021, Volume 146, 106274
- [30] Particle and Fibre Toxicology volume 17, Article number: 55 (2020)
- [31, 32] The Guardian March 18, 2021
- [33, 34] MeehanMd.com November 20, 2020

Masks, false safety and real dangers, Part 1:
Friable mask particulate and lung vulnerability

Boris Borovoy, Colleen Huber, Q Makeeta

Abstract

There is no biological history of mass masking until the current era. It is important to consider possible outcomes of this society-wide experiment. The consequences to the health of individuals is as yet unknown.

Masked individuals have measurably higher inspiratory flow than non-masked individuals. This study is of new masks removed from manufacturer packaging, as well as a laundered cloth mask, examined microscopically. Loose particulate was seen on each type of mask. Also, tight and loose fibers were seen on each type of mask. If every foreign particle and every fiber in every facemask is always secure and not detachable by airflow, then there should be no risk of inhalation of such particles and fibers. However, if even a small portion of mask fibers is detachable by inspiratory airflow, or if there is debris in mask manufacture or packaging or handling, then there is the possibility of not only entry of foreign material to the airways, but also entry to deep lung tissue, and potential pathological consequences of foreign bodies in the lungs.

Introduction

The nose and mouth are the gateways to the lungs for land vertebrates. There is no known history of a species that has begun to voluntarily or involuntarily obstruct, partially obstruct or filter the orifices to their airways and lungs. We have no biological history of such a species or how they would have adapted to or possibly survived such a novel practice.

However, recently, in mid-2020, throughout the world, in some countries far more than others, human self-masking has become commonplace, whether due to insistence by governments, requirement of employers, educational institutions and business-owners, or social pressures in one's immediate social circles. The proximal reason behind these reasons is abundant fear and desire for protection from COVID-19 throughout the world in 2020. People have been either coerced or otherwise pressured to wear "face coverings," allegedly for the purpose of "slowing the spread of COVID-19." The general public's response is to use disposable surgical masks, and a wide variety of cloth masks and other cloth face coverings. In the western hemisphere at least these facemasks had not been worn outside of certain hospital facilities, not outside of surgical settings and intensive care units of hospitals.

Prior research has overwhelmingly shown that there is no significant evidence of benefits of masks, particularly regarding transmission of viral infections, and that there are well-established risks. Evidence from peer-reviewed clinical studies and meta-analyses on problems concerning the effectiveness and safety of masks are summarized in this article.[1]

Optimal oxygen intake in humans has been calculated in the absence of any obstruction to the airways. The US Occupational Safety and Health Administration (OSHA) has determined that the optimal range of oxygen in the air for humans is between 19.5 and 23.5%. In previous times, before the COVID-19 era, OSHA required that any human-occupied airspace where oxygen measured less than 19.5% to be labelled as “not safe for workers.”[2] The percentage of oxygen inside a masked airspace generally measures 17.4% within several seconds of wearing. It has been observed that maximal voluntary ventilation and maximal inspiratory pressure increase during lower availability of oxygen at ascent in altitude, [3] as well as for those who live at high altitude.[4] Because oxygen is so essential to life, and in adequate amounts, humans and animals have developed the ability to sense changes in oxygen concentration, and to adapt to such challenges quickly. The medulla oblongata and carotid bodies are sensitive to such changes. Both lower ambient oxygen and increased ambient carbon dioxide stimulates ventilation, as the body quickly and steadfastly attempts to acquire more oxygen.[5] As a compensatory mechanism, inspiratory flow is measurably higher in mask-wearers than in controls.[6]

The question then arises: If inspiratory flow is increased over normal while wearing a mask, is every fiber attached to one’s facemask secure enough not to be inhaled into the lungs of the mask-wearer? Is it good enough for a majority of these fibers to be secure? Or must every part of every mask fiber of every mask be secure at all times?

Materials Used in Masks

Inhaled cotton fibers have been shown to cause subpleural ground glass opacities at the surface of the visceral pleura, as well as centrilobular and peribronchovascular interstitial thickening, as well as fibrous thickening of peribronchiolar interstitium. It was found by spectral analysis by infrared spectrophotometry that the foreign bodies in the lungs had an identical pattern to that of cellulose, which must have come from the inhaled cotton fibers.[7] Cotton and even silk may contribute to COPD in textile workers. Byssinosis is a pulmonary syndrome related to textile work. When textile workers were exposed to organic dusts from textiles in the workplace, both reversible and irreversible pulmonary conditions, such as asthma and COPD developed.[8] It should be remembered that unmasked textile workers would not have such high inspiratory flow as masked individuals.

Therefore, there is even more need that the fibers, debris and other particulate attached to cloth masks would stay entirely intact; every fiber, and every part of every fiber, and throughout every breath, at all times, even down to the size of nanometers.

Disposable surgical face masks are made of synthetic fibers, including polymers such as polypropylene, polyurethane, polyacrylonitrile, polystyrene, polycarbonate, polyethylene or polyester. There is an inner layer of soft fibers and a middle layer, which is a melt-blown filter, as well as a water-resistant outer layer of nonwoven fibers.[9] This study shows FT-IR spectra of the degrading fibers of disposable masks. It found that disposable face masks “could be emerging as a new source of microplastic fibers, as they can degrade/fragment or break down into smaller size/pieces . . . . [10]

Research on synthetic fibers has shown a correlation between the inhalation of synthetic fibers and various bronchopulmonary diseases, such as asthma, alveolitis, chronic bronchitis, bronchiectasis, fibrosis, spontaneous pneumothorax and chronic pneumonia. Cellular proliferation made up of histiocytes and fibroblasts were found in the lungs of those exposed to synthetic fibers in ambient air. Focal lesions in the lungs showed granulomas and collagen fibers containing both fine dust and long fibers. Some of the lung illnesses from this exposure could be reversed, while others had already proceeded to pulmonary fibrosis.[11]

Bioburden of masks has also been established. This study found bioburden on each type of mask studied, even after first use in a surgical environment. Speaking while wearing masks resulted in a significantly higher bioburden cultured from the face side of a mask.[12]

Possible Risk of Pulmonary Fibrosis

Pulmonary fibrosis is among the worst diseases that can be suffered or witnessed. It kills exceedingly slowly, by ever-thickening matrix formation, a kind of scar tissue, obstructing the alveoli and reducing their air exchange. The illness worsens slowly over time, and suffocates the victim very gradually. Nothing is available to the sufferer from conventional medicine. Neither medication nor radiation can undo the damage of the fibrous matrix laid down in the lungs' tissue. Similarly, surgery is not available to eliminate the insidious, suffocating mesh that painstakingly takes the life of the unfortunate patient. Neither is any known cure available in the realm of natural or alternative medicine. Neither nutrient, herb, nor any other known treatment can even reduce the fibrogenesis, let alone eliminate it. The 5-year survival rate is only 20%.[13] The only remedy against this scourge is diligent prevention of small and microscopic inhaled foreign bodies.

Inhaled particles, particularly nanoparticles, can begin the process of pulmonary fibrosis by forming free radicals such as superoxide anions. The resulting oxidative stress promotes inflammatory responses and surface reactivity.[14] The pathogenesis of idiopathic pulmonary fibrosis begins when Type 2 alveoli are injured and epithelia is not fully healed. Interstitial fibroblasts differentiate into myofibroblasts, which gather in fibrotic foci and form fibers with contractile properties.[15] This is followed by synthesis and deposit of extracellular matrix, which seems to be key in suffocating the air exchange of alveoli.

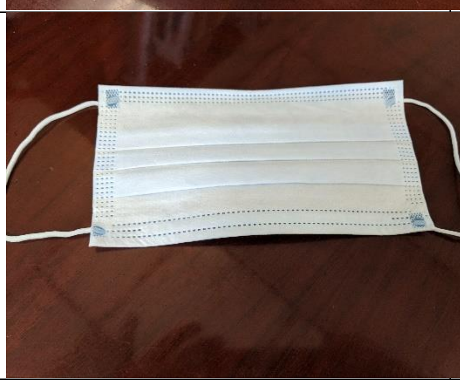
Particles of nanometer to micrometer size have been implicated as causative agents in pulmonary fibrosis.[16] Airborne inhaled nano-size particles are especially dangerous for the lungs, but are small enough to undergo transcytosis across epithelial and endothelial cells to enter blood and lymph, reaching the cardiovascular system, spleen, bone marrow, and have been observed to travel along axons and dendrites of the central nervous system and ganglia, a phenomenon that has been known for decades.[17]

Inhaled particles of 20 nm have deposited, more than other sizes of nano-particles, in the alveolar region, during nose-breathing of a person at rest.[18]

Methods

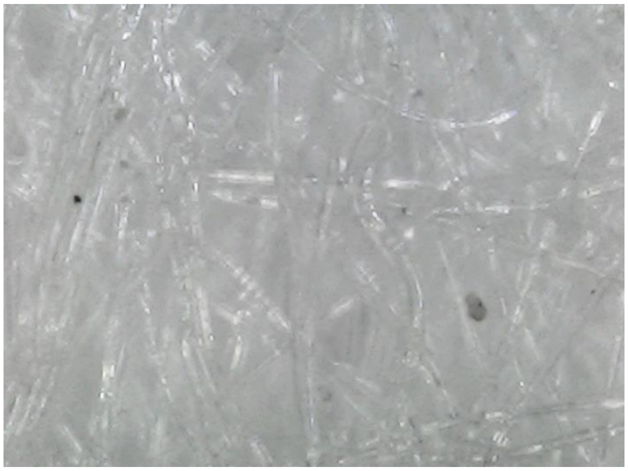
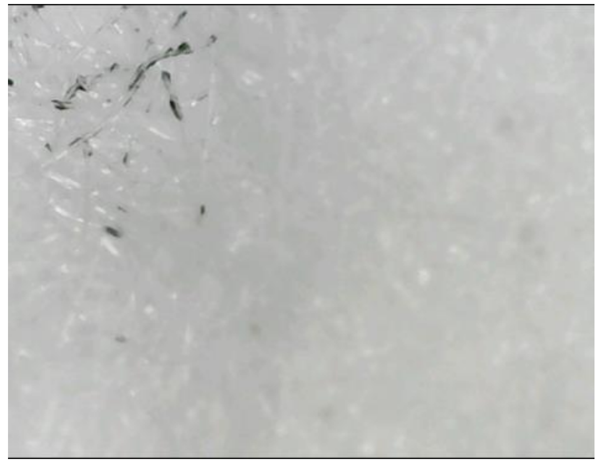
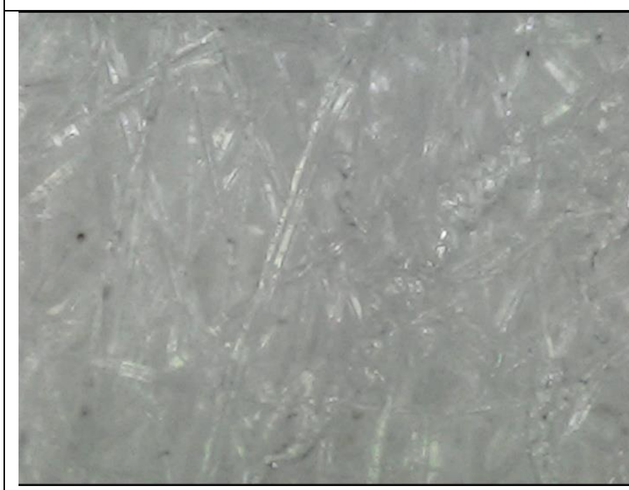
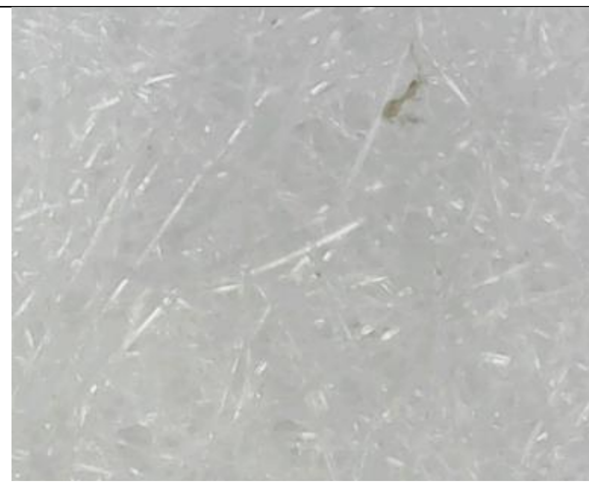
We examined microscopically the concave face side of a variety of new masks, taken directly out of their packaging from the manufacturer, not yet worn. However, the cloth mask below was worn for one day, and then laundered, and never worn again.

The following are the types of masks and the macroscopic view of the face side of each:

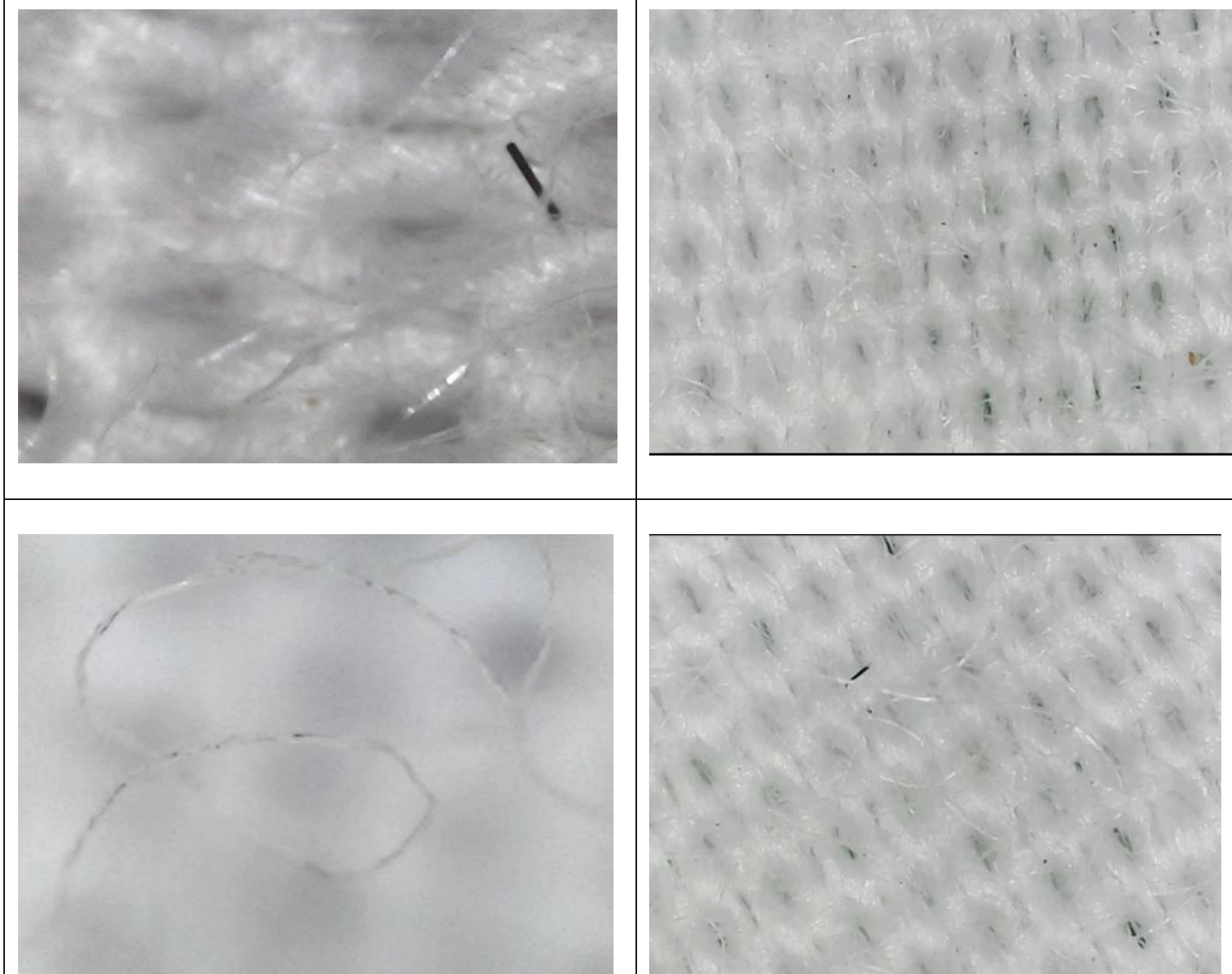
Cup mask		Cloth mask, worn one day, then laundered, and not used again	
N-95 mask #1		N-95 mask #2	
Surgical mask			

The following photos were taken of the same masks at 40x to 100 x magnification.
Higher resolution photos from other sources are in Appendix A.

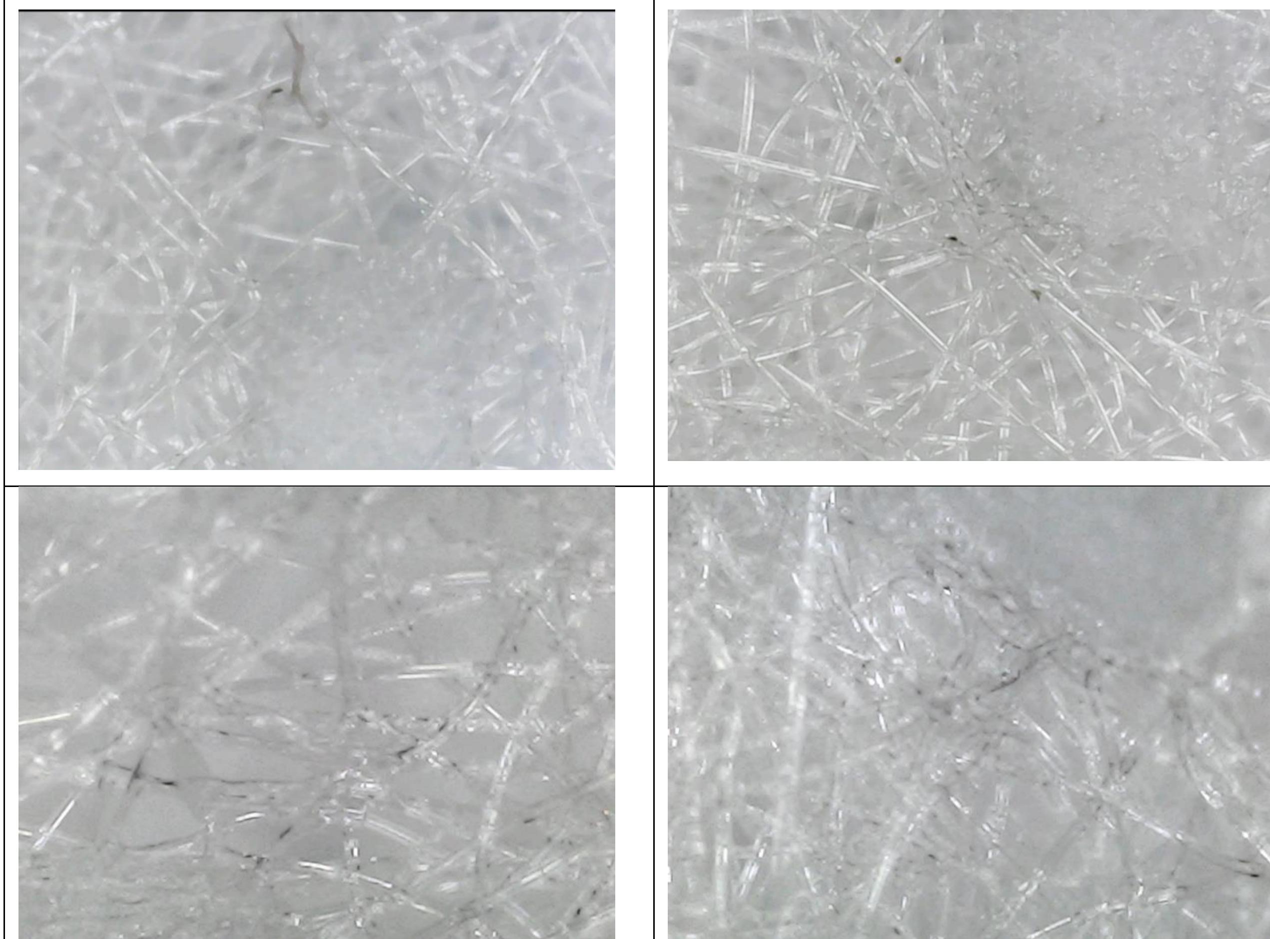
Cup mask particulate and soiled appearing fibers

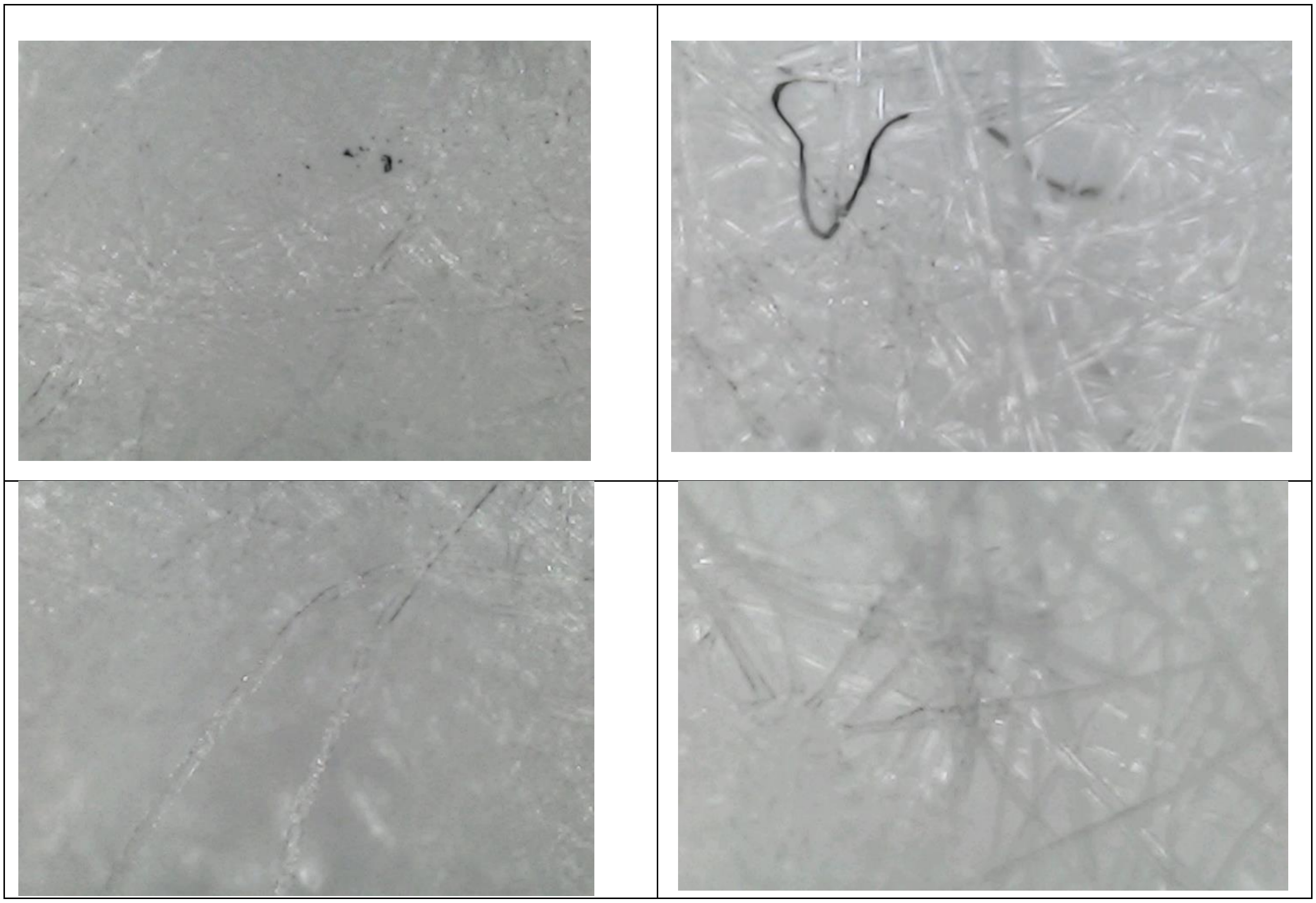
Cloth mask particulate and loosened fibers after one day use and laundering once



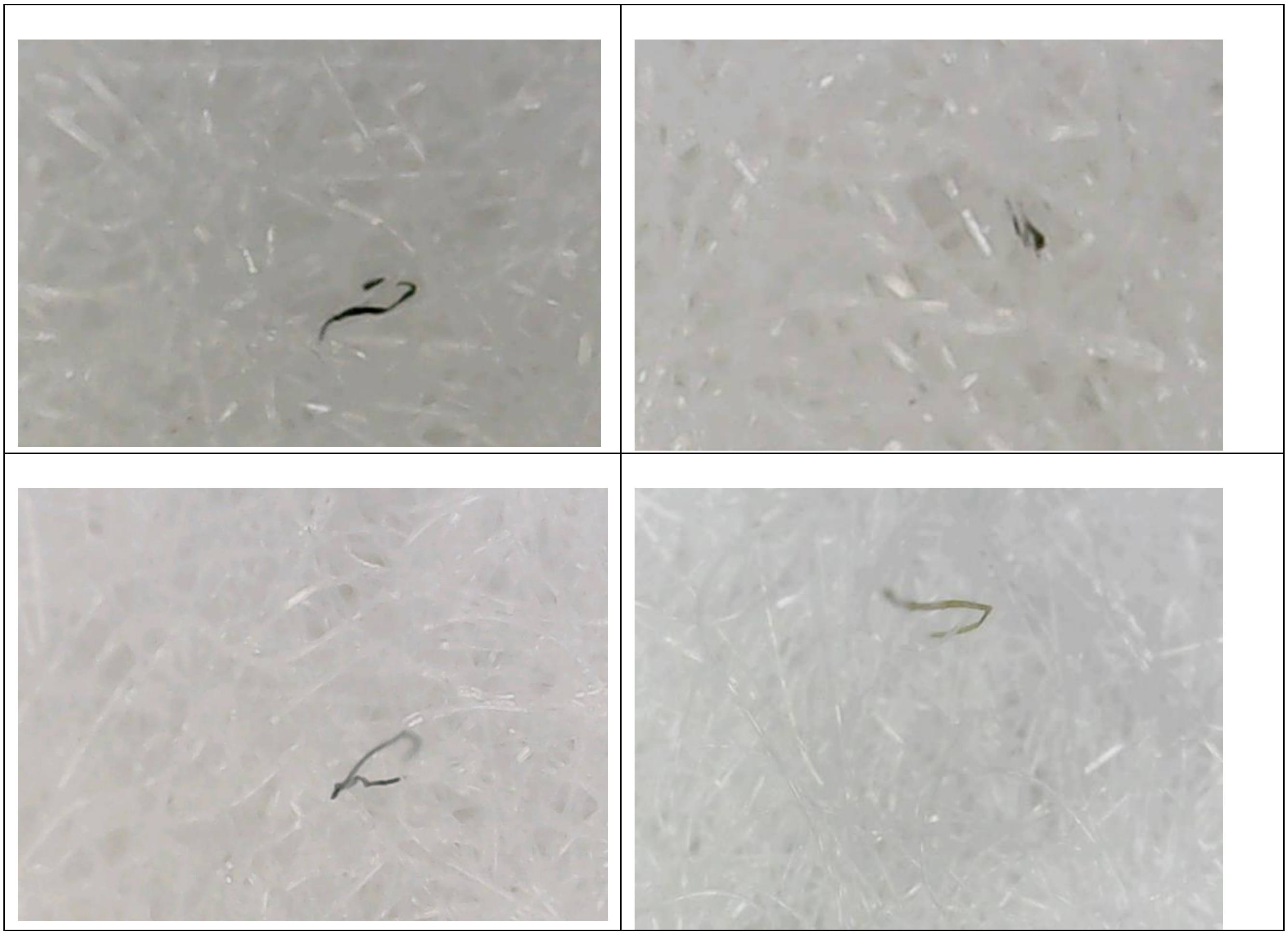
Surgical mask soiled appearance and particulate



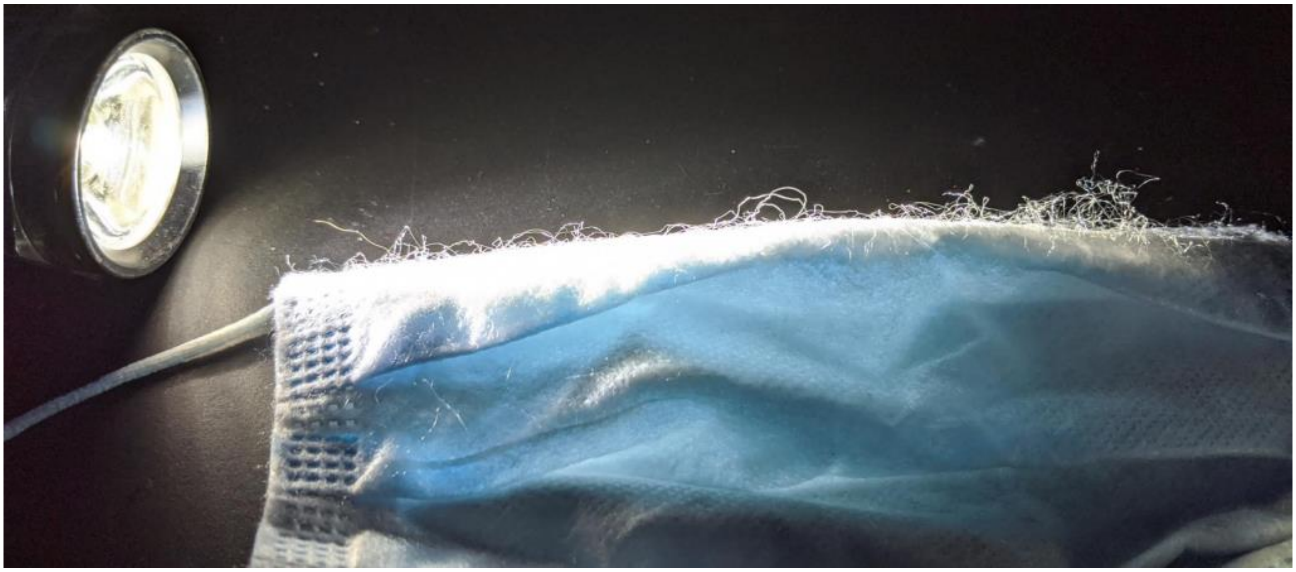
N-95 #1 particulate and soiled appearing fibers



N-95 #2 particulate



On the other hand, when masks are used, particulate and fibers may become further loosened. The following photo shows a lightly used hospital face mask illuminated by a consumer LED flashlight.



Results

A variety of face masks were examined macroscopically and microscopically. Each type of new, just unpackaged mask showed particulate matter and/or unidentified fibers. The first N-95 showed the fewest loose particles. All of the masks showed partially loose fibers in nearly every visual field. The cloth mask had been used previously but was laundered and then not used again. This also showed loose fibers dangling from the woven fabric of the mask, as well as particulate debris. The cloth mask had more loose fibers than the others, typically 4 or 5 partially loose or dangling fibers that were compressible toward the weave in each visual field.

The unclean appearance surrounding the oval shapes of the surgical mask may be due to an artifact of the thermal processing of mask textile. This may be some drops of melted polyethylene or other polymer plastic.

Conclusion

Surgical personnel are trained to never touch any part of a mask, except the loops and the nose bridge. Otherwise, the mask is considered useless and is to be replaced. Surgical personnel are strictly trained not to touch their masks otherwise. However, the general public may be seen touching various parts of their masks. Even the masks just removed from manufacturer packaging have been shown in the above photos to contain particulate and fiber that would not be optimal to inhale.

Both cotton and polymer clothing have been well-tolerated without pathology when covering any other part of the body, except over the only entry points/gateway to the respiratory system. Inhalation risks, such as the constant ventilation of the respiratory process, increased by the greater effort to attempt to fulfill bodily oxygen needs, with mostly and closely covered orifices are of great concern for those who would want to protect pulmonary health, without inhalation of unwanted particulate. When partial airway obstruction, i.e. masking, is added, deeper and more forceful breathing occurs. When this phenomenon is combined with the particles found herein on microscopic examination of the face side of newly unpackaged, never worn masks, there can arise the risk of a dangerous level of foreign material entering lung tissue. Furthermore, worn masks can only either lose these particles to lodge in the lungs of the wearer, or they would accumulate during use, to the burden (both biological and debris) of non-mask material carried on the inside of the mask.

Further concerns of macrophage response and other immune and inflammatory and fibroblast response to such inhaled particles specifically from facemasks should be the subject of more research.

If widespread masking continues, then the potential for inhaling mask fibers and environmental and biological debris continues on a daily basis for hundreds of millions of people. This should be alarming for physicians and epidemiologists knowledgeable in occupational hazards.

About the authors:

Boris A Borovoy, MPH has a Master in Public Health from Moscow Medical Academy.

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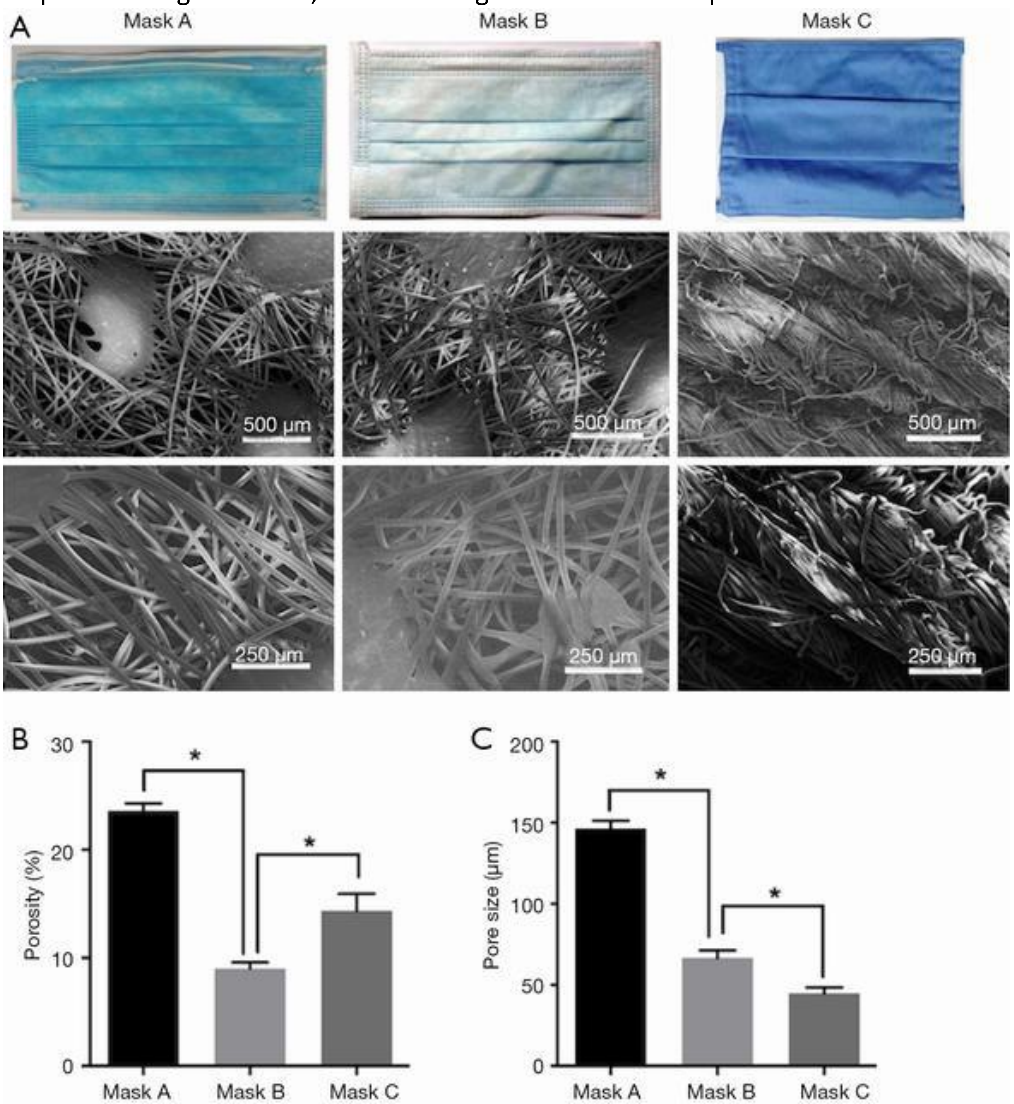
Q Makeeta, DC graduated from Pennsylvania College of Chiropractic.

Appendix A

The following are higher resolution microscopic photos of masks, with links to the sources of the photos.

Disposable surgical masks, with scanning electron microscope views.

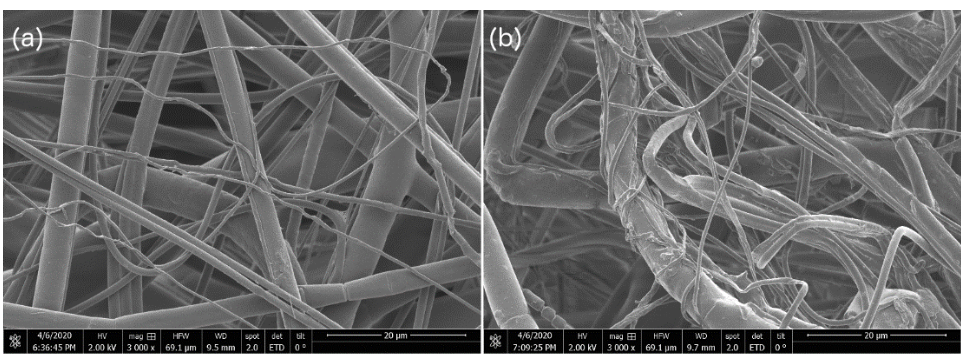


http://atm.amegroups.com/article/view/32465/html
http://cdn.amegroups.cn/journals/amepc/files/journals/16/articles/32465/public/32465-PB4-7346-R1.png

Cotton cloth photo at 40x magnification

https://i.pinimg.com/originals/8e/cf/29/8ecf29ee6e2062ed0d92313042e58dd3.jpg

N-95 Respirator, at 20 micron resolution, scanning electron microscope



https://groups.oist.jp/sites/default/files/imce/u92/fmask/SEM200mu.png

[1] C Huber. Masks are neither effective nor safe: A summary of the science. Jul 6 2020. Primary Doctor. https://www.primarydoctor.org/masks-not-effect

[2] Occupational Safety and Health Administration (OSHA), US Department of Labor. Confined or enclosed spaces and other dangerous atmospheres. https://www.osha.gov/SLTC/etools/shipyard/shiprepair/confinedspace/oxygendeficient.html

[3] S Sharma, B. Brown. Spirometry and respiratory muscle function during ascent to higher altitudes. Lung. Mar-Apr 2007. 185 (2): 113-21. doi: 10.1007/s00408-006-0108-y https://pubmed.ncbi.nlm.nih.gov/17393241/

[4] S Malik, I Singh. Ventilatory capacity among highland Bods: a possible adaptive mechanism at high altitude. Ann Hum Biol. Sep-Oct 1979. 6 (5) 471-6. doi: 10.1080/03014467900003851 https://pubmed.ncbi.nlm.nih.gov/533244/

[5] W Williams. Physiological response to alterations in [O2] and [CO2]: relevance to respiratory protective devices. J Int Soc Resp Protection. National Institute for Occupational Safety and Health (NIOSH). 27 (1): 27-51. 2010. https://www.isrp.com/the-isrp-journal/journal-public-abstracts/1154-vol-27-no-1-2010-pp-27-51-wiliams-open-access/file

[6] I Holmer, K Kuklane et al. Minute volumes and inspiratory flow rates during exhaustive treadmill walking using respirators. Ann Occup Hygiene. 51 (3): 327-335. Apr 2007. https://doi.org/10.1093/annhyg/mem004 https://academic.oup.com/annweh/article/51/3/327/139423

[7] H Kobayashi, S Kanoh, et al. Diffuse lung disease caused by cotton fibre inhalation but distinct from byssinosis. Thorax. Nov 2004. 59 (12). https://thorax.bmj.com/content/59/12/1095

[8] P Lai, D Christiani. Long-term respiratory health effects in textile workers. Curr Opin Pulm Med. Mar 2013. 19 (2): 152-157. doi: 10.1097/MCP.0b013e32835cee9a https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3725301/

[9] O Fadare, E Okoffo. Covid-19 face masks: A potential source of microplastic fibers in the environment. Sci Total Environ. Oct 1 2020. 737:140279. doi: 10.1016/j.scitotenv.2020.140279 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7297173/

[10] Ibid O Fadare, E Okoffo.

[11] J Cortez Pimentel, R Avila et al. Respiratory disease caused by synthetic fibers: a new occupational disease. Thorax. 1975. 30 (204): 205-19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC470268/pdf/thorax00140-0084.pdf

[12] Z Liu, D Yu, et al. Understanding the factors involved in determining the bioburdens of surgical masks. Ann Trans Med. Dec 2019. 7 (23). http://atm.amegroups.com/article/view/32465/html

[13] W Wuyts, C Agostini, et al. The pathogenesis of pulmonary fibrosis: a moving target. Eur Rep J. 2013 (41): 1207-1218. DOI: 10.1183/09031936.00073012 https://erj.ersjournals.com/content/41/5/1207

[14] G Oberdorster, E Oberdorster, et al. Nanotoxicology: An emerging discipline evolving from studies of ultrafine particles. Environ Health Perspect. Jul 2005. 113(7): 823-839. doi: 10.1289/ehp.7339 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1257642/

[15] C Scotton, R Chambers. Molecular targets in pulmonary fibrosis: the myofibroblast in focus. Chest. Oct 2007. 132 (4) 1311-21. doi: 10.1378/chest.06-2568. https://pubmed.ncbi.nlm.nih.gov/17934117/

[16] J Byrne, J Baugh. The significance of nanoparticles in particle-induced pulmonary fibrosis. McGill J Med. Jan 2008. 11 (1): 43-50. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2322933/

[17] D Bodian, H Howe. Experimental studies on intraneural spread of poliomyelitis virus. Bull Johns Hopkins Hops. 1941a; 69:248-267. https://www.cabdirect.org/cabdirect/abstract/19422700792

[18] International Commission on Radiological Protection. Human respiratory model for radiological protection. Ann ICRP. 1994. 24: 1-300. **The original of this article does not seem to be available. It was updated at this link:** https://www.researchgate.net/publication/5658235_Updating_the_ICRP_human_respiratory_tract_model

Masks, false safety and real dangers, Part 2: Microbial challenges from masks

Boris Borovoy, Colleen Huber, Maria Crisler

Abstract

Face masks have come into common use in many countries since mid-2020, for all age groups. Some aspect of this may be voluntary, but certainly much of this use is either accompanied by force, threats, subtle coercion, or a continuum of subtle to fierce societal pressures on the individual to conform to mask-wearing. From widespread fear of COVID-19, associated with the virus named SARS-CoV2, mask-wearing is recently assumed by many to be a prudent measure against contagion. In this paper, the second in our series, we continue our examination of the potential hazards of masks, in which we now turn attention to microbial contamination from masks and mask use, changes in oral and nasal microbiota, and potential risks to the lungs and other organ systems from microbial factors. Because widespread masking is a very new society-wide experiment, the impact of this experiment, the obstruction of airways from free breathing and a typical air exchange interplay with oral microbiota is not yet known. Furthermore, the effects of such changes in the lungs and beyond are not yet known. This paper will explore some considerations of these changes, by examining mask effectiveness against transmission, historical evidence of epidemiology from the 1918-1919 pandemic, microbial contamination, respiratory disease and the role of oral bacteria in systemic disease; and infections involving fungi, yeast, and molds. Compiling statistical and scientific evidence from these subjects alone should help equip any individual with adequate information on risks and benefits when choosing whether to wear a mask.

Are masks effective in preventing transmission of infection and are there unintended consequences when wearing them?

Face masks have been adopted by the public of several countries in 2020, with astonishing speed. Conflicting instructions from public health authorities left individual citizens unsure of whether to wear a mask, such that relying on gathered commentary from media and acquaintances in order to make such a decision has become standard. When an individual's preferences are not well formed, merely observing another person makes the option chosen by the other person a social default, that is more likely to be chosen by the observer also.[1]

Concerns regarding use of masks among the public have been voiced by many medical professionals. Over 2,000 Belgian medical professionals, including hundreds of medical doctors, have urged prevention of COVID-19 by means of strengthening natural immunity. Their recommendations, among other measures, include specifically to exercise in fresh air *without a mask.* [2] A number of reasons for this concern have been raised. In this paper, we will examine specifically microbial concerns with regard to mask-wearing.

Masks have been shown through overwhelming clinical evidence to have no effect against transmission of viral pathogens.[3] Penetration of cloth masks by viral particles was almost 97% and of surgical masks was 44%.[4] Even bacteria, approximately ten times the volume of coronaviruses, have been poorly impeded by both cloth masks and disposable surgical masks. Face masks became almost ineffective after two hours of use, and after 150 minutes of use, more bacteria was emitted through the disposable mask than from the same subject unmasked.[5] One must wonder, if new masks worn by healthcare workers, that are soiled by wear during a work shift, transmit more bacteria to patients than from an unmasked healthcare worker, then what is happening to the lungs of the mask-wearer?

Use of personal protective equipment (PPE) has long been debated for healthcare workers regarding their interactions with patients who are carrying highly pathogenic organisms, and this study found about half of even trained healthcare workers in clinical settings make at least one protocol deviation in donning and doffing PPE.[6] Certainly the general public without such training is likely to have a higher rate of similar or more egregious errors in PPE protocol. Masks have been determined to be unnecessary even in surgical settings, and of no benefit in preventing infections.[7] In fact, "The rate of wound infections [while unmasked] was less than half what it was when everyone wore masks." Oral microbial flora dispersed by unmasked healthcare workers standing one meter from the workspace failed to contaminate exposed plates on that surface.[8]

Let us also examine the entire surface area of the masked person when considering that person's potential for transmitting pathogens. Facemasks generally only cover the lower half of the face, which we know from studying burn victims is less than 2% of the entire body surface area.[9] We know that numbers of airborne bacteria expelled from the upper airway are insignificantly small compared with the volume of bacteria shed from the skin.[10] The bacteria shed from the skin of mask wearers was found to create more contamination than from non-mask wearers, presumably due to shifting, wiggling and increased rubbing and exfoliation.[11] [12]

The challenge to the masked person is that the lungs normally expel bacteria with freely exhaled breath, a necessary exhaust system not previously challenged throughout human or even vertebrate history with deliberate obstruction. In this paper we also explore both the effect of masks on microbial transmission as well as the risks and demonstrated problems of re-directed and re-inhaled bacteria and other microbes into the airways.

Are masks effective in preventing transmission of COVID-19 in particular?

COVID-19 is a remarkably low transmissibility disease. This paper shows patterns of transmission to close contacts from those who tested positive for SARS CoV2 in New South Wales high schools and primary schools. From 18 initial positive tests, only 2 out of 863 close contacts tested positive as a secondary case.[13]

In July 2020, the Council of Foreign Relations conducted a survey of 25 countries, with the following question to their citizens:

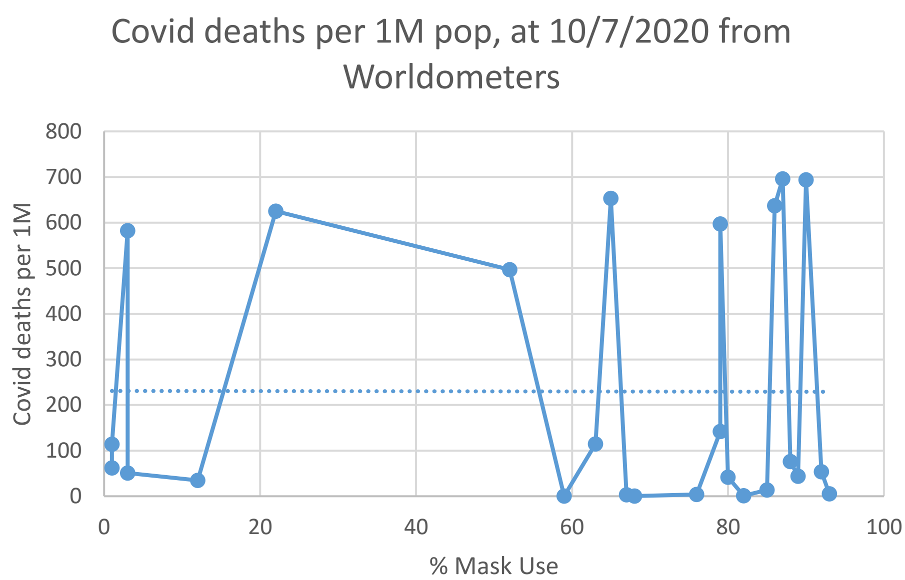
“Have you always worn a face mask outside the home in the last seven days?” The “Yes” responses ranged from 1% in Finland and Denmark, to 93% in Singapore.[14]

We then examined each of the same 25 countries for prevalence of mask use versus Covid-19 deaths per 1 million population. This data was gathered from Worldometers statistics.[15] That data is shown in Table 1, also represented in Graph 1.

Table 1

	% mask use over Jul 6-12, 2020 from CFR survey	Covid deaths per 1M pop, at 10/7/2020 from Worldometers
Singapore	93	5
Philippines	92	54
Brazil	90	694
UAE	89	44
India	88	76
Spain	87	696
Mexico	86	637
Hong Kong	85	14
Thailand	82	0.8
Indonesia	80	42
Italy	79	597
Saudi Arabia	79	142
Malaysia	76	4
Vietnam	68	0.4
China	67	3
United States	65	653
Germany	63	115
Taiwan	59	0.3
France	52	497
United Kingdom	22	625
Australia	12	35
Norway	3	51
Sweden	3	582
Denmark	1	114
Finland	1	62

Graph 1



As we see from the above data, there was no significant correlation with mask use and either increase or reduction of deaths from COVID-19; thus masking could not have caused a significant reduction in deaths. In fact, two of the countries with the highest COVID-19 deaths also had high rates of mask use: Spain at 87% mask use and Brazil at 90% mask use. Again, masking could not have caused a significant reduction in deaths.

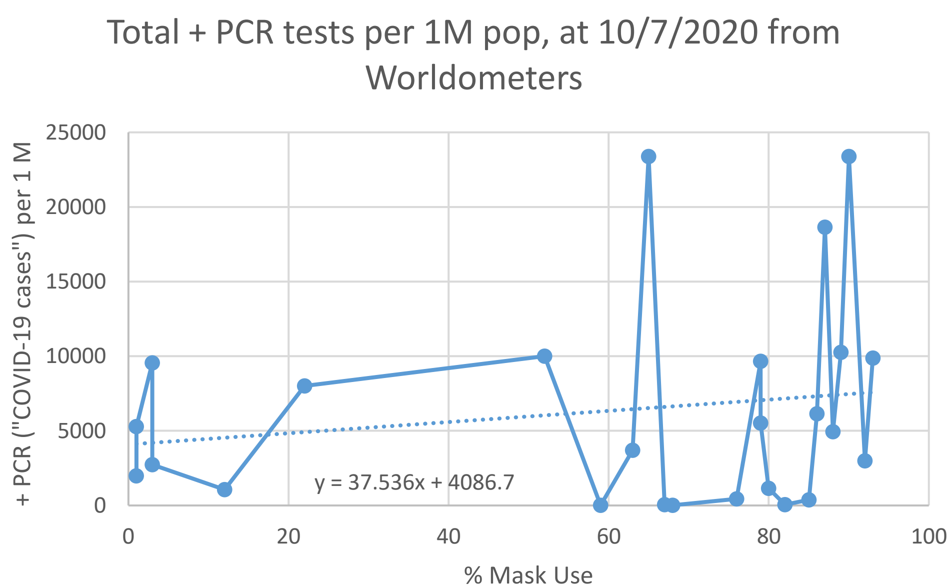
Another table presented from Worldometers data also demonstrates the rate of positive COVID-19 PCR tests per one million population in the same 25 countries surveyed. This data is reported in Table 2 and Graph 2.

Table 2

	% mask use over Jul 6-12, 2020 from CFR survey	Total + PCR tests per 1M pop, at 10/7/2020 from Worldometers
Singapore	93	9866
Philippines	92	2998
Brazil	90	23378
UAE	89	10264
India	88	4938
Spain	87	18654
Mexico	86	6146
Hong Kong	85	385
Thailand	82	52
Indonesia	80	1151

Italy	79	5525
Saudi Arabia	79	9661
Malaysia	76	431
Vietnam	68	11
China	67	59
United States	65	23385
Germany	63	3708
Taiwan	59	22
France	52	10006
United Kingdom	22	8006
Australia	12	1063
Norway	3	2742
Sweden	3	9557
Denmark	1	5297
Finland	1	1993

Graph 2



Contrary to data in table 1, we do see a significant trend in table 2. Curve-fitting a trend line, we see a positive slope for this line of 37.536. That is, for every increased percentage point of mask use in a country, there were an average of 37.536 additional positive PCR tests per one million population. This shows that masking has not accomplished the advertised function of reducing the number of positive PCR tests, but rather seems to be correlated with an increased number of positive PCR tests for COVID-19.

The historical role of bacteria in a viral pandemic

It is not at all an anomaly for fatal pneumonia to follow coronavirus infections.[16] Indeed, historical data support a correlation between pandemic and bacterial pneumonia. It is thought that the majority of deaths in the 1918-1919 pandemic "likely resulted directly from secondary bacterial pneumonia caused by common upper respiratory-tract bacteria." [17] Histopathology of lung tissue sections from that time reveal, "in virtually all cases, compelling histologic evidence of severe acute bacterial pneumonia, either as the predominant pathology or in conjunction [with influenza]." Histological evidence revealed presence of bacterial pneumonia, including bronchopneumonia. Lobar consolidation characteristic of pneumococcal pneumonia, as well as pathognomonic characteristics of streptococcal and staphylococcal pneumoniae were found. In fact, there were no negative lung culture results in any of the specimens. "Bacteria were commonly observed in the sections, often in massive numbers." In fact the bacterial damage was extensive. Vasculitis, capillary thrombosis and necrosis surrounding areas of bronchiolar damage were found. And "without this secondary bacterial pneumonia, experts generally believed that most patients would have recovered."[18]

Interestingly the above-cited paper that found a majority of 1918-1919 pandemic deaths to be from bacterial pneumonia was co-authored by Anthony Fauci, MD who has been tasked with advising the US on proper response to the 2020 COVID-19 pandemic, yet he has not publicly discussed this precedented risk of bacterial pneumonia in 2020, even having performed extensive research himself. It is also known that the 1918-1919 pandemic was the last time that human societies experimented with widespread long-term masking. As now, healthy people were made to wear masks, and it is thought by some that there would have been no pandemic in 1918 without masking. Are we repeating known mistakes from our history and what are the consequences?

The cities of Stockton CA and Boston MA were compared as follows during that pandemic.[19]

"**Masks:** The wearing of proper masks in a proper manner should be made compulsory in hospitals and for all who are directly exposed to infection. It should be made compulsory for barbers, dentists, etc. The evidence before the committee as to beneficial results consequent upon the enforced wearing of masks by the entire population at all times was contradictory, and it has not encouraged the committee to suggest the general adoption of the practice. Persons who desire to wear masks, however, in their own interests, should be instructed as to how to make and wear proper masks, and encouraged to do so.

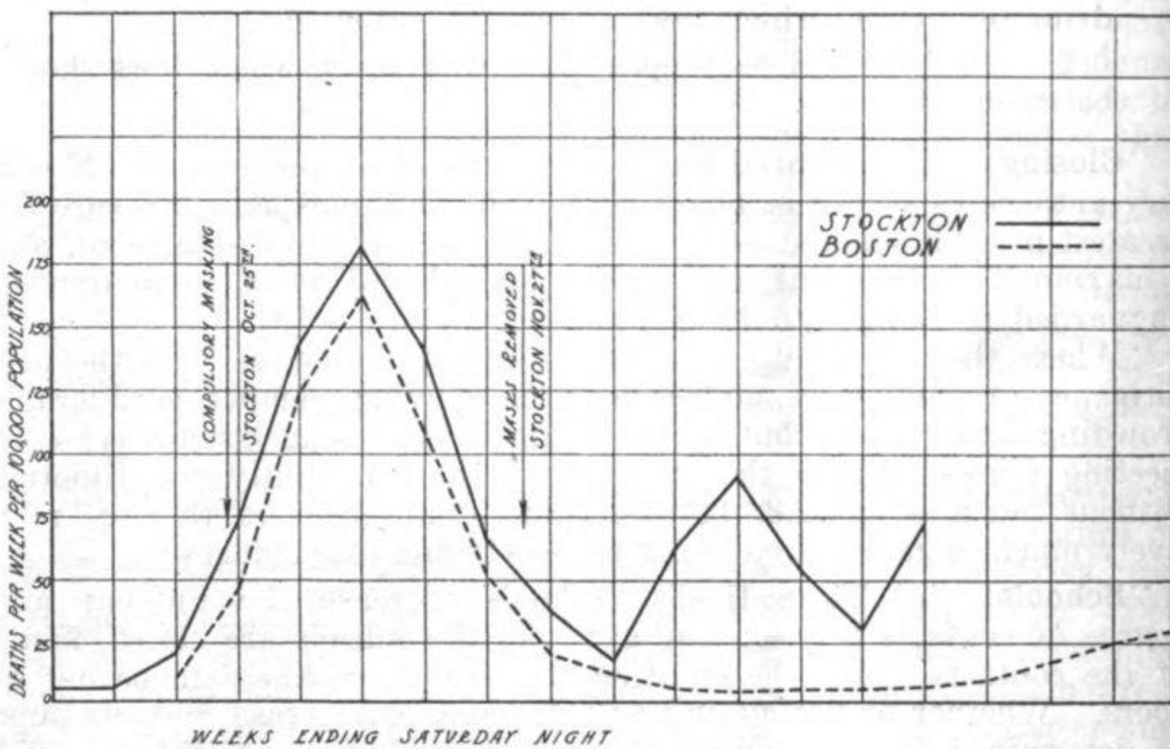


FIG. 17. Stockton, California, and Boston, Massachusetts. Comparative death rates per 100,000 population, by weeks. The use of masks was made compulsory in Stockton, but not in Boston.

One historian writes, "The quarantine, isolation and mask-wearing failed to diminish the spread of the influenza. Instead the practices likely increased fatality and had disastrous economic consequences. The medical policy of 1918 was contrary to the medical science of 1918, and the destructive practices of quarantine, isolation and mask-wearing were largely abandoned."[20]

The harm extended to the next generation. Subsequent health outcomes included increased prevalence of heart disease in infants born in 1919. [21]

Microbial contamination of and from masks

Bacteria are on average ten times the size of viruses, particularly coronaviruses, and have less penetration through masks.[22] Therefore, at least part of the re-circulated flow of bacteria in aerosolized and droplet exhalation does not escape the vicinity of the oral and nasal environment. Bacteria and other microbes are not only retained in this space, but masks themselves are warm, moist repositories of these microbes.

Laboratory testing of used masks from 20 train commuters revealed that 11 of the 20 masks tested contained over 100,000 bacterial colonies. Molds and yeasts were also found. Three of the masks contained more than one million bacterial colonies.[23] Because such particles have been cultured from masks, they are expected to remain fully available to the airways while a mask is worn.

The outside surfaces of surgical masks were found to have high levels of the following microbes, even in hospitals, more concentrated on the outside of masks than in the environment.[24] Staphylococcus species (57%) and Pseudomonas spp (38%) were predominant among bacteria, and Penicillium spp (39%) and Aspergillus spp. (31%) were the predominant fungi. These correlated with the same bacteria and fungi found in samples of the ambient air where the masks were worn.[25]

Evidence is still not abundant of injury from mask-carried microbes due to the experimental and newly adopted practice of widespread masking. Even in Asia, where public use of masks had been more common than in the west, masks were generally only worn by those who had to travel in public while suffering a respiratory illness or those suffering from seasonal pollen allergies. Without regard to the 1918-1919 epidemic, widespread masking is new again in 2020.

We further demonstrate absence of evidence is not evidence of absence. Decades of clinical evidence have attributed a variety of moderate and severe pathologies to microbes that originate in the mouth and nose, as we discuss in this paper.

The mechanism of pathology originating from masks is likely as follows: Microbe-carrying droplets, trapped in masks, stay damp while the mask is worn, whereas without a mask, exhaled droplets and aerosol are known to dry quickly. In the continually damp environment of the mask, bacteria start to proliferate, are re-inhaled and then transferred throughout the body, as discussed below.

Bacteria are exhaled through masks at an increasing rate over the time of use.[26] Outward penetration of masks by bacteria is made worse by the plosive force of coughing, sneezing and talking loudly. Scatter mechanics from the mesh of the mask and resulting chaotic collisions of aerosolized droplets in turn produce a wider contaminated airspace outside the masked mouth than outside the unmasked mouth, in the same way that a screen placed under a faucet disperses the water falling through it.

Cloth mask wearers had significantly higher influenza-like illness when compared to unmasked.[27] This meta-analysis found no benefit of masks against transmission of laboratory-confirmed influenza, in analysis of 14 randomized controlled trials.[28]

James Meehan MD reports seeing patients clinically that have facial rashes, fungal infections, bacterial infections. "Reports coming from my colleagues from all over the world, are suggesting that the bacterial pneumonias are on the rise." Dr. Meehan reports that this is "because untrained members of the public are wearing medical masks repeatedly . . . in a non-sterile fashion."[29]

Recently, a group A strep throat outbreak of unusual size in Michigan public schools where masks are mandatory was reported during the week before this writing.[30] A number of factors may be involved in this outbreak. Not only are students being forced to wear masks, but also schools were closed during lockdown long enough to possibly allow buildup of microbes in their ventilation systems. The problem may be compounded by masks damaging immunity, not being properly washed, poor training of PPE use, or even trapping Streptococcus while forcibly trying to inhale and exhale. After all, deeper inhalation, as we know happens with mask wearing, could have produced a concerning health hazard.

What may be an even more intractable health hazard is the vast range of possibilities where normally colonized strains of oral and nasal bacteria interact with newer virulent strains in the favorable incubating environment of face masks. The possibility of superstrains and their consequences in the population will likely eclipse the effects and the incidence of the relatively mild COVID-19 virus (estimated IFR 0.015[31]),, as we have seen from the autopsies discussed above of the 1918-1919 pandemic victims.

Respiratory diseases from oral bacteria

CPAP has been used for decades, but universal masking is very new. We know that wearing the CPAP mask has led to life-threatening Legionella pneumonia as well as Streptococcus infections.[32] This disproves the hypothesis that microbial growth on masks is always benign.

Aspiration pneumonia is a consequence of oral bacteria aspirated into the lungs. The teeth and gums are reservoirs for respiratory pathogens.[33] [34] Oral dysbiosis is a disordered ecosystem of commensal as well as pathogenic bacteria in the mouth. Dental caries and periodontal disease are common results of such dysbiosis. One dental practice estimates that 50% of their patients are suffering from mask-induced dental problems, including decaying teeth, receding gum lines and "seriously sour breath."[35] The dentists theorize that these new oral infections are mostly caused by the tendency for people to mouth-breathe while wearing a mask, which is not consistent with the evolution of the form and functionality of the airways of humans or any other species.

The oral flora is known to comprise over 700 bacterial species, inhabiting the epithelial debris, nutrients and oral secretions in the oral environment. Streptococci, lactobacilli and staphylococci are among the most common of these bacteria. Together, they comprise the biofilm that coats the surfaces of the oral cavity. Clearly, the bacteria benefit from the host, but the host may also benefit from the bacteria and contribute to our immunity by the production of secretory antibodies against new pathogens. The commensal relationship of oral flora with the host is generally benign and stable, unless the same bacteria achieve access to deeper tissues and blood. A number of serious and life-threatening diseases result when this happens.

Bacteria that live in the mouth and upper respiratory tract may be aspirated and cause infection in the lungs. We know that mask-wearers have greater inspiratory flow than non-mask wearers.[36] This is presumably due to the hypoxic condition of mask obstruction to the airways. As a result, microbes may be more likely to be aspirated while wearing a mask than not wearing one.

Damage to the airways results from bacterial colonization. When bacteria localize to the site(s) of infections in the respiratory tract and induce local airway inflammation, epithelial damage results. Such damage only requires bacterial colonization of the airways to begin this process, and to progress to bacterial-induced chronic airway inflammation.[37] This process begins with resident bacteria in oral secretions being aspirated and then adhering to the respiratory epithelium. These stimulate cytokine production and inflammation.[38]

In fact, the very same periodontopathic bacteria are involved in the pathogenesis of respiratory diseases. These may be some of the diseases implicated in COVID-19.[39] Conversely, oral hygiene measures have correlated with improved outcomes in pneumonia patients[40] and those generally with respiratory tract infections, [41] as well as other lung diseases, such as COPD.[42]

Infections don't only take hold from one species of pathogenic microbes. A pathogenic synergy can result in the flourishing of a particular pathogen. This was found to be the case with Aggregatibacter actinomycetemcomitans together with Streptococcus gordonii, both of which are commonly found in the mouth and in its abscesses.[43] With the concentration and culturing of microbes on the surface of a mask, is this pathogenic synergy made more likely while wearing a mask?

Systemic diseases from oral and nasal bacteria

When oral bacteria gain access to blood and deep tissues, they may cause pneumonia, abscesses in lung tissue, subacute bacterial endocarditis, sepsis and meningitis. [44] It is important to consider that endocarditis can be a lifelong infection. Strep pyogenes bacteria has been observed for decades to cause irreversible fibrosis in heart tissue long after the bacteria were no longer found.[45] This bacteria is known by many as "flesh eating strep". Former Streptococcus infections that had seemingly resolved a long time ago may still be positive in an

Antistreptolysin O test. For years afterward, flares of toxins can be released in the body at times of stress or secondary infection and cause debilitating symptoms.

Additionally Type 2 diabetes, hypertension, and cardiovascular diseases have been the result of oral bacteria gaining access to deeper tissue.[46] These are among the diseases reported as co-morbidities associated with an increased risk of death attributed to COVID-19. COPD[47] and in this enormous study, cancer can also result simply from the access of oral bacteria to deeper tissue.[48]

Immune-mediated inflammatory disorders, commonly known as auto-immune diseases are correlated with oral dysbiosis. We know that transient bacteria from an oral infection or a dental procedure can gain access to the blood for systemic circulation. Those bacteria can produce toxins that trigger tissue damage or other pathological changes. These molecules may react with antibodies that produce large complexes, which are associated with acute and chronic inflammatory changes.[49] [50] Such auto-immune diseases as rheumatoid arthritis, systemic lupus erythematosus and Sjogren's syndrome all have features of oral dysbiosis.[51]

Autoimmune encephalitis occurs when microbes access brain tissue, triggering neurological or psychiatric symptoms. This complex of diseases include basal ganglia encephalitis, and can be triggered by bacterial, viral and fungal infections. Some of the most pernicious of this group of diseases is pediatric autoimmune neuropsychiatric disorders associated with streptococcal infections (PANDAS). Group A Streptococcus (GAS) is a very common illness, and the most common bacterial infectious agent of sore throat, "strep throat," and is one of the microbial agents involved in PANDAS. GAS causes one million to 2.6 million cases of strep throat each year.[52]

Repeated infections in the nasal cavity can lead to Th1 and Th17 lymphocytes in the surrounding nasal tissue. These are pro-inflammatory and target host cells in a misdirected immune response. The Th17 cells travel into the brain along the olfactory nerves, through the cribriform plate from the nose or throat or palate and into the brain. These in turn stimulate cytokines, which then stimulate microglia. The endothelial cells in the blood brain barrier are broken down by damaging both the tight junctions in the endothelium, and by increasing transcytosis of auto-antibodies that are circulating in the blood to access the brain. This mechanism has been shown to lead to the abrupt onset of neurological and psychiatric symptoms associated with the PANDAS diagnosis.[53]

Our nasal passages are colonized by Staphylococcus bacteria, among other organisms. Under typical circumstances, these pose no threat to the individual; however, Mayo Clinic has warned, (although this statement has now been erased from their site):

> ***"A growing number of otherwise healthy people are developing life-threatening staph infections because of mask wearing."[54]***

One of the risks of mask wearing is that masks maintain bacteria in greater numbers and for a longer period of time. This increases the risk of those bacteria entering the respiratory system and/or blood stream through micro wounds.

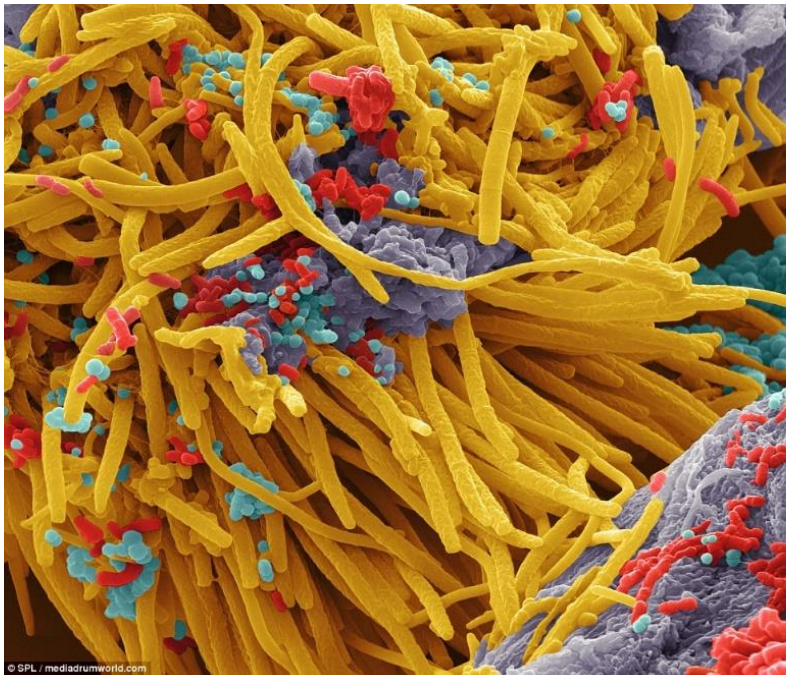
The following are some of the diseases and conditions that may result. Bacteremia is a condition in which bacteria can travel to internal organs, muscle, bone and prosthetic devices. Toxic shock syndrome is a condition in which some strains of Staphylococcus produce toxins that create high fever, nausea, vomiting and other symptoms. Septic arthritis occurs when staph bacteria infect the joints, which may result in pain, swelling and fever.

The risk of pericarditis caused by staphylococcus has been known since at least 1945.[55] This life-threatening disease has been treated with prolonged antibiotic therapy and aggressive drainage of the pericardium,[56] and, in severe cases, surgical resection of the pericardium.[57] Purulent pericarditis is the most serious consequence of bacterial pericarditis, and is always fatal if untreated. Even in treated patients the mortality rate is 40%.[58]

Streptococcus is a commensal organism of the oral mucosa, and is the most common infective agent causing endocarditis.[59] It is not so unusual for oral Streptococci to gain access to the bloodstream, and oral Streptococci comprise more than half of colonies cultured from blood following dental procedures. "Oral streptococcal bacteremia is frequently associated with the development of septic shock and death."[60]

Cardiovascular and rheumatological outcomes from mask-wearing are unlikely to be realized in the United States for at least several months due to the recentness of mask wearing; although we can learn from the history of prevalence of cardiovascular disease many years after the 1918-1919 forced masking pandemic described previously. These are enormous concerns on the horizon for future public health considerations.

Oral bacteria, with added color, under scanning electron microscope.
https://www.dailymail.co.uk/sciencetech/article-3549713



Infections involving fungi, yeast and molds

Aspergillosis is an infection of the lungs by the spores of the Aspergillus fumigatus fungus. These spores are ubiquitous in the environment, indoors and outdoors, and are usually harmless. There are many environmental sources of Aspergillus. Decaying leaves and compost in the outdoors around trees and plants, as well as indoors in bathrooms are common locations of Aspergillus. These spores may be inhaled by those with weakened immune systems and can be a cause or a result of bronchiectasis.[61] This is a chronic airway infection syndrome, and as indicated above, a risk from inhaled fibers. Fungal fibers may be inhaled and accumulate as fungal balls known as aspergillomas. At its worst, Aspergillosis can proceed to systemic infection, with consequences to the brain, heart and kidneys. Invasive aspergillosis spreads rapidly and may be fatal.

Aspergillus as well as candida also produce gliotoxins, which are immunosuppressive toxins that in turn enable proliferation of candida. The mechanism of immunosuppression appears to be by alteration of the structure and function of PMN neutrophils.[62]

It is possible that a warm moist environment, such as a mask worn outdoors or in bathrooms may pick up and harbor fungal spores as well as particulate and/or loose fibers. This is normally not a concern for a healthy person or an unmasked person. When mold spores are inhaled by a healthy person, immune system cells surround and destroy them. Masks provide an alternative environment whereby mold and fungi are held and trapped beyond typical airborne levels. When maintained over the airways, this can create a risk for the mask-wearer. Simply, if the masks retain fungal spores, these may be dislodged with inhalation.

Conclusion

Masks have been shown consistently over time and throughout the world to have no significant preventative impact against any known pathogenic microbes. Specifically, regarding COVID-19, we have shown in this paper that mask use is not correlated with lower death rates nor with lower positive PCR tests.

Masks have also been demonstrated historically to contribute to increased infections within the respiratory tract. We have examined the common occurrence of oral and nasal pathogens accessing deeper tissues and blood, and potential consequences of such events. We have demonstrated from the clinical and historical data cited herein, we conclude the use of face masks will contribute to far more morbidity and mortality than has occurred due to COVID-19.

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[1] Y Huh, J Vosgerau, et al. Social defaults: Observed choices become choice defaults. J Consumer Research, Inc Chicago Journals. Aug 28 2014. 11:55 746-760. http://www.jstor.org/stable/10.1086/677315?origin=JSTOR-pdf

[2] Docs 4 Open Debate. Letter from medical doctors and health professionals to all Belgian authorities and all Belgian media. Sept 5 2020.
https://docs4opendebate.be/en/open-letter/

[3] C Huber. Masks are neither effective nor safe. Primary Doctor. Jul 6 2020.
https://www.primarydoctor.org/masks-not-effect

[4] C MacIntyre, H Seale, et al. A cluster randomized trial of cloth masks compared with medical masks in healthcare workers. BMJ Open. 2015; 5(4)
https://bmjopen.bmj.com/content/5/4/e006577

[5] U Kelkar, B Gogate, et al. How effective are face masks in operation theatre? A time frame analysis and recommendations. Int J Inf Control. 2013. 9 (1). https://doi.org/10.3396/ijic.v9i1.10788
https://www.ijic.info/article/view/10788

[6] J Kwon, C Burnham, et al. Assessment of healthcare worker protocol deviations and self-contamination during personal protective equipment donning and doffing. Inf Control Hosp Epidemiol. Sep 2017. 38 (9): 1077-1083. https://dx.doi.org/10.1017%2Fice.2017.121. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6263164/

[7] N Orr. Is a mask necessary in the operating theatre? Ann Royal Coll Surg Eng. 1981. 63. 390-392.
https://muchadoaboutcorona.ca/wp-content/uploads/2020/08/annrcse01509-0009.pdf

[8] N Mitchell, S Hunt. Surgical face masks in modern operating rooms – a costly and unnecessary ritual? J Hosp Inf. Jul 1991. 18 (3): 239-242. https://doi.org/10.1016/0195-6701(91)90148-2
https://www.sciencedirect.com/science/article/abs/pii/0195670191901482

[9] Michigan Medicine, University of Michigan. Estimating the size of a burn. https://www.uofmhealth.org/health-library/sig254759

[10] N Mitchell, S Hunt. Surgical face masks in modern operating rooms – a costly and unnecessary ritual? J Hosp Inf. Jul 1991. 18 (3): 239-242. https://doi.org/10.1016/0195-6701(91)90148-2 https://www.sciencedirect.com/science/article/abs/pii/0195670191901482

[11] H McClure, C Talboys, et al. Surgical face masks and downward dispersal of bacteria. Anaesthesia. 53 (7). Apr 6 2002. https://doi.org/10.1046/j.1365-2044.1998.435-az0528.x. https://associationofanaesthetists-publications.onlinelibrary.wiley.com/doi/full/10.1046/j.1365-2044.1998.435-az0528.x

[12] R Schweizer. Mask wiggling as a potential cause of wound contamination. Lancet. Nov 20 1976. 2 (7995). 1129-1130. doi: 10.1016/s0140-6736(76)91101-6 https://pubmed.ncbi.nlm.nih.gov/62960/

[13] New South Wales Government, National Centre for Immunisation Research and Surveillance. COVID-19 in schools – the experience in NSW. http://ncirs.org.au/sites/default/files/2020-04/NCIRS%20NSW%20Schools%20COVID_Summary_FINAL%20public_26%20April%202020.pdf

[14] C Felter, N Bussemaker. Which countries are requiring face masks? Council on Foreign Relations. Aug 4, 2020. https://www.cfr.org/in-brief/which-countries-are-requiring-face-masks

[15] Worldometers. https://www.worldometers.info/coronavirus/?%3D%3D

[16] R Channappanavar, S Perlman. Pathogenic human coronavirus infections: causes and consequences of cytokine storm and immunopathology. Semin Immunopathol. Jul 2017. 39 (5): 529-539. doi: 10.1007/s00281-017-0629-x. https://pubmed.ncbi.nlm.nih.gov/28466096/

[17] D Morens, J Taubenberger, et al. Predominant role of bacterial pneumonia as a cause of death in pandemic influenza: implications for pandemic influenza preparedness. J Inf Dis. Octo 1 2008. 198 (7). 962-970. https://doi.org/10.1086/591708. https://academic.oup.com/jid/article/198/7/962/2192118

[18] E Opie, F Blake, et al. The pathology and bacteriology of pneumonia following influenza. Chapter IV, Epidemic respiratory disease. The pneumonias and other infections of the respiratory tract accompanying influenza and measles. 1921, St. Louis. CV Mosby. 107-281.

[19] W Vaughan. Influenza: An epidemiologic study. Baltimore MD: Am J Hygiene. Monographic series. 1921. 1. 241.

[20] A Ciani. A pandemic of socialism. American Thinker. Aug 24, 2020. https://www.americanthinker.com/articles/2020/08/a_pandemic_of_socialism.html#ixzz6ZkgXX16k

[21] D Almond, B Mazumder. The 1918 influenza pandemic and subsequent health outcomes: An analysis of SIPP data. Am Econ Rev. May 2005. 95 (2): 258-262. doi: 10.1257/000282805774669943. https://pubmed.ncbi.nlm.nih.gov/29125265/

[22] A Prussin, E Garcia, et al. Total virus and bacteria concentrations in indoor and outdoor air. Environ Sci Technol Lett. 2015. 2 (4). 84-88. https://dx.doi.org/10.1021%2Facs.estlett.5b00050 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4515362/

[23] Blick. Your corona mask really is that gruesome. [article in German]. Sep 16, 2020. https://amp.blick.ch/wirtschaft/gebrauchte-exemplare-getestet-so-gruusig-ist-ihre-corona-maske-wirklich-id16096358.html?utm_source=twitter&utm_medium=social_user&utm_campaign=blick_amp

[24] L Zhiqing, C Yongyun. Surgical masks as source of bacterial contamination during operative procedures. J Ortho Translation. July 2018. 14. 57-62. https://doi.org/10.1016/j.jot.2018.06.002 https://www.sciencedirect.com/science/article/pii/S2214031X18300809

[25] P Luksamijarulkul, N Ajempradit, et al. Microbial contamination on used surgical masks among hospital personnel and microbial air quality in their working wards: A hospital in Bangkok. Oman Med J. Sept 2014. 29 (5). 346-350. https://dx.doi.org/10.5001%2Fomj.2014.92. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4202234/

[26] U Kelkar, B Gogate, et al. How effective are face masks in operation theatre? A time frame analysis and recommendations. Int J Inf Control. 2013. 9 (1). https://doi.org/10.3396/ijic.v9i1.10788 https://www.ijic.info/article/view/10788

[27] C MacIntyre, H Seale, et al. A cluster randomized trial of cloth masks compared with medical masks in healthcare workers. BMJ Open. 2015; 5(4) https://bmjopen.bmj.com/content/5/4/e006577

[28] J Xiao, E Shiu, et al. Nonpharmaceutical measures for pandemic influenza in non-healthcare settings – personal protective and environmental measures. Centers for Disease Control. 26(5); 2020 May. https://wwwnc.cdc.gov/eid/article/26/5/19-0994_article

[29] J Manley. Medical Doctor warns that "bacterial pneumonias are on the rise" from mask wearing. Oct 6 2020. https://www.globalresearch.ca/medical-doctor-warns-bacterial-pneumonias-rise-mask-wearing/5725848

[30] C Cichoracki. Health department investigating after high number of strep throat cases reported at Shepherd schools. ABC News. Oct 2 2020. https://www.abc12.com/app/2020/10/02/health-department-investigating-after-high-number-of-strep-throat-cases-at-shepherd-schools/?fbclid=IwAR2ECNvuIrMVGX_1adk_btUieta6sUPfCTu532-2UC2inKv6m9Hmb8Ey3W4

[31] US Centers for Disease Control. Coronavirus disease 2019 (COVID-19). Sep 10 2020 update. https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html#table-1

[32] R Schnirman, N Nur et al. A case of legionella pneumonia caused by home use of continuous positive airway pressure. SAGE Open Med Case Rep. 2017; 5: 2050313X17744981. doi:10.1177/2050313X1774498 https://journals.sagepub.com/doi/10.1177/2050313X17744981

[33] F Scannapieco. Role of oral bacteria in respiratory infection. J Periodontol. Jul 1999. 70 (7): 793-802. doi: 10.1902/jop.1999.70.7.793. https://pubmed.ncbi.nlm.nih.gov/10440642/

[34] O Ortega, P Clave. Oral hygiene, aspiration and aspiration pneumonia: From pathophysiology to therapeutic strategies. Curr Phys Med Rehabil Rep. Oct 2013. 1:292-295. DOI 10.1007/s40141-013-0032-z.

[35] R Ramondi. Interview with FOX News. 'Mask mouth': Dentists coin new term for smelly side effect of wearing a mask. Aug 7 2020. https://www.foxnews.com/health/mask-mouth-dentists-new-term

[36] I Holmer, K Kuklane et al. Minute volumes and inspiratory flow rates during exhaustive treadmill walking using respirators. Ann Occup Hygiene. 51 (3): 327-335. Apr 2007. https://doi.org/10.1093/annhyg/mem004 https://academic.oup.com/annweh/article/51/3/327/139423

[37] OA Khair, RJ Davies, et al. Bacterial-induced release of inflammatory mediators by bronchial epithelial cells. Eur Resp J. 1996(9): 1913-1922. https://erj.ersjournals.com/content/9/9/1913

[38] F Scannapieco, B Wang, et al. Oral bacteria and respiratory infection: Effects on respiratory pathogen adhesion and epithelial cell proinflammatory cytokine production. Ann Periodontol. Dec 1, 2001. https://doi.org/10.1902/annals.2001.6.1.78
https://aap.onlinelibrary.wiley.com/doi/abs/10.1902/annals.2001.6.1.78

[39] J Patel, V Sampson. The role of oral bacteria in COVID-19. Lancet. https://doi.org/10.1016/S2666-5247(20)30057-4.
https://www.thelancet.com/journals/lanmic/article/PIIS2666-5247(20)30057-4/fulltext

[40] A Azarpazhooh, JL Leake. Systematic review of the association between respiratory diseases and oral health. J Periodontol. 2006 (77): 1465-1482.
https://pubmed.ncbi.nlm.nih.gov/16945022/

[41] P Sjogren, E Nilsson, et al. A systematic review of the preventive effect of oral hygiene on pneumonia and respiratory tract infection in elderly people in hospitals and nursing homes: effect estimates and methodological quality of randomized controlled trials. J Am Geriatr Soc. 2008 (56): 2124-2130.
https://pubmed.ncbi.nlm.nih.gov/18795989/

[42] D Manger, M Walshaw, et al. Evidence summary: The relationship between oral health and pulmonary disease. Br Dent J. Apr 7 2017. 222 (7): 527-533. doi: 10.1038/sj.bdj.2017.315
https://pubmed.ncbi.nlm.nih.gov/28387268/

[43] A Stacy, D Fleming et al. A commensal bacterium promotes virulence of an opportunistic pathogen via cross-respiration. Am Soc for Microbiol. 7 (3) e00782-16. doi:10.1128/mBio.00782-16
https://mbio.asm.org/content/7/3/e00782-16/article-info

[44] K Todar. The Normal Bacterial Flora of Humans. Online Textbook of Bacteriology. 2020.
http://www.textbookofbacteriology.net/normalflora_3.html

[45] R Glaser, W Thomas, et al. The incidence and pathogenesis of myocarditis in rabbits after group A streptococcal pharyngeal infections. J Exp Med. Jan 1 1956.. 103 (1): 173-188. doi: 10.1084/jem.103.1.173.
https://pubmed.ncbi.nlm.nih.gov/13278463/

[46] J Patel, V Sampson. The role of oral bacteria in COVID-19. Lancet. https://doi.org/10.1016/S2666-5247(20)30057-4.
https://www.thelancet.com/journals/lanmic/article/PIIS2666-5247(20)30057-4/fulltext

[47] A Ramesh, S Varghese, et al. Chronic obstructive pulmonary disease and periodontitis – Unwinding their linking mechanisms. Sept 2015. J Oral Biosci. 58 (1).
https://www.researchgate.net/publication/283116707_Chronic_obstructive_pulmonary_disease_and_periodontitis_-_Unwinding_their_linking_mechanisms

[48] P Heikkila, A But, et al. Periodontitis and cancer mortality: Register-based cohort study of 68,273 adults in 10-year follow-up. Cancer Epidem. Int J Cancer. 142 (11). Jan 11 2018. https://doi.org/10.1002/ijc.31254
https://onlinelibrary.wiley.com/doi/full/10.1002/ijc.31254

[49] N Babu, A Gomes. Systemic manifestations of oral diseases. J Oral Maxillofac Pathol. 15 (2); May-Aug 2011.
https://dx.doi.org/10.4103%2F0973-029X.84477
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3329699/

[50] C Bingham, M Moni. Periodontal disease and rheumatoid arthritis: the evidence accumulates for complex pathobiologic interactions. Curr Opin Rheumatol. Jul 8 2015.
https://dx.doi.org/10.1097%2FBOR.0b013e32835fb8ec
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4495574/

[51] B Feldman. The oral microbiome and its links to autoimmunity. The Doctor Weighs In. Aug 26, 2018.
https://thedoctorweighsin.com/oral-microbiome-links-autoimmunity/

[52] US Centers for Diseases Control. Erythromycin-resistant Group A Streptococcus.
https://www.cdc.gov/drugresistance/pdf/threats-report/gas-508.pdf

[53] T Dileepan, E Smith, et al. Group A Streptococcus intranasal infection promotes CNS infiltration by streptococcal-specific Th17 cells. J Clin Invest. Jan 2016. 126 (1): 303-317. doi: 10.1172/JCI80792
https://pubmed.ncbi.nlm.nih.gov/26657857/

[54] Mayo Clinic. Staph Infections. [Article is now partially censored.]
https://www.mayoclinic.org/diseases-conditions/staph-infections/symptoms-causes/syc-20356221

[55] J Terrasse, J Lere, et al. Septicèmie, ostéomyelite, percardite suppurée a staphylocoques; guerison par la pénicilline intraveineuse, intramusculaire, intrapéricardique. [Article in French]. Bull Mem So Med Hop Paris, 1945. 61 (26-31): 400-402.
https://pubmed.ncbi.nlm.nih.gov/21021328/

[56] R Rubin, R Moellering. Clinical, microbiologic and therapeutic aspects of purulent pericarditis. Am J Med. Jul 1975. 59 (1): 68-78. doi: 10.1016/0002-9343(75)90323-x.
https://pubmed.ncbi.nlm.nih.gov/1138554/

[57] A Majid, A Omar. Diagnosis and management of purulent pericarditis. Experience with pericardiectomy. J Thorac Cardiovasc Surg. Sept 1991. 102 (3): 413-417.
https://pubmed.ncbi.nlm.nih.gov/1881180/

[58] S Pankuweit, A Ristic, et al. Bacterial pericarditis: diagnosis and management. Am J Cardiovasc Drugs. 2005. 5 (2): 103-112. doi: 10.2165/00129784-200505020-00004.
https://pubmed.ncbi.nlm.nih.gov/15725041/

[59] R Taib, D Penny. Infective Endocarditis. In Paediatric Cardiology. (Third Edition). 2010.
https://www.sciencedirect.com/book/9780702030642/paediatric-cardiology

[60] G Chhatwal, R Graham. Streptococcal diseases. In International Encyclopedia of Public Health (Second Edition). 2017. https://www.sciencedirect.com/referencework/9780128037089/international-encyclopedia-of-public-health

[61] A DeSoyza, S Alberti. Bronchiectasis and aspergillosis: How are they linked? Med Mycol Jan 1 2017. 55 (1): 69-81. doi: 10.1093/mmy/myw109. https://pubmed.ncbi.nlm.nih.gov/27794529/

[62] D Shah, S Jackman, et al. Effect of gliotoxin on human polymorphonuclear neutrophils. Infect Dis Obstet Gynecol. 1998. 6 (4). 168-175. https://dx.doi.org/10.1002%2F(SICI)1098-0997(1998)6%3A4%3C168%3A%3AAID-IDOG6%3E3.0.CO%3B2-Z
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1784797/

Masks, False safety and real dangers, Part 3:
Hypoxia, hypercapnia and physiological effects

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Abstract

Wearing a mask causes physiological changes to multiple organ systems, including the brain, the heart, the lungs, the kidneys and the immune system. We examine changes in oxygen and carbon dioxide concentrations in masked airspace that is available to the airways over the first 45 seconds of wear. Our findings of reduced oxygen and increased carbon dioxide in a masked airspace are not inconsistent with previously reported data. We also consider the range of injuries known to occur to the above-named organ systems in a state of hypoxia and hypercapnia. As an excretory pathway, carbon dioxide release by cells throughout the body, and then past the alveoli and then the airways and orifices, has not been previously challenged by deliberate obstruction in the history of the animal kingdom, except for relatively rare human experiments. Self-deprivation of oxygen is also unknown in the animal kingdom, and rarely attempted by humans. We examine the physiological consequences of this experiment.

MASKS and HYPERCAPNIA

Do masks cause systemic hypercapnia?

Airway obstruction is a long recognized cause of retention of carbon dioxide and respiratory acidosis. A sustained level of increased carbon dioxide stays inside of masked air, compared to room air, which in turn sustains a low level of hypercapnia. Rebreathing of exhaled air has been found to quickly elevate [CO_2] in available air above 5000 ppm, and to increase arterial CO_2 concentration and to increase acidosis.[1] The mechanism of mask-induced hypercapnia may also include the moisture on a mask trapping carbon dioxide from exhalation. Some carbon dioxide diffuses in the air, more so if dry, but some portion of it, trapped by water vapor and mask moisture, would form a weak, unstable acid with water, for re-circulation to the airways and lungs. The mechanism is that retention of CO_2 causes an increase in PCO_2. This is the primary disturbance in respiratory acidosis. It results in an increased concentration of both HCO_3^- and H^+, which is measured as a lower pH.

Masks increase respiratory drive and bronchodilation in mild hypercapnia, from sensitive chemoreceptors picking up changes in pH of cerebrospinal fluid. Ultimately in severe hypercapnia, respiratory drive is actually depressed.

Hypercapnia is widely recognized to be an independent risk factor for death.[2,3,4,5] A number of organ systems are negatively impacted, including the brain, heart, lungs, immune system and musculoskeletal system.[6,7]

How quickly do masks increase carbon dioxide in the masked airspace?

We used a new calibrated carbon dioxide meter to measure ambient carbon dioxide in room air, and then inside the masked airspace of three different masks after donning each in turn. This experiment involved a disposable surgical mask, a N-95 mask and a cloth mask. We recorded carbon dioxide parts per million inside the masked airspace. The meter refreshed its readings at 5-second intervals, and we used those same intervals in recording CO2 parts per million. The maximum CO2 reading on the meter is 10,000 parts per million.

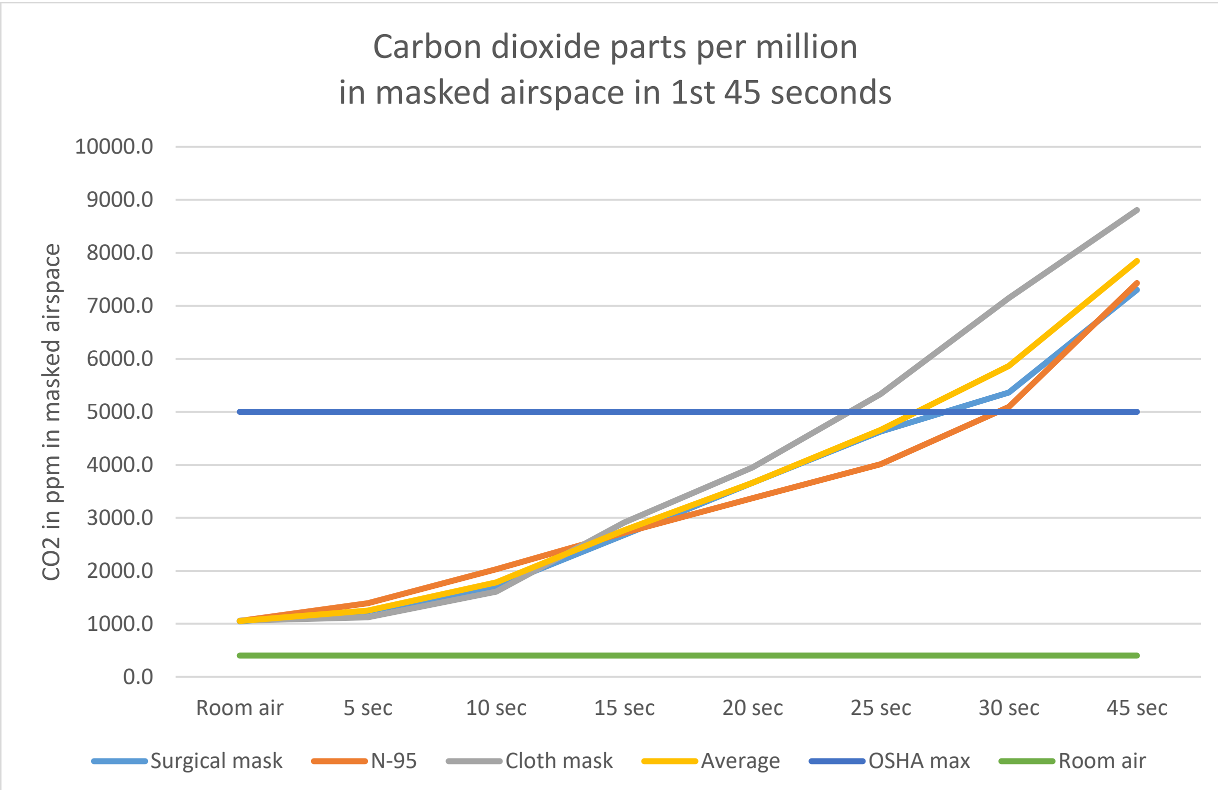
The table of those values are shown in Table 1, with the mean values shown for each 5-second interval in the first 45 seconds. After 45 seconds, the readings passed the maximum meter reading of 10,000 ppm [CO2], and were thereafter indeterminate from the meter.

Table 1: Measured [CO2] in masked airspace

	Room air	**5 sec**	**10 sec**	**15 sec**	**20 sec**	**25 sec**	**30 sec**	**45 sec**	**60 sec**	**75 sec**	**90 sec**
Surgical mask	1072	1298	1757	2256	2995	3215	3306	3074	3378	5483	7472
	1022	1086	1317	1667	2221	2792	3526	6479	7755	9964	>10000
	1074	1202	1502	2400	2619	2746	2948	4794	5994	8095	>10000
	1089	1211	1357	3090	5520	8230	9381	>10000			
	989	1265	1700	3257	4221	5412	6764	9465	>10000		
	1026	1363	2590	3392	4384	5377	6263	>10000			
Mean	**1045.3**	**1237.5**	**1703.8**	**2677.0**	**3660.0**	**4628.7**	**5364.7**	**7302.0**			
N-95	1050	1323	1834	2518	3184	4281	4689	7042	9684	>10000	
	1037	1517	3360	4133	4708	5315	5394	9082	>10000		
	1049	1475	1599	1800	1911	2773	6346	6563	>10000		
	1083	1292	1834	3312	3730	3901	4140	5692	7855	>10000	
	1073	1450	1975	2621	3820	4407	5629	7279	9240	>10000	
	1033	1266	1583	1926	2874	3392	4371	8921	>10000		
Mean	**1054.2**	**1387.2**	**2030.8**	**2718.3**	**3371.2**	**4011.5**	**5094.8**	**7429.8**			
Cloth mask	1084	1115	1718	2218	2725	3300	4914	6494	8410	>10000	
	1066	1057	1558	2467	3644	6369	8480	>10000			
	1050	1189	1686	3573	4400	5080	5768	8966	>10000		
	1062	1200	1685	4129	5848	7863	>10000				
	1051	1078	1430	2301	3580	5087	8555	>10000			
	1044	1115	1569	2772	3503	4321	5149	7385	9260	>10000	
Mean	**1059.5**	**1125.7**	**1607.7**	**2910.0**	**3950.0**	**5336.7**	**7144.3**	**8807.5**			

If we look at the time in which our readings did not yet exceed the maximum of the meter, then we have the following graph, Graph 1, of the average rise in carbon dioxide concentration inside the masked air for each mask, as [CO2] rose over the first 45 seconds of wear.

Graph 1



The blue horizontal line in Graph 1 represents the maximum allowable average CO2 concentration in workspace air during an 8-hour work shift, by the Occupational Safety and Health Administration (OSHA) of the US Department of Labor.[8] The green horizontal line represents typical [CO2] in room air, which is 400 parts per million.

After donning each mask, we see that [CO2] in the masked airspace rose above acceptable OSHA limits within the first 30 seconds.

The concentration of carbon dioxide rises similarly during the time of wearing each kind of mask. These findings are consistent with known data on the carbon dioxide concentration of available airspace inside of a mask.[9]

Industrial workspace standards established by OSHA for carbon dioxide concentration in the workspace are for ambient room air, and these have been established since 1979. It is not the case that OSHA has mandated specific CO2 concentrations for masked airspace. However, we examine these standards for available room air, and compare masked airspace to them, because in both cases we may consider [CO2] concentration in the air that is available to the airways and the lungs.

The Food Safety and Inspection Service of the United States Department of Agriculture notes that carbon dioxide gas is used to euthanize both poultry and swine.[10] Concentration of this gas is therefore of concern regarding the use of masks by human beings. That government agency publishes the following warnings:

5,000 ppm = 0.5% is the OSHA Permissible Exposure Limit (PEL) for 8-hour exposure, [11] averaged over the workday. Each of our masks surpassed that level within the masked airspace in the first 25 to 30 seconds of wear.

At 10,000 ppm of short exposure, OSHA says there are typically no effects, possible drowsiness.

At 20,000 ppm, the Food Safety and Inspection Service advises: "Do not enter areas where CO2 levels exceed 20,000 ppm until ventilation has been provided to bring the concentration down to safe levels." We should remember here that each of the masks we studied rose to half of this concentration within the first minute alone.

At 30,000 ppm = 3% [CO2], there is "moderate respiratory stimulation and increased heart rate and blood pressure."

At 40,000 ppm = 4%, OSHA finds [CO2] to be "immediately dangerous to life or health." [12]

Hypercapnia is known to rapidly cause intracellular acidosis in all cells in the body. There is no way to wall off the damage to only affect the lungs, due to constant gas exchange. That is, there is no known way to restrict hypercapnic effects to only the lungs.

The effects of hypercapnia progress in this order: Compensatory attempt at respiratory ventilation, labored breathing, hyperpnea; nervous system changes with changes in motor skills, visual acuity, judgment and cognition, cerebral vasodilation with increasing pressure inside the skull and headache, stimulation of the sympathetic nervous system, resulting in tachycardia, and finally, in case of extreme hypercapnia, central depression.[13] [14]

Hypercapnia effects on the lungs and immune system

Exhaled breath contains about 5% = 50,000 ppm carbon dioxide. This is more than 100 times the average of room air which is about 0.04% [CO2]. Exhaled [CO2] is 10 times the upper limit permitted by OSHA in ambient air. Yet each of us exhales this concentration with every breath. Should we re-breathe our own exhaled breath?

A study of healthy healthcare workers found increased [CO2] and decreased [O2] in the respiratory dead space inside a N95 filtering respirator while walking on a treadmill. Within one hour of use, these were “significantly above and below, respectively, the ambient workplace standards.”[15] The exhalation valve of the N95 masks did not significantly change its impact on P(CO2).

Hypercapnia has a number of damaging effects on the lungs. Those effects seem to begin with disruption of Na+-K+-ATPase, which leads to impaired alveolar fluid reabsorption. This results in alveolar edema, which in turn obstructs optimal gas exchange.[16] Hypercapnia also inhibits repair of alveoli by impairing proliferation of alveolar epithelial cells via inhibition of the citric acid cycle and resulting mitochondrial dysfunction.[17]

Cilia are made immotile by hypercapnia, along with mask changes in humidity and temperature in the upper airway. This leads to predisposing mask wearers to lower respiratory tract infections by allowing deep seeding of oropharyngeal flora.[18] The lower respiratory system is usually sterile because of the action of the cilia that escalate debris and microorganisms up toward the orifices. Impairment of this process, such as in hypercapnia, may partly explain a correlation of hypercapnia with increased mortality from pulmonary infections.

Hypercapnia correlates with increased mortality in hospitalized patients with community-acquired pneumonia.[19] This seems to be due to a number of factors, including that hypercapnia inhibits IL-6 and TNF as well as inhibiting immune cell function generally,[20] including alveolar macrophages.[21]

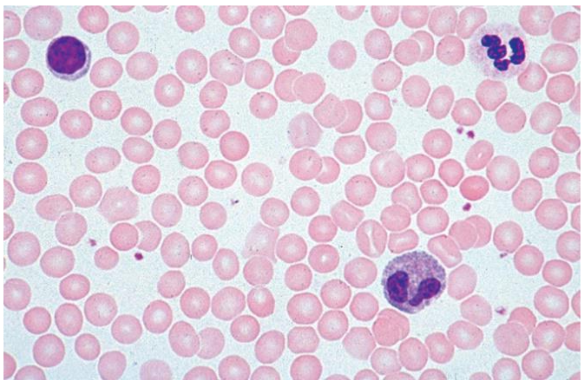
Hypercapnia was found to downregulate genes related to immune response. The researchers that had studied this in depth found that “hypercapnia would suppress airway epithelial innate immune response to microbial pathogens and other inflammatory stimuli.”[22] They also found suppressive effects of hypercapnia on macrophage, neutrophil and alveolar epithelial cell functions. Hypercapnia was found to decrease bacterial clearance in rats.[23]

In our previous paper in this series, we found a historical correlation with a hypercapnic practice, specifically mask-wearing, and a severe surge of bacterial pneumonia deaths.[24] This time period was mis-named the Spanish Flu, due to a number of reasons, too extensive for this paper. Dr. Anthony Fauci’s research team found that every cadaver exhumed from that time in 1918 – 1919 showed the cause of death was bacterial pneumonia, secondary to typical upper respiratory bacteria.[25]

Common and life-threatening diseases of impeded air flow include both obstructive disorders such as asthma, COPD, bronchiectasis and emphysema, as well as restrictive disorders, such as pneumothorax, atelectasis, respiratory distress syndrome and pulmonary fibrosis.

Hypercapnia effects on the blood

Excess carbon dioxide is buffered exclusively in the intracellular fluid, especially in red blood cells. CO_2 crosses cell membranes by diffusion, and combines with water to convert to H^+ and HCO_3^-. The hydrogen is then buffered by intracellular proteins such as hemoglobin and organic phosphates. The price paid by the red blood cells for this buffering is seen in the comparison of normal red blood cells on the left versus the damaged and depleted red blood cells on the right.



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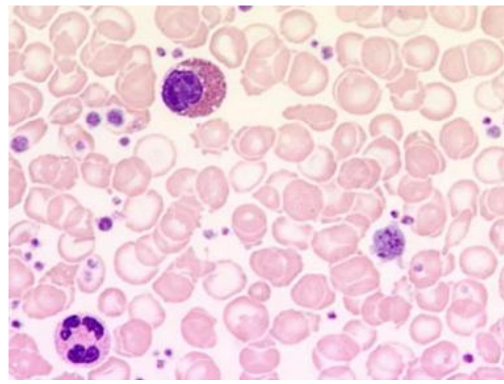

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The above photo on the right demonstrates secondary polycythemia.. This is a known consequence of hypoxia. This abnormal blood finding may also correlate with dehydration from wearing a mask. The US National Institute of Occupational Safety and Health (NIOSH) says that "particular features of PPE can impose a physiological . . . burden on the healthcare worker." And "dehydration can be a significant problem while wearing PPE."[26] Individuals suffering from dehydration are at risk for relative erythrocytosis, which can manifest as polycythemia vera.[27] Polycythemia vera is an independent risk factor for other cancers, commonly treated with lifelong blood thinning medication. Polycythemia develops slowly over years. Are today's mask wearers at future risk of developing this blood cancer?

Hypercapnia effects on the kidneys

The kidneys are tasked with compensating for the damage inflicted on the blood stream by respiratory acidosis. They must excrete hydrogen ions and reabsorb the newly made HCO_3^-. The Henderson-Hasselbalch equation indicates the extent to which increased HCO_3^- compensates for the acidic condition.

$$pH=pK+\log[HCO_3^-]/(P_{CO_2})$$

The [HCO3-] is a reflection of renal or metabolic compensation, whereas the PCO2 reflects the primary disturbance, where airway obstruction created an acidemia.[28]

The kidneys show decreased GFR and decreased urine output, as well as increased renal vascular resistance, as a result of hypercapnia.[29] Aciduria increases as a compensatory mechanism to excrete acid. This in turn damages tubules and has been shown to worsen kidney function in those with established chronic diseases.[30]

Hypercapnia effects on the cardiovascular system

A hypercapnic patient may be warm, flushed and tachycardic. A bounding pulse and sweating may also be present. Arrhythmias may be present if there is significant hypoxemia. Arterial pCO2 above 90 mmHg is not compatible with life, because hypercapnia is necessarily accompanied by hypoxemia, in this case by pO2 = 37.[31] It has been noted that masked patients are often found to be tachycardic, to be discussed more further on in this paper.

Hypercapnia effects on the central nervous system

Central nervous system effects, such as headache, fatigue, dizziness and drowsiness are common effects of chronic obstructive pulmonary disease (COPD),[32] In this patient cohort we also see defects in proprioception, instability of posture and gait, as well as falls, with strong evidence that these result from hypercapnia.[33] There is a progressively increasing sedation from mask use and increased intracranial pressure. Headaches are a common complaint of mask wearers, and are found to be attributable to hypercapnia.[34] Increases in PCO2 lead to increases in cerebral flood flow and cerebral blood volume, as well as a resulting intracranial pressure.[35] These are consistent with findings through the rest of the body.

Slowed performance of reasoning tasks was observed at 20 minutes of inhaling 4.5% to 7.5% [CO2]. [36] When subjects were exposed to 2,500 parts per million carbon dioxide in room air, it was found that their decision-making ability declined by 93%, which was comparable to being drunk or having a head injury.[37] At this same level of [CO2], it was also found that visual performance suffered.[38] We measured this same level of [CO2] inside masked airspace at 15 seconds.

Even smaller CO2 concentrations had deleterious effects. CO2 exposure beginning at 1000 ppm affected cognitive performance, such as problem resolution and decision-making.[39] We measured 1000 ppm [CO2] in masked airspace within the first few seconds of wear.

MASKS and HYPOXIA

Masks create hypoxia in the wearers

A study of 53 surgeons who were non-smokers and without chronic lung disease were shown to have a decrease in saturation of arterial pulsations (SpO2) when performing surgery while masked. Oxygen saturation decreased significantly after the operations in both age groups, with a greater decrease in surgeons over the age of 35.[40]

A study of 39 end-stage renal disease patients wearing N-95 masks for 4 hours during hemodialysis were found to have significantly reduced PaO2 over that time. The average drop in PaO2 was from a baseline PaO2 of 101.7 to 15.8, $p = 0.006$. Respiratory rate increased from 16.8 to 18.8 respirations per minute, $p < 0.001$. Chest discomfort and respiratory distress were also reported by the subjects.[41]

Hypoxia is a health hazard

Hypoxia is deadly. Each year, many workers are injured or die due to oxygen deficiency.[42] "There have been reports of workers who have opened a hatch to an O2-deficient atmosphere and died with only their head inside the hazard. The low level of O2 resulted in a feeling of euphoria and the workers could not comprehend that they only needed to lean back out of the hatch to save their lives."[43]

The issue of mask wearing is especially critical for children. In children, any hypoxic condition is even more of an emergency than it is for an adult. This is partly due to their more horizontal ribs and barrel-shaped chest, resulting in children relying primarily on diaphragm muscles for breathing, not nearly so much intercostal muscles, as in adults. These diaphragm muscles have proportionately fewer type I muscle fibers, resulting in earlier fatigue.[44] Also, a child's tongue is relatively large in proportion to the size of the pharynx, and the epiglottis is floppy.[45] These anatomical differences make a child potentially more vulnerable than an adult to injury from hypoxic assault.

We consider it urgent for children to be released from mask "mandates," based on this information.

Hypoxia in masked airspace

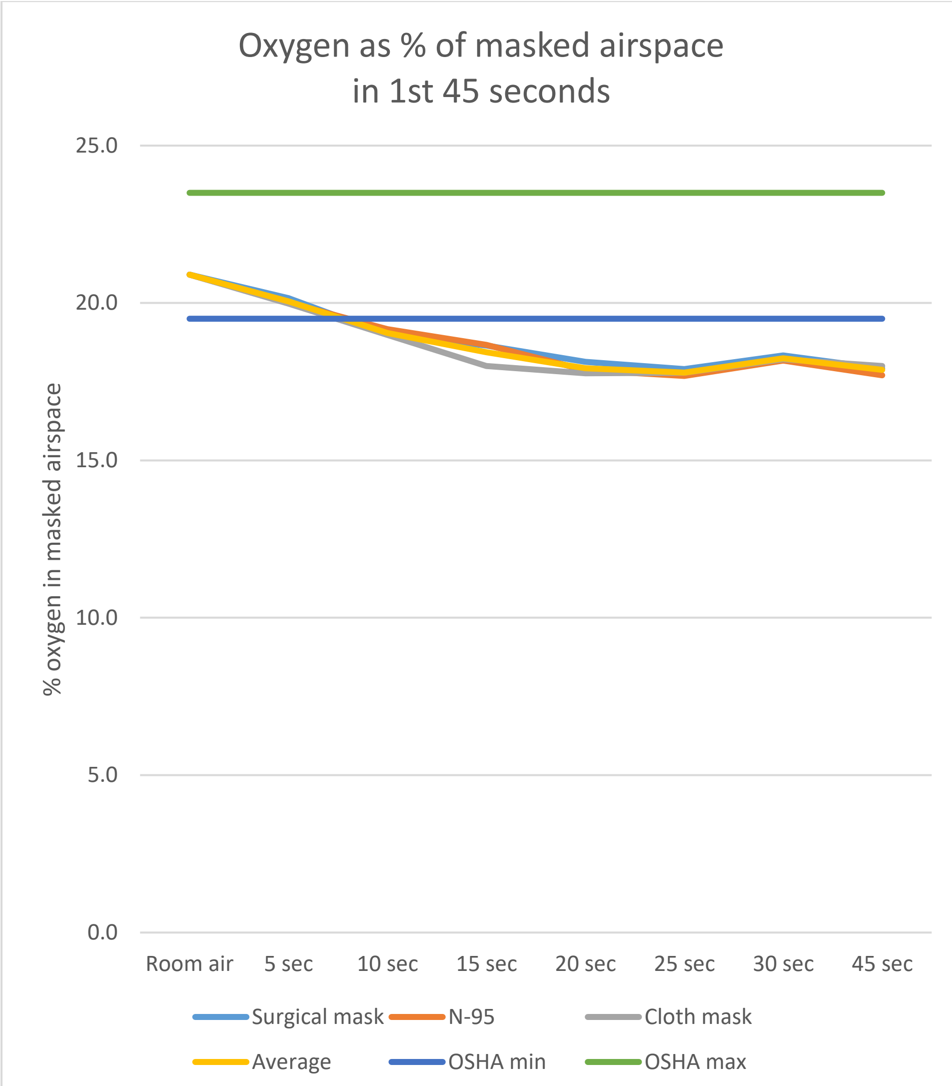
In order to determine the percent of oxygen in masked airspace, we ran 6 trials each for 45 seconds of 3 types of masks: a disposable surgical mask, a N-95 mask and a laundered cloth mask.

We charted the results as follows, showing the average for each type of mask, compared to OSHA workspace requirements for air available to the airways.

Table 2 Measured [O2] in masked airspace

	Room air	**5 sec**	**10 sec**	**15 sec**	**20 sec**	**25 sec**	**30 sec**	**45 sec**	**60 sec**
Surgical mask	20.9	20.2	19.2	19.1	18.5	19.1	18.4	18.1	17.7
	20.9	20.1	18.9	18.7	18.1	17.7	18.1	17.9	17.4
	20.9	20.3	18.7	18.1	18.1	18.2	17.9	17.6	17.7
	20.9	19.6	19.1	18.7	17.7	17.1	18.5	17.1	17.5
	20.9	19.8	19.1	18.9	18.2	17.4	18.7	18.6	16.7
	20.9	20.9	19.0	18.4	18.2	17.9	18.4	18.2	18.6
Average	**20.9**	**20.2**	**19.0**	**18.7**	**18.1**	**17.9**	**18.3**	**17.9**	**17.6**
N-95	20.9	20.0	19.1	18.1	17.7	18.2	18.4	17.2	17.4
	20.9	19.7	19.3	18.5	17.3	18.0	18.3	18.2	16.7
	20.9	19.6	18.1	18.6	18.4	18.2	17.8	17.5	17.1
	20.9	20.1	19.4	19.1	18.0	17.6	18.3	17.2	17.8
	20.9	19.8	19.3	19.0	17.8	16.9	18.1	18.2	17.4
	20.9	20.9	19.8	18.7	18.0	17.2	18.1	17.9	17.7
Average	**20.9**	**20.0**	**19.2**	**18.7**	**17.9**	**17.7**	**18.2**	**17.7**	**17.4**
Cloth mask	20.9	19.6	19.5	17.7	16.7	17.5	17.5	16.7	17.5
	20.9	20.1	19.2	17.2	17.1	16.9	17.1	17.0	17.4
	20.9	20.2	19.3	18.4	18.4	18.2	19.0	17.9	17.1
	20.9	20.0	18.9	18.6	19.0	19.8	19.3	18.8	18.7
	20.9	20.1	18.4	18.3	17.7	17.3	17.9	18.1	17.7
	20.9	19.9	18.6	17.8	17.7	17.0	18.5	19.5	17.1
Average	**20.9**	**20.0**	**19.0**	**18.0**	**17.8**	**17.8**	**18.2**	**18.0**	**17.6**

Graph 2



It can be seen from Graph 2 that all of the masks showed similar results, and that in each type of mask, available oxygen as a percentage of available air volume decreased to less than the OSHA required minimum of 19.5%[46] in less than 10 seconds of wear, and stayed below that threshold. Breathing seemed to be shallow until 30 seconds of wear. Then the wearer's responsive drawing of air through pores and side gaps and top gaps around the mask appeared to occur mostly at 30 seconds, but did not compensate adequately to return [O2] in the masked airspace back above the OSHA minimum requirement of 19.5% [O2] in available air.

The above findings are consistent with known decrease of oxygen concentration in the airspace inside of masks.[47] The standards for oxygen concentration in airspace available to workers has been so strictly enforced by OSHA that in a low-oxygen workspace, employee access must be restricted by using locks or barriers. Oxygen-level monitoring is required before entry, and the space must meet OSHA oxygen-level standards during the entire time that it is in use.[48] Is the space of available airflow to the human airways any less important to protect from low ambient O2, simply because it is the very small space between the mask and the respiratory orifices?

The United States Code of Federal Regulations in paragraph (d) of 29 CFR 1910.134 "requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors." This "shall include a reasonable estimate of employee exposures to respiratory hazard(s) . . ." Exceptions are permitted "if the employer can meet the difficult evidentiary burden of showing that the oxygen content can be controlled reliably enough to remain within the ranges specified . . ."[49] Does this leave employers liable for injuries to workers who wear masks?

Hypoxia accompanies hypercapnia

Retention of carbon dioxide reduces oxygen availability, as in COPD. As CO2 builds up in alveoli, the available volume for oxygen in the airspace is reduced. "For each increment in the PaCO2, there will be a more than one-to-one decrease in the PaO2, which will result in severe oxygen deficits, as illustrated in the following graph."[50]

$$P_{IO_2} = P_AO_2 + P_aO_2 \quad (4\text{-}16)$$

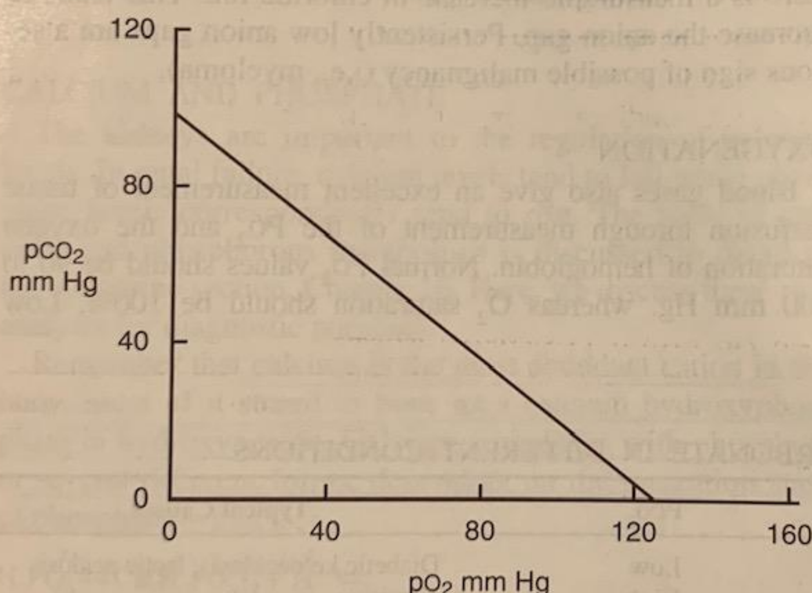


Figure 4–3. The effect of increased P_{CO_2} on the P_{O_2} in the alveolus and in arterial blood. This figure demonstrates that as the P_{CO_2} increases, there is a greater than a one-to-one decrease of P_{O_2}.

From J Henry. Clinical Diagnosis and Management by Laboratory Methods. 19th ed. WB Saunders Co. © 1996.

Hypoxia effects on the brain

Hypoxia, which is the lack of oxygen available to the respiratory system and to the tissues generally, stimulates mitochondria to generate reactive oxygen species (ROS). All body tissues are vulnerable to ROS, but the brain is especially vulnerable. ROS damage lipids, protein and DNA. The brain is 60-70% lipids and low in antioxidants, and is therefore especially vulnerable to ROS damage.[51] For the immature brain, the problem is even worse. Poorly developed scavenging systems and the high availability of free iron leave the child's brain, especially neurons and oligodendrocytes, vulnerable to the oxidative damage of free radicals.[52]

A biochemical mechanism of hypoxia damage to the brain is that hypoxia stimulates a kallikrein – bradykinin – nitric oxide pathway.[53] As a result, the blood-brain barrier can become more permeable. Extravasation of plasma proteins and brain edema may result.[54]

Neurologist and neurophysiologist Dr. Margarite Friesz-Brisson says this about forcing masks on children: "The child needs the brain to learn, and the brain needs oxygen to function. We don't need a clinical study for that. This is simple, indisputable physiology." She warns of a "tsunami of dementia" in the future, because of oxygen deprivation from wearing masks today. She points out long-recognized physiology that re-inhaling our exhaled air creates a state of oxygen deficiency and an excess of carbon dioxide.

Normalization is a phenomenon observed in medicine in which the individual adapts to disadvantageous conditions. Mask wearers may believe that they have become accustomed to wearing a mask. However, the effects of degenerative processes in the brain accumulate during a state of oxygen deprivation. [55]

Cardiovascular effects of hypoxia

It is established that mask wearers work harder at breathing and have greater inspiratory flow than unmasked individuals. This in turn increases sympathetic vasoconstrictor outflow to limb skeletal muscle. After donning a mask, even at rest, mean arterial blood pressure increased by 12 mmHg, and heart rate increased by 27 BPM.[56] Cardiac output is increased and so is prolongation of the QT interval. Vasoactive effects include systemic arterial vasodilation and pulmonary arterial vasoconstriction. It has been found that even at low workloads, in a hypoxic environment, there is not only increased heart rate and blood pressure, but also aortic pressure and left ventricular pressures increase, which in turn promote cardiac overload and coronary demand.[57]

Let us now look at the mechanisms of how this happens. When there is hypoxic assault on the body, hemoglobin is the first sensor. The red blood cells are stimulated to produce nitric oxide, which causes vasodilation and increased blood flow. Hypoxia decreases the threshold needed for this to happen.[58] This vasodilation is a protective effect on the tissues from hypoxic assault, and as a result, the individual becomes tachycardic and agitated.

Hypoxia effects on erythropoiesis

Mask wearing results in loss of available oxygen transport to the tissues. This in turn results in increased erythrocyte production. If hypoxia persists, then free 2,3-DPG is depleted. This leads to increased glycolysis. This leads to production of more 2,3-DPG, which reduces oxygen affinity for hemoglobin. As a result, oxygen is released to the tissues away from vital organs, such as the brain, liver, kidneys and heart. Low oxygenation stimulates production of erythropoietin, which results in more red blood cell production.[59]

Why would we deliberately expose ourselves to persistent hypoxia, which leads to tissue hypoxia in vital organs and increased red blood cell production? Conditions featuring erythroid hyperplasia include but are not limited to: acute myeloid leukemia, congenital dyserythropoietic anemia, microangiopathic hemolytic anemia and sideroblastic anemia.[60] In turn, these can increase risk of polycythemia vera, a disease of thick blood from overproduction of red blood cells. In fact, loss of oxygen is the most common cause of polycythemia vera.[61]

Hypoxia and the gastrointestinal tract

Hypoxia and hypoxia-dependent signaling pathways are becoming better-appreciated in their role in intestinal disease. Tissue hypoxia is recognized as a feature of inflammatory bowel disease.[62] Although intestinal tissue averages 7% [O2], hypoxic stress occurs in infection and inflammation, states which are characterized by oxygen demand being higher than supply. [63] As a result of induced hypoxia, the delicate balance of commensal bacteria on the one hand and limitation of pathogenic bacterial access to tissues on the other is vulnerable to new disruption.

Hypoxia and cancer risk

When there is resistance to inspiratory and expiratory flow, respiratory acidosis and increased lactate levels have been found.[64] At the [O2] levels we measured in the masked airspace, at 17%, higher levels of lactic acid accumulated.[65] This is no surprise given the understanding we have of the metabolic initiation of cancer from Nobel Prize biochemist Otto Warburg. He found that the removal of oxygen initiates the destruction of respiration in cells, and that this process leads to formation of cancer.[66] As tissue oxygenation drops, cells resort to anaerobic glycolysis, which ends the glycolytic pathway with conversion of pyruvate to lactic acid. A marked increase in tissue lactic acidosis results. When oxygen saturation lowers to 30%, blood pH drops to 7.2, which shifts the oxygen-hemoglobin dissociation curve to the right, and sets a vicious cycle in motion, as seen here.

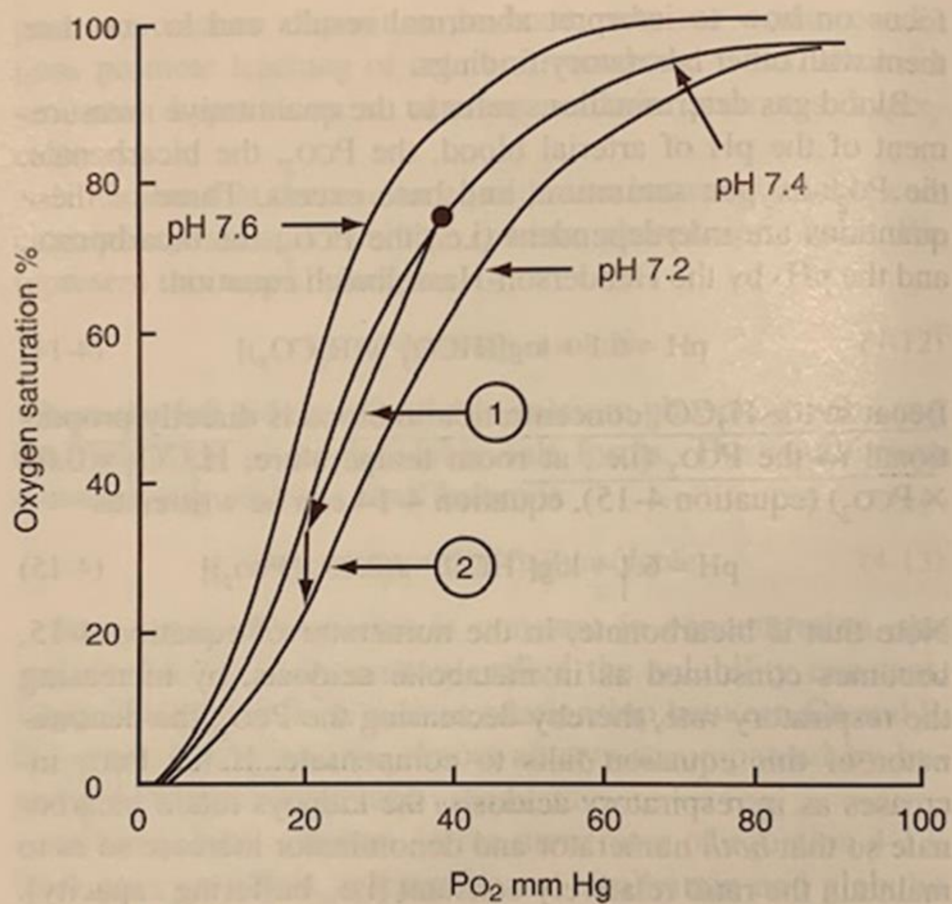


Figure 4–4. The effects of decreasing Po_2 in the allosteric zone of the oxygen-hemoglobin dissociation curve. On the pH 7.4 curve, if the Po_2 drops from 80 to 60, there is little effect on the oxygen saturation. However, a drop from 40 to 20 mm Hg results in a large drop in oxygen saturation from about 80 to 30% (arrow 1 in the figure). With this low oxygen saturation, there is a marked tissue lactic acidosis from anaerobic metabolism. The increased acidosis results in a drop in blood pH to 7.2, shifting the oxygen-hemoglobin dissociation to the right (pH 7.2 curve). Now, for a Po_2 of 30, the oxygen saturation drops even further (arrow 2 in the figure) to about 20%, setting a vicious cycle in motion.

From J Henry. Clinical Diagnosis and Management by Laboratory Methods. 19th ed. WB Saunders Co. © 1996.

Warburg showed that cancer cells live in hypoxic conditions, and that an initial assault on normal cells leads to hypoxia that in turn damages mitochondria, which is the first step in the cancerous process. He found "the root cause of cancer is oxygen deficiency. . . . Cancer cannot survive in the presence of high levels of oxygen."[67]

Hypoxia also negatively impacts the mobility of natural killer cells,[68] which are one of the strongest defenses of the immune system against cancer.

For over a quarter century, Guy Crittenden was editor of HazMat Management, an award-winning occupational health and safety journal. That journal routinely published articles regarding masks and compliance with health and safety laws. He has several major concerns with mask use by the public.[69] One of them is that the disposable surgical masks are sterilized with ethylene oxide, a known carcinogen.[70] Another is that the disposable surgical masks and N-95 respirators are woven with polytetrafluoroethylene (PTFE),[71] [72] PTFE is made using perfluorooctanoic acid (PFOA), a known carcinogen. PFOA has been associated with cancer of the breast,[73] testicles, liver and pancreas.[74] As noted above, inspiratory flow is greater in mask wearers, which brings these compounds deep into the lungs.

Hypoxia and immune function

During a state of hypoxia, the body produces hypoxia-inducible factor-1 (HIF-1). HIF-1 is known to lower T-cell function.[75] CD-4 T-cells have been observed to decline in this process, and they are known to fight viral infections.[76] This raises concerns about whether masks can function as desired during the COVID-19 era. The sudden increase of widespread masking throughout much of the world in 2020 has been motivated by a desire to limit or control the spread of the SARS-CoV-2 virus that is associated with COVID-19. As we have demonstrated, the hypoxia caused by mask-wearing defeats the objective of anti-viral strategy. As we showed in our previous paper in this series, mask use is correlated with higher, not lower, incidence of COVID-19.[77]

Other effects of masks

Masks have been observed to create skin damage in 526 of 542 = 97% of healthcare workers studied. The affected sites were especially the nasal bridge, but also hands, cheeks and forehead. Longer exposure worsened outcome.[78]

US FDA definition of a "medical device"

According to the United States Food and Drug Administration (FDA), a medical device has a specific definition, and it is defined as follows:

> *"An instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article, including a component part or accessory which is: recognized in the official National Formulary, or the United States Pharmacopeia, or any supplement to them,*
>
> *-Intended for use in the diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease in man or other animals, or*
>
> *- intended to affect the structure or any function of the body of man or other animals, and which does not achieve its primary intended purposes through chemical action within or on the body of man or other animals and which is not dependent upon being metabolized for the achievement of its primary intended purposes."* [79] [80]

According to the FDA, a prescription for use of a medical device falls to state laws and regulations that determine who can write a prescription for a medical device in each state.[81] The FDA defers to the states regarding who can write a valid prescription. At this time in the United States at least, there are no known prescription rights granted to anyone who does not already hold a license to practice medicine.

However, also in the United States at this time, there are prominent politicians, as well as elected and appointed government leaders, who are "mandating" that citizens in their jurisdictions wear masks when in public.

We submit that a face mask is an apparatus ostensibly intended for prevention of disease, and therefore that it fits within the FDA definition of a medical device, although it is commonly sold over the counter, with no prescription. Therefore, is there now a situation in the United States, and throughout the world, of political leaders prescribing medical devices, including for complete strangers, without so much as a medical consult? Are these same political leaders practicing medicine without a license? If so, are they liable for injuries through these actions, and will they be prosecuted for their actions?

And if these political leaders are prescribing a medical device, without informed consent, then is it also the case that the same politicians and government officials are violating US federal laws regarding informed consent? The US Code of Federal Regulations (CFR) Title 21, Subchapter A, Part 50, Subpart B discusses the requirements of informed consent. Certainly, the same officials are in violation of the Universal Declaration of Human Rights and the Nuremberg Code, which are internationally honored guiding documents on citizens' freedom from medical coercion and medical experimentation.

We therefore urge that people everywhere consider this definition of medical device, and to consider if they want their political leaders and / or their news media to practice medicine on them, without prior medical training, a license to practice medicine, or even so much as an individualized clinical consult.

Conclusion

Our first paper in this series on the false safety and real dangers of masks examined the loose particulate and loose fibers that we found on new masks of various kinds at 40 times and greater magnification, along with the consideration of possible consequences of inhalation of such debris.

Our second paper in this series examined microbial challenges from masks, the dysregulation and imbalance of microbiota in the respiratory tract, and the consequences of such imbalances throughout the body. We showed that face masks are more likely to trap and re-circulate respiratory droplets and microbes, with incubation and proliferation of the same, inside the masked airspace and airways, which increases – not decreases – the risk of infections for major respiratory pathogens, bacterial, fungal and viral.

This paper, the third in our series, focuses on physiological changes induced by hypoxia and hypercapnia. Our findings of reduced oxygen and increased carbon dioxide in a masked airspace are not inconsistent with previously reported data.[82 83] Evidence of damage to multiple organ systems from the documented levels of [O2] and [CO2] in available airspace between a facemask and the airways are cited above and are abundant in the medical literature.

The pathological triad of micro-particles as long-term hazards, and bacterial and fungal infections as mid-term hazards, as well as injury from hypoxia and hypercapnia in the short-term, are expected to have synergistic results in endangering the health of masked people. Because of the extensive risk to mask wearers documented in these three papers, we urgently recommend that no adult or child be coerced to wear a mask under any circumstances. We further recommend that facemask hazards be published prominently and that masks only be worn by adults who choose to do so, and only with freely given informed consent, with full knowledge of their hazards, and that their use be prohibited for children, adult students and workers.

If on the other hand, widespread use of masks and mandating the same continue, then the question arises, from the data shown herein, whether morbidity and mortality from mask-wearing will exceed those of COVID-19 or other known infectious diseases. What will be the long-term effects of mask wearing if it continues? And will we be able to distinguish mask injury from COVID-19 or other pathologies? The evidence presented here, in summary of clinical data from around the world, show that masks can accelerate morbidity and mortality in those who are already ill, and that masks can sicken healthy people. Before masks are forced onto school children and workers, why are animal studies not being done with all-day masking, to investigate safety issues? How much of an increase in mask-related illnesses will we have to observe before mask "mandates" end?

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[1] T Jacobson, J Kler, et al. Direct human health risks of increased atmospheric carbon dioxide. Nat Sustain. 2019. 2 (8). 691-701. https://www.nature.com/articles/s41893-019-0323-1

[2] D Sin, S Man, et al. Arterial carbon dioxide tension on admission as a marker of in-hospital mortality in community-acquired pneumonia. Am J Med. Feb 1 2005. 118 (2). 145-150.
https://doi.org/10.1016/j.amjmed.2004.10.014
https://www.amjmed.com/article/S0002-9343(04)00680-1/fulltext

[3] P Murtagh, V Giubergia, et al. Lower respiratory infections by adenovirus in children. Clinical features and risk factors for bronchiolitis obliterans and mortality. Ped Pulm. 44. 450-456. https://doi.org/10.1002/ppul.20984
https://www.nature.com/articles/s41598-018-32008-x#ref-CR10

[4] N Nin, A Muriel et al. Severe hypercapnia and outcome of mechanically ventilated patients with moderate or severe acute respiratory distress syndrome. Int Care Med 43. 200-208.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5630225/

[5] K Moser, E Shibel, et al. Acute respiratory failure in obstructive lung disease. JAMA. Aug 13 1973. 225. 705-707.
https://jamanetwork.com/journals/jama/article-abstract/349944

[6] B Chandrasekaran, S Fernandes. Exercise with facemask; Are we handling a devil's sword? – A physiological hypothesis. Nov 2020. 144 (110002). doi: 10.1016/j.mehy.2020.110002
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7306735/#b0135

[7] M Joyner, D Casey. Regulation of increased blood flow (hyperemia) to muscles during exercise: a hierarchy of competing physiological needs. Physiol Rev. Apr 2015. 95 (2). 549-601. doi: 10.1152/physrev.00035.2013.
https://pubmed.ncbi.nlm.nih.gov/25834232/

[8] Carbon Dioxide Health Hazard Information Sheet. Food Safety Inspection Service, US Department of Agriculture.
https://www.fsis.usda.gov/wps/wcm/connect/bf97edac-77be-4442-aea4-9d2615f376e0/Carbon-Dioxide.pdf?MOD=AJPERES

[9] Z Zhaoshi. Potential risks when some special people wear masks. No. 1 Dept of Neurology, The Third Hospital of Jilin University. Apr 18 2020. https://jamanetwork.com/journals/jama/fullarticle/2764955

[10] Carbon Dioxide Health Hazard Information Sheet. Food Safety Inspection Service, US Department of Agriculture.
https://www.fsis.usda.gov/wps/wcm/connect/bf97edac-77be-4442-aea4-9d2615f376e0/Carbon-Dioxide.pdf?MOD=AJPERES

[11] Occupational Chemical Database: Carbon Dioxide. US Department of Labor, Occupational Safety and Health Administration. https://www.osha.gov/chemicaldata/chemResult.html?RecNo=183

[12] Carbon Dioxide Health Hazard Information Sheet. Food Safety Inspection Service, US Department of Agriculture.
https://www.fsis.usda.gov/wps/wcm/connect/bf97edac-77be-4442-aea4-9d2615f376e0/Carbon-Dioxide.pdf?MOD=AJPERES

[13] Acid-base physiology, 4.4 Respiratory acidosis-Metabolic effects. https://www.anaesthesiamcq.com/AcidBaseBook/ab4_4.php

[14] J Williams, J Krah, et al. The physiological burden of prolonged PPE use on healthcare workers during long shifts. US Centers for Disease Control and Prevention. Jun 10 2020. https://blogs.cdc.gov/niosh-science-blog/2020/06/10/ppe-burden/

[15] R Roberge, A Coca, et al. Physiological impact of the N95 filtering facepiece respirator on healthcare workers. Respir Care. May 2010. 55 (5). 569-577. https://pubmed.ncbi.nlm.nih.gov/20420727/

[16] M Shigemura, e Lecuona et al. Effects of hypercapnia on the lung. J Physiol. Jan3 2017. 595 (8). https://doi.org/10.1113/JP273781 https://physoc.onlinelibrary.wiley.com/doi/full/10.1113/JP273781

[17] C Vohwinkel, E Lecuona et al. Elevated CO(2) levels cause mitochondrial dysfunction and impair cell proliferation. J Biol Chem. Oct 28 2011. 286 (43). 37067-76. doi: 10.1074/jbc.M111.290056. https://pubmed.ncbi.nlm.nih.gov/21903582/

[18] C Kempeneers, C Seaton, et al. Ciliary functional analysis: beating a path towards standardization. Pediatr Pulmonol. Oct 2019. 54 (10). 1627-1638. https://doi.org/10.1002/ppul.24439 https://pubmed.ncbi.nlm.nih.gov/31313529/

[19] E Laserna, O Sibila, et al. Hypocapnia and hypercapnia are predictors for ICU admission and mortality in hospitalized patients with community-acquired pneumonia. Chest. Nove 2012. 142 (5): 1193-1199. doi: 10.1378/chest.12-0576 https://pubmed.ncbi.nlm.nih.gov/22677348/

[20] A Lardner. The effects of extracellular pH on immune function. J Leukoc Biol. Apr 2001. 69 (4). 522-30 https://pubmed.ncbi.nlm.nih.gov/11310837/

[21] C Lang, P Dong, et al. Effect of CO2 on LPS-induced cytokine responses in rats alveolar macrophages. Am J Physiol Lung Cell Mol Physiol. Jul 2005. 289 (1). L96-L103. doi: 10.1152/ajplung.00394.2004 https://pubmed.ncbi.nlm.nih.gov/15778246/

[22] S Casalino-Matsuda, N Wang, et al. Hypercapnia alters expression of immune response, nucleosome assembly and lipid metabolism genes in differentiated human bronchial epithelial cells. Sep 10 2018. Sci Rep. 13508. https://www.nature.com/articles/s41598-018-32008-x

[23] D O'Croinin, et al. Sustained hypercapnic acidosis during pulmonary infection increases bacterial load and worsens lung injury. Crit Care Med. 36. 2128-2135. https://doi.org/10.1097/CCM.0b013e31817d1b59 https://pubmed.ncbi.nlm.nih.gov/18552698/

[24] B Borovoy, C Huber, Maria Crisler. Masks, false safety and real dangers, Part 2: Microbial challenges from masks. Oct 2020. https://PDMJ.org

[25] D Morens, J Taubenberger, et al. Predominant role of bacterial pneumonia as a cause of death in pandemic influenza: implications for pandemic influenza preparedness. J Inf Dis. Octo 1 2008. 198 (7). 962-970. https://doi.org/10.1086/591708. https://academic.oup.com/jid/article/198/7/962/2192118

[26] J Williams, J Cichowitz, et al. US Centers for Disease Control (CDC) National Institute of Occupational Safety and Health (NIOSH) Science Blog. Jun 10 2020. https://blogs.cdc.gov/niosh-science-blog/2020/06/10/ppe-burden/

[27] D Harmening. Clinical Hematology and Fundamentals of Hemostasis, 4th ed. Davis Company. 2002. 349.

[28] L Costanzo. Physiology. W B Saunders Company. 1998. 286-287.

[29] A Yartsev. Pharmacology of carbon dioxide. Deranged Physiology. https://derangedphysiology.com/main/cicm-primary-exam/required-reading/respiratory-system/Chapter%20311/pharmacology-carbon-dioxide

[30] A Voulgaris, O Marrone, et al. Chronic kidney disease in patients with obstructive sleep apnea. A narrative review. Sleep Med Rev. 2019. 10 (47). 74-89. https://pubmed.ncbi.nlm.nih.gov/31376590/

[31] Medicine Libre Texts. 6.4: Metabolic effects. Aug 13 2020. https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Book%3A_Acid-base_Physiology_(Brandis)/06%3A_Respiratory_Acidosis/6.04%3A_Metabolic_Effects

[32] C Smith, J Whitelaw, et al. Carbon dioxide regreathing in respiratory protective devices: influence of speech and wor rate in full-face masks. Ergonomics. 2013. 56 (5): 781-790. https://pubmed.ncbi.nlm.nih.gov/23514282/

[33] D Stevens, B Jackson, et al. The impact of obstructive sleep apnoea on balance, gait and falls risk: a narrative review of the literature. J Gerontol A Biol Sci Med Sci. Feb 2020. 10glaa014. Online ahead of print. https://pubmed.ncbi.nlm.nih.gov/32039438/

[34] E Lim, R Seet, etal. Headaches and the N-95 face-mask amongst healthcare providers. Acta Neurol Scand Mar 2006. 113 (3). 199-202. doi: 10.1111/j.1600-0404.2005.00560.x https://pubmed.ncbi.nlm.nih.gov/16441251/

[35] N Fabregas, J Fernández-Candil. Hypercapnia. Dec 2016. In book Complications in Neuroanesthesia. 157-168. https://doi.org/10.1016/B978-0-12-804075-1.00020-1 https://www.sciencedirect.com/science/article/pii/B9780128040751000201?via%3Dihub

[36] J Sayers, R Smith, et al. Effects of carbon dioxide on mental performance. J Appl Physiol. Jul 1985. 63 (1). 25-30. doi: 10.1152/jappl.1987.63.1.25 https://pubmed.ncbi.nlm.nih.gov/3114218/

[37] U Satish, M Mendell, et al. Is CO2 an indoor pollutant? Direct effects of low-to-moderate CO2 concentrations on human decision-making performance. Environ Health Perspect. Dec 2012. 120 (12). 1671-1677. https://dx.doi.org/10.1289%2Fehp.1104789 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3548274/

[38] Y Yang, C Sun, et al. The effect of moderately increased CO2 concentration on perception of coherent motion. Aviat Space Environ Med. Mar 1997. 68 (3). 187-191. https://pubmed.ncbi.nlm.nih.gov/9056025/

[39] K Azuma, N Kagi, et al. Effects of low-level inhalation exposure to carbon dioxide in indoor environments: A short review on human health and psychomotor performance. Environ Int. Dec 2018. 121 (Pt1). 51-56. doi: 10.1016/j.envint.2018.08.059 https://pubmed.ncbi.nlm.nih.gov/30172928/

[40] A Beder, U Buyukkocak, et al. Preliminary report on surgical mask induced deoxygenation during major surgery. Neurocirugia 2008. 19. 121-126. http://scielo.isciii.es/pdf/neuro/v19n2/3.pdf

[41] T Kao, K Huang, et al. The physiological impact of wearing an N95 mask during hemodialysis as a precaution against SARS in patients with end-stage renal disease. J Formos Med Assoc. Aug 2004. 103 (8). 624-628. https://pubmed.ncbi.nlm.nih.gov/15340662/

[42] Bureau of Labor Statistics. News Release. USDL-11-1247. National Census of Fatal Occupational Injuries in 2010. Preliminary Results. Aug 25 2011. https://scholar.google.com/scholar?cluster=5019350129886890079&hl=en&as_sdt=805&sciodt=0,3

[43] D Spelce, R McKay, et al. Respiratory protection for oxygen deficient atmospheres. J Int Soc Respir Prot. 2016. 33 (2). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7183576/

[44] K Fedor. Noninvasive respiratory support in infants and children. Respiratory Care. Jun 2017. Vol 62 (6). 699-717. doi: 10.4187/respcare.05244 https://pubmed.ncbi.nlm.nih.gov/28546373/

[45] J Weinstein, J Smith. Pediatric BIPAP. J Emer Med Svcs. Sep 19 2019. https://www.jems.com/2019/09/19/pediatric-bipap/

[46] US Department of Labor, Occupational Safety & Health Administration. Confined or enclosed spaces and other dangerous atmospheres >> Oxygen deficient or oxygen enriched atmospheres. https://www.osha.gov/SLTC/etools/shipyard/shiprepair/confinedspace/oxygendeficient.html

[47] Z Zhaoshi. Potential risks when some special people wear masks. No. 1 Dept of Neurology, The Third Hospital of Jilin University. Apr 18 2020. https://jamanetwork.com/journals/jama/fullarticle/2764955

[48] C Luther. OSHA oxygen concentration standards. Sep 15 2020. https://work.chron.com/osha-oxygen-concentration-standards-15047.html

[49] D Spelce, R McKay, et al. Respiratory protection for oxygen deficient atmospheres. J Int Soc Respir Prot. 2016. 33 (2). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7183576/

[50] J Henry. Clinical Diagnosis and Management by Laboratory Methods. 19th ed. WB Saunders Co. © 1996. P. 86.

[51] T Carbonell, R Rama. Respiratory hypoxia and oxidative stress in the brain.Is the endogenous erythropoietin an antioxidant? Current Chem Biol. 2009. 3 (3). https://doi.org/10.2174/2212796810903030238 https://www.eurekaselect.com/93407/article/respiratory-hypoxia-and-oxidative-stress-brain-endogenous-erythropoietin-antioxidant

[52] K Blomgren, H Hagberg. Free radicals, mitochondria and hypoxia-ischemia in the developing brain. Free radic Biol Med. Feb 1 2006. 40 (3). 388-397. https://pubmed.ncbi.nlm.nih.gov/16443153/

[53] G Padhy, A Gangwar, et al. Plasma kallikrein-bradykinin pathway promotes circulatory nitric oxide metabolite availability during hypoxia. Nitric Oxide. Vol 55-56. May-June 2016. 36-44. https://www.sciencedirect.com/science/article/abs/pii/S1089860316300155

[54] J Greenwod. Mechanisms of blood-brain barrier breakdown. Neuroradiology. 1991. 33 (2): 95-100. doi: 10.1007/BF00588242. https://pubmed.ncbi.nlm.nih.gov/2046916/

[55] M Griesz-Brisson. Interview. Technocracy News. https://www.technocracy.news/german-neurologist-on-face-masks-oxygen-deprivation-causes-permanent-neurological-damage/

[56] C St. Croix, B Morgan, et al. Fatiguing inspiratory muscle work causes reflex sympathetic activation in humans. J Physiol. Dec 1 2000. 529 Pt 2 (Pt 2). 493-504. doi: 10.1111/j.1469-7793.2000.00493.x. https://pubmed.ncbi.nlm.nih.gov/11101657/

[57] V Melnikov, V Divert, et al. Baseline values of cardiovascular and respiratory parameters predict response to acute hypoxia in young healthy men. Physiol Res. 2017. 66 (3). 467-479. https://pubmed.ncbi.nlm.nih.gov/28248531/

[58] J Crawford, T Isbell, et al. Hypoxia, red blood cells, and nitrite regulate NO-dependent hypoxic vasodilation. Blood. Jan 15 2006. 107 (2). 566-574. https://dx.doi.org/10.1182%2Fblood-2005-07-2668 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1895612/

[59] J Henry. Clinical Diagnosis and Management by Laboratory Methods. 19th ed. WB Saunders Co. © 1996. P. 599.

[60] MedGen. Erythroid hyperplasia. https://www.ncbi.nlm.nih.gov/medgen/4536#rdis_1634824

[61] D Harmening. Clinical Hematology and Fundamentals of Hemostasis., 4th ed. Davis Company. 2002. 348-349.

[62] E Cummins, D Crean. Hypoxia and inflammatory bowel disease. Microbes and Infection. 19 (3). March 2017. 210-221. https://www.sciencedirect.com/science/article/abs/pii/S1286457916301319?via%3Dihub

[63] N Zeitouni, S Chotikatum, et al. The impact of hypoxia on intestinal epithelial cell functions: consequences for invasion by bacterial pathogens. Mol Cell Ped. 2016. 14. https://doi.org/10.1186/s40348-016-0041-y https://molcellped.springeropen.com/articles/10.1186/s40348-016-0041-y

[64] W Zhu. Should, and how can, exercise be done during a coronavirus outbreak? An interview with Dr. Jeffrey A Woods. J Sport Health Sci. Mar 2020. 9 (2). 105-107. doi: 10.1016/j.jshs.2020.01.005. https://pubmed.ncbi.nlm.nih.gov/32099717/

[65] M Hogan, R Cox, et al. Lactate accumulation during incremental exercise with varied inspired oxygen fractions. J Appl Physiol Respir Environ Exerc Physiol. Oct 1983. 55 (4). 1134-1140. doi: 10.1152/jappl.1983.55.4.1134 https://pubmed.ncbi.nlm.nih.gov/6629944/

[66] O Warburg. On the origin of cancer cells. Science. Feb 24 1956. 123 (3191). DOI:10.1126/science.123.3191.309. https://science.sciencemag.org/content/123/3191/309

[67] O Warburg. On the origin of cancer cells. Science. Feb 24 1956. 123 (3191). https://www.jstor.org/stable/1750066?seq=1

[68] A Chambers, S Matosevic. Immunometabolic dysfunction of natural killer cells mediated by the hypoxia-CD73 axis in solid tumors. Front Mol Biosci. 2019. 6 (60). Jul 24 2019. https://dx.doi.org/10.3389%2Ffmolb.2019.00060 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6668567/

[69] G Crittenden. Is your mask giving you lung cancer? Oct 21 2020. https://neverb4.net/is-your-mask-giving-you-lung-cancer/

[70] M Chua, W Cheng, et al. Face masks in the new COVID-19 normal: materials, testing and perspectives. Research (Wash DC) Aug 7 2020. https://dx.doi.org/10.34133%2F2020%2F7286735 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7429109/

[71] Solvay. Material for Covid-19 PPE and medical equipment: N-95 masks. https://www.solvay.com/en/chemical-categories/specialty-polymers/healthcare/medical-equipment-emergency-production/n95-masks

[72] M Chua, W Cheng, et al. Face masks in the new COVID-19 normal: materials, testing and perspectives. Research (Wash DC) Aug 7 2020. https://dx.doi.org/10.34133%2F2020%2F7286735 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7429109/

[73] P Pierozan, F Jemeren, et al. Perfluorooctanoic acid (PFOA) exposure promotes proliferation, migration and invasion potential in human breast epithelial cells. Arch Toxicol. 2018. (92 (5). 1729-1739. Mar 3 2018. https://dx.doi.org/10.1007%2Fs00204-018-2181-4 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5962621/

[74] K Steenland, T Fletcher, et al. Epidemiologic evidence on the health effects of perfluorooctanoic acid (PFOA). Environ Health Perspect. Aug 2010. 118 (8): 1100-1108. https://dx.doi.org/10.1289%2Fehp.0901827 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2920088/

[75] D Lukashev, B Klebanov. Cutting edge: Hypoxia-inducible factor 1alpha and its activation- inducible short isoform I.1 negatively regulate functions of CD4+ and CD8+ T lymphocytes. J Immun. Oct 15 2006. 177 (8). 4962 – 4965. DOI: https://doi.org/10.4049/jimmunol.177.8.4962 https://www.jimmunol.org/content/177/8/4962

[76] A Sant, A McMichael. Revealing the role of CD-4+ T cells in viral immunity. J Exp Med. Jul 30 2012. 209 (8). https://dx.doi.org/10.1084%2Fjem.20121517 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3420330/

[77] B Borovoy, C Huber, Maria Crisler. Masks, false safety and real dangers, Part 2: Microbial challenges from masks. Oct 2020. https://PDMJ.org

[78] J Lan, Z Song, et al. Research letter: Skin damage among health care workers managing coronavirus disease-2019. Mar 9 2020. J Am Acad Dermatol. 82 (5). 1215-1216. https://www.jaad.org/article/S0190-9622(20)30392-3/pdf

[79] US Food and Drug Administration. Definition of a medical device. Section 201(h). https://www.fda.gov/media/131268/download

[80] US Food and Drug Administration. Medical device overview. https://www.fda.gov/industry/regulated-products/medical-device-overview#What%20is%20a%20medical%20device

[81] Us Food and Drug Administration. "Who can write a prescription for a medical device?" https://www.fda.gov/medical-devices/home-use-devices/frequently-asked-questions-about-home-use-devices#5

[82] E Sinkule, J Powell, et al. Evaluation of N95 respirator use with a surgical mask cover: effects on breathing resistance and inhaled carbon dioxide. [Table 4] Ann Occup Hygiene. Oct 29 2012. 57 (3). 384-398. https://doi.org/10.1093/annhyg/mes068 https://academic.oup.com/annweh/article/57/3/384/230992

[83] Z Zhaoshi. Potential risks when some special people wear masks. No. 1 Dept of Neurology, The Third Hospital of Jilin University. Apr 18 2020. https://jamanetwork.com/journals/jama/fullarticle/2764955

Masks are neither effective nor safe:
A summary of the science

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In 2020 there is a surge in use of facemasks in public places, including for extended periods of time, in the United States as well as in other countries. The public has been instructed by media and their governments that one's use of masks, even if not sick, may prevent others from being infected with SARS-CoV-2, the infectious agent of COVID-19.

A review of the peer-reviewed medical literature examines impacts of masks on human health, both immunological, as well as physiological. The purpose of this paper is to examine data regarding the effectiveness of facemasks, as well as safety data. The reason that both are examined in one paper is that for the general public as a whole, as well as for each individual, a risk-benefit analysis is necessary to guide decisions on if and when to wear a mask.

Are masks effective at preventing transmission of respiratory pathogens?

A 2020 meta-analysis found that face masks have no detectable effect against transmission of viral infections.[1] It found: "Compared to no masks, there was no reduction of influenza-like illness cases or influenza for masks in the general population, nor in healthcare workers."

Another 2020 meta-analysis, published by the US Centers for Disease Control (CDC), found that evidence from randomized controlled trials of face masks did not support a substantial effect on transmission of laboratory-confirmed influenza, either when worn by infected persons (source control) or by persons in the general community to reduce their susceptibility.[2]

Yet another 2020 analysis, found that masks had no effect specifically against Covid-19, although facemask use seemed linked to, in 3 of 31 studies, "very slightly reduced" odds of developing influenza-like illness.[3] The remainder of the 31 studies did not verify that finding.

A 2019 study of 2862 participants showed that both N95 respirators and surgical masks "resulted in no significant difference in the incidence of laboratory confirmed influenza."[4]

A 2016 meta-analysis found that both randomized controlled trials and observational studies of N95 respirators and surgical masks used by healthcare workers did not show benefit against transmission of acute respiratory infections. It was also found that acute respiratory infection transmission "may have occurred via contamination of provided respiratory protective equipment during storage and reuse of masks and respirators throughout the workday."[5]

A 2011 meta-analysis of 17 studies regarding masks and effect on transmission of influenza found that "none of the studies established a conclusive relationship between mask/respirator use and protection against influenza infection."[6] However, authors speculated that effectiveness of masks may be linked to early, consistent and correct usage.

Face mask use was likewise found to be not protective against the common cold, compared to controls without face masks among healthcare workers.[7]

Airflow around masks

Masks have been assumed to be effective in obstructing forward travel of viral particles. Considering those positioned next to or behind a mask wearer, there have been farther transmission of virus-laden fluid particles from masked individuals than from unmasked individuals, by means of "several leakage jets, including intense backward and downwards jets that may present major hazards," and a "potentially dangerous leakage jet of up to several meters."[8] All masks were thought to reduce forward airflow by 90% or more over wearing no mask. However, Schlieren imaging showed that both surgical masks and cloth masks had farther brow jets (upward airflow past eyebrows) than not wearing any mask at all, 182 mm and 203 mm respectively, vs none discernible with no mask. Backward airflow was found to be strong with all masks compared to not masking.

For both N95 and surgical masks, it was found that expelled particles from 0.03 to 1 micron were deflected around the edges of each mask, and that there was measurable penetration of particles through the filter of each mask.[9]

Penetration through masks

A study of 44 mask brands found mean 35.6% penetration ($\pm$ 34.7%). Most medical masks had over 20% penetration, while "general masks and handkerchiefs had no protective function in terms of the aerosol filtration efficiency." The study found that "Medical masks, general masks, and handkerchiefs were found to provide little protection against respiratory aerosols."[10]

It may be helpful to remember that an aerosol is a colloidal suspension of liquid or solid particles in a gas. In respiration, the relevant aerosol is the suspension of bacterial or viral particles in inhaled or exhaled breath.

In another study, penetration of cloth masks by particles was almost 97% and medical masks 44%.[11]

N95 respirators

Honeywell is a manufacturer of N95 respirators. These are made with a 0.3 micron filter.[12] N95 respirators are so named, because 95% of particles having a diameter of 0.3 microns are filtered by the mask forward of the wearer, by use of an electrostatic mechanism. Coronaviruses are approximately 0.125 microns in diameter.

A meta-analysis found that N95 respirators did not provide superior protection to facemasks against viral infections or influenza-like infections.[13] Another study did find superior protection by N95 respirators when they were fit-tested compared to surgical masks.[14]

Another study found that 624 out of 714 people wearing N95 masks left visible gaps when putting on their own masks.[15]

Surgical masks

A 2010 study found that surgical masks offered no protection at all against influenza.[16] Another study found that surgical masks had about 85% penetration ratio of aerosolized inactivated influenza particles and about 90% of Staphylococcus aureus bacteria, although S aureus particles were about 6 times the diameter of influenza particles.[17]

Use of masks in surgery were found to slightly *increase* incidence of infection over not masking in a study of 3,088 surgeries.[18] The surgeons' masks were found to give no protective effect to the patients.

Other studies found no difference in wound infection rates with and without surgical mask use during surgery.[19] [20]

A 2015 study found that "there is a lack of substantial evidence to support claims that facemasks protect either patient or surgeon from infectious contamination."[21]

A 2020 study found that medical masks have a wide range of filtration efficiency, with most showing a 30% to 50% efficiency.[22]

Specifically, are surgical masks effective in stopping human transmission of coronaviruses? Both experimental and control groups, masked and unmasked respectively, were found to "not shed detectable virus in respiratory droplets or aerosols."[23] In that study, they "did not confirm the infectivity of coronavirus" as found in exhaled breath.

A study of aerosol penetration showed that two of the five surgical masks studied had 51% to 89% penetration of polydisperse aerosols.[24]

In another study, that observed subjects while coughing, "neither surgical nor cotton masks effectively filtered SARS-CoV-2 during coughs by infected patients." And more viral particles were found on the outside than on the inside of masks tested.[25]

Cloth masks

Cloth masks were found to have low efficiency for blocking particles of 0.3 microns and smaller. Aerosol penetration through a variety of cloth masks examined was found to be between 74 and 90%. The filtration efficiency of fabric materials was 3% to 33%[26]

Healthcare workers wearing cloth masks were found to have 13 times the risk of influenza-like illness than those wearing medical masks.[27]

This 1920 analysis of cloth mask use during the 1918 pandemic examines the failure of masks to impede or stop flu transmission at that time, and concluded that the number of layers of fabric required to prevent pathogen penetration would have required a suffocating number of layers, and could not be used for that reason, as well as the problem of leakage vents around the edges of cloth masks.[28]

A 2020 Duke University study found that a likely reason for the poor effect of cloth masks is that the mesh of the mask dispersed larger expired respiratory droplets "into a multitude of smaller droplets . . . which explains the apparent increase in droplet count relative to no mask in that case." It was also noted that those smaller particles are likely to stay airborne longer than larger droplets, which resulted in "counterproductive" use of these cloth masks.[29]

Masks against Covid-19

The New England Journal of Medicine editorial on the topic of mask use versus Covid-19 assesses the matter as follows:

> "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 20 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."[30]

Are masks safe?

During walking or other exercise

Surgical mask wearers had significantly increased dyspnea after a 6-minute walk than non-mask wearers.[31]

Researchers are concerned about possible burden of facemasks during physical activity on pulmonary, circulatory and immune systems, due to oxygen reduction and air trapping reducing substantial carbon dioxide exchange. As a result of hypercapnia, there may be cardiac overload, renal overload, and a shift to metabolic acidosis.[32]

Risks of N95 respirators

Pregnant healthcare workers were found to have a loss in volume of oxygen consumption by 13.8% compared to controls when wearing N95 respirators. 17.7% less carbon dioxide was expired.[33] Patients with end-stage renal disease were studied during use of N95 respirators. Their partial pressure of oxygen (PaO2) decreased significantly compared to controls and increased respiratory adverse effects.[34] 19% of the patients developed various degrees of hypoxemia while wearing the masks.

Healthcare workers' N95 respirators were considered as personal bioaerosol samplers, for collecting influenza virus.[35] And 25% of healthcare workers' facepiece respirators were found to contain influenza in an emergency department during the 2015 flu season.[36]

Risks of surgical masks

Healthcare workers' surgical masks were considered as "personal bioaerosol samplers" and were found to collect and to harbor influenza virus.[37]

Various respiratory pathogens were found on the outer surface of used medical masks, which could result in self-contamination. The risk was found to be higher with longer duration of mask use.[38]

Surgical masks were also found to be a repository of bacterial contamination. The source of the bacteria was determined to be the body surface of the surgeons, rather than the operating room environment.[39] Given that surgeons are gowned from head to foot for surgery, this finding should be especially concerning for laypeople who wear masks. Without the protective garb of surgeons, laypeople generally have even more exposed body surface to serve as a source for bacteria to collect on their masks.

Risks of cloth masks

Healthcare workers wearing cloth masks had significantly higher rates of influenza-like illness after four weeks of continuous on-the-job use, when compared to controls.[40]

The increased rate of infection in mask-wearers may be due to a weakening of immune function during mask use. Surgeons have been found to have lower oxygen saturation after surgeries even as short as 30 minutes.[41] Low oxygen induces hypoxia-inducible factor 1 alpha (HIF-1). This in turn down-regulates CD4+ T-cells.[42] CD4+ T-cells, in turn, are necessary for viral immunity.[43]

Weighing risk versus benefit of mask use

In 2020 the United States is seeing an unprecedented surge of mask use by the public. Homemade and store-bought cloth masks and surgical masks or N95 masks are being used by the public especially when entering stores and other publicly accessible buildings. Sometimes bandanas or scarves are used. The use of face masks, whether cloth, surgical or N95, creates a poor obstacle to aerosolized pathogens as we can see from the meta-analyses and other studies in this paper, allowing both transmission of aerosolized pathogens to others in various directions, as well as self-contamination. Forward projection of exhaled material may be partly replaced by lateral, backward, downward and upward projection, and to greater distances, with longer time airborne, from a masked person than from an unmasked person.

It must also be considered that masks impede the necessary volume of air intake required for adequate oxygen / carbon dioxide exchange, which results in observed physiological effects that may be undesirable. Even 6-minute walks, let alone more strenuous activity, resulted in dyspnea. The volume of unobstructed oxygen in a typical breath is about 100 ml, used for normal physiological processes. 100 ml O2 greatly exceeds the volume of a pathogen required for transmission.

The foregoing data show that masks serve more as instruments of obstruction of normal breathing, rather than as effective barriers to pathogens. Therefore, masks should not be used by the general public, either by adults or children, and their limitations as prophylaxis against pathogens should also be considered in medical settings. The clinical studies and meta-analyses that are referenced, cited and linked herein are presented in order to provide the best opportunity for informed decision-making, and for individuals to consider and compare the risks versus benefits of mask use.

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[1] T Jefferson, M Jones, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses. MedRxiv. 2020 Apr 7.
https://www.medrxiv.org/content/10.1101/2020.03.30.20047217v2

[2] J Xiao, E Shiu, et al. Nonpharmaceutical measures for pandemic influenza in non-healthcare settings – personal protective and environmental measures. Centers for Disease Control. 26(5); 2020 May.
https://wwwnc.cdc.gov/eid/article/26/5/19-0994_article

[3] J Brainard, N Jones, et al. Facemasks and similar barriers to prevent respiratory illness such as COVID19: A rapid systematic review. MedRxiv. 2020 Apr 1.
https://www.medrxiv.org/content/10.1101/2020.04.01.20049528v1.full.pdf

[4] L Radonovich M Simberkoff, et al. N95 respirators vs medical masks for preventing influenza among health care personnel: a randomized clinic trial. JAMA. 2019 Sep 3. 322(9): 824-833.
https://jamanetwork.com/journals/jama/fullarticle/2749214

[5] J Smith, C MacDougall. CMAJ. 2016 May 17. 188(8); 567-574.
https://www.cmaj.ca/content/188/8/567

[6] F bin-Reza, V Lopez, et al. The use of masks and respirators to prevent transmission of influenza: a systematic review of the scientific evidence. 2012 Jul; 6(4): 257-267.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5779801/

[7] J Jacobs, S Ohde, et al. 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 Jun; 37(5): 417-419.
https://pubmed.ncbi.nlm.nih.gov/19216002/

[8] M Viola, B Peterson, et al. Face coverings, aerosol dispersion and mitigation of virus transmission risk.
https://arxiv.org/abs/2005.10720, https://arxiv.org/ftp/arxiv/papers/2005/2005.10720.pdf

[9] S Grinshpun, H Haruta, et al. Performance of an N95 filtering facepiece particular respirator and a surgical mask during human breathing: two pathways for particle penetration. J Occup Env Hygiene. 2009; 6(10):593-603.
https://www.tandfonline.com/doi/pdf/10.1080/15459620903120086

[10] H Jung, J Kim, et al. Comparison of filtration efficiency and pressure drop in anti-yellow sand masks, quarantine masks, medical masks, general masks, and handkerchiefs. Aerosol Air Qual Res. 2013 Jun. 14:991-1002.
https://aaqr.org/articles/aaqr-13-06-oa-0201.pdf

[11] C MacIntyre, H Seale, et al. A cluster randomized trial of cloth masks compared with medical masks in healthcare workers. BMJ Open. 2015; 5(4)
https://bmjopen.bmj.com/content/5/4/e006577.long

[12] N95 masks explained. https://www.honeywell.com/en-us/newsroom/news/2020/03/n95-masks-explained

[13] V Offeddu, C Yung, et al. Effectiveness of masks and respirators against infections in healthcare workers: A systematic review and meta-analysis. Clin Inf Dis. 65(11), 2017 Dec 1; 1934-1942.

https://academic.oup.com/cid/article/65/11/1934/4068747

[14] C MacIntyre, Q Wang, et al. A cluster randomized clinical trial comparing fit-tested and non-fit-tested N95 respirators to medical masks to prevent respiratory virus infection in health care workers. Influenza J. 2010 Dec 3. https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1750-2659.2011.00198.x?fbclid=IwAR3kRYVYDKb0aR-su9_me9_vY6a8KVR4HZ17J2A_80f_fXUABRQdhQlc8Wo

[15] M Walker. Study casts doubt on N95 masks for the public. MedPage Today. 2020 May 20. https://www.medpagetoday.com/infectiousdisease/publichealth/86601

[16] C MacIntyre, Q Wang, et al. A cluster randomized clinical trial comparing fit-tested and non-fit-tested N95 respirators to medical masks to prevent respiratory virus infection in health care workers. Influenza J. 2010 Dec 3. https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1750-2659.2011.00198.x?fbclid=IwAR3kRYVYDKb0aR-su9_me9_vY6a8KVR4HZ17J2A_80f_fXUABRQdhQlc8Wo

[17] N Shimasaki, A Okaue, et al. Comparison of the filter efficiency of medical nonwoven fabrics against three different microbe aerosols. Biocontrol Sci. 2018; 23(2). 61-69. https://www.jstage.jst.go.jp/article/bio/23/2/23_61/_pdf/-char/en

[18] T Tunevall. Postoperative wound infections and surgical face masks: A controlled study. World J Surg. 1991 May; 15: 383-387. https://link.springer.com/article/10.1007%2FBF01658736

[19] N Orr. Is a mask necessary in the operating theatre? Ann Royal Coll Surg Eng 1981: 63: 390-392. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2493952/pdf/annrcse01509-0009.pdf

[20] N Mitchell, S Hunt. Surgical face masks in modern operating rooms – a costly and unnecessary ritual? J Hosp Infection. 18(3); 1991 Jul 1. 239-242. https://www.journalofhospitalinfection.com/article/0195-6701(91)90148-2/pdf

[21] C DaZhou, P Sivathondan, et al. Unmasking the surgeons: the evidence base behind the use of facemasks in surgery. JR Soc Med. 2015 Jun; 108(6): 223-228. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4480558/

[22] L Brosseau, M Sietsema. Commentary: Masks for all for Covid-19 not based on sound data. U Minn Ctr Inf Dis Res Pol. 2020 Apr 1. https://www.cidrap.umn.edu/news-perspective/2020/04/commentary-masks-all-covid-19-not-based-sound-data

[23] N Leung, D Chu, et al. Respiratory virus shedding in exhaled breath and efficacy of face masks Nature Research. 2020 Mar 7. 26,676-680 (2020). https://www.researchsquare.com/article/rs-16836/v1

[24] S Rengasamy, B Eimer, et al. Simple respiratory protection – evaluation of the filtration performance of cloth masks and common fabric materials against 20-1000 nm size particles. Ann Occup Hyg. 2010 Oct; 54(7): 789-798. https://academic.oup.com/annweh/article/54/7/789/202744

[25] S Bae, M Kim, et al. Effectiveness of surgical and cotton masks in blocking SARS-CoV-2: A controlled comparison in 4 patients. Ann Int Med. 2020 Apr 6. https://www.acpjournals.org/doi/10.7326/M20-1342

[26] S Rengasamy, B Eimer, et al. Simple respiratory protection – evaluation of the filtration performance of cloth masks and common fabric materials against 20-1000 nm size particles. Ann Occup Hyg. 2010 Oct; 54(7): 789-798. https://academic.oup.com/annweh/article/54/7/789/202744

[27] C MacIntyre, H Seale, et al. A cluster randomized trial of cloth masks compared with medical masks in healthcare workers. BMJ Open. 2015; 5(4)
https://bmjopen.bmj.com/content/5/4/e006577.long

[28] W Kellogg. An experimental study of the efficacy of gauze face masks. Am J Pub Health. 1920. 34-42.
https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.10.1.34

[29] E Fischer, M Fischer, et al. Low-cost measurement of face mask efficacy for filtering expelled droplets during speech. Science Advances. Sep 2 2020. 6 (36).
https://advances.sciencemag.org/content/6/36/eabd3083?fbclid=IwAR0TPVlflF_sUEiSdad6oM1NVQGO5w2S7WfstCIKaIJ15JJaKaDMzBkD5YY

[30] M Klompas, C Morris, et al. Universal masking in hospitals in the Covid-19 era. N Eng J Med. 2020; 382 e63.
https://www.nejm.org/doi/full/10.1056/NEJMp2006372

[31] E Person, C Lemercier et al. Effect of a surgical mask on six minute walking distance. Rev Mal Respir. 2018 Mar; 35(3):264-268.
https://pubmed.ncbi.nlm.nih.gov/29395560/

[32] B Chandrasekaran, S Fernandes. Exercise with facemask; are we handling a devil's sword – a physiological hypothesis. Med Hypothese. 2020 Jun 22. 144:110002.
https://pubmed.ncbi.nlm.nih.gov/32590322/

[33] P Shuang Ye Tong, A Sugam Kale, et al. Respiratory consequences of N95-type mask usage in pregnant healthcare workers – A controlled clinical study. Antimicrob Resist Infect Control. 2015 Nov 16; 4:48.
https://pubmed.ncbi.nlm.nih.gov/26579222/

[34] T Kao, K Huang, et al. The physiological impact of wearing an N95 mask during hemodialysis as a precaution against SARS in patients with end-stage renal disease. J Formos Med Assoc. 2004 Aug; 103(8):624-628.
https://pubmed.ncbi.nlm.nih.gov/15340662/

[35] F Blachere, W Lindsley et al. Assessment of influenza virus exposure and recovery from contaminated surgical masks and N95 respirators. J Viro Methods. 2018 Oct; 260:98-106.
https://pubmed.ncbi.nlm.nih.gov/30029810/

[36] A Rule, O Apau, et al. Healthcare personnel exposure in an emergency department during influenza season. PLoS One. 2018 Aug 31; 13(8): e0203223.
https://pubmed.ncbi.nlm.nih.gov/30169507/

[37] F Blachere, W Lindsley et al. Assessment of influenza virus exposure and recovery from contaminated surgical masks and N95 respirators. J Viro Methods. 2018 Oct; 260:98-106.
https://pubmed.ncbi.nlm.nih.gov/30029810/

[38] A Chughtai, S Stelzer-Braid, et al. Contamination by respiratory viruses on our surface of medical masks used by hospital healthcare workers. BMC Infect Dis. 2019 Jun 3; 19(1): 491.
https://pubmed.ncbi.nlm.nih.gov/31159777/

[39] L Zhiqing, C Yongyun, et al. J Orthop Translat. 2018 Jun 27; 14:57-62.
https://pubmed.ncbi.nlm.nih.gov/30035033/

[40] C MacIntyre, H Seale, et al. A cluster randomized trial of cloth masks compared with medical masks in healthcare workers. BMJ Open. 2015; 5(4)
https://bmjopen.bmj.com/content/5/4/e006577

[41] A Beder, U Buyukkocak, et al. Preliminary report on surgical mask induced deoxygenation during major surgery. Neurocirugia. 2008; 19: 121-126.
http://scielo.isciii.es/pdf/neuro/v19n2/3.pdf

[42] D Lukashev, B Klebanov, et al. Cutting edge: Hypoxia-inducible factor 1-alpha and its activation-inducible short isoform negatively regulate functions of CD4+ and CD8+ T lymphocytes. J Immunol. 2006 Oct 15; 177(8) 4962-4965.
https://www.jimmunol.org/content/177/8/4962

[43] A Sant, A McMichael. Revealing the role of CD4+ T-cells in viral immunity. J Exper Med. 2012 Jun 30; 209(8):1391-1395.
https://europepmc.org/article/PMC/3420330