Do Masks Really Work?

Lately, there has been a lot of confusion and/or misinformation on face masks and their use. This is a summary of the literature sent to the Arizona Medical Association regarding the perspective that cloth masks used by the public do not provide a benefit and/or are a risk to the public in general. Each article was reviewed individually and examined scientifically; they are presented below, each with its own summary, explanation for why it was being used in the argument against masks (if one was given for that article), with an analysis of that argument using the article.

The details of each article are listed below, divided into the categories that were presented to ArMA. First will be a summary of the major issues identified in doing this literature review. The review was conducted by the ArMA President, Ross F. Goldberg, MD, FACS. His qualifications are as follows, he has been a practicing General Surgeon in Arizona for the past eight years, teaching both residents and medical students, in which utilizing and analyzing evidence-based medicine is a daily occurrence. Before that he was in training in both residency and fellowship for a total of nine years, which included a two-year surgical research fellowship in the Department of Surgery at Massachusetts General Hospital, where he was doing basic science lab work. This culminated with a first author publication in the Proceedings of the National Academy of Sciences of the United States of America. He has been involved with evaluating evidence-based, peer-reviewed journals since the beginning of medical school, and has continued that practice throughout his career, being an author on numerous peer-reviewed articles throughout the years. He is also, currently, an active peer reviewer for numerous surgical journals.

While reviewing all these articles, some misunderstanding of certain concepts was found, as well as the inappropriate use of principles of applying certain scientific articles to support an argument even though the pieces do not fit.

First, let us focus on the biology of the virus. Several articles listed below were focused on the influenza virus, instead of the coronavirus that that we currently face during this pandemic. One cannot use studies done on a separate virus to meet the arguments of a different, unrelated virus. The influenza virus and the coronavirus are two different organisms, with different characteristics and patterns of behavior. To compare the two viruses as if they were similar would be the same as to compare one human to another human, ignoring all other differences.

The influenza virus is a segmented, negative strand RNA genome. They are of the family *Orthomyxoviridae*. This is different from the coronavirus, specifically the COVID-19 virus, which is a positive stranded RNA virus of the family *Orthocoronaviriniae* of the *Coronaviridae* family. Their transmission rates are different, as are their incubation rates and are showing different patterns of symptom presentation. One cannot use studies done regarding the influenza virus and use them as an equivalent for the coronavirus.

Second, and more importantly, is the concept of using masks. While the terminology is the same, and the overall function is the same, to cover the nose and mouth, the purpose of each mask is vastly different. Focusing first on the N95 mask, these should be used by solely health care workers in an environment where they are taking care of COVID-positive patients. The purpose of the N95, which is even proven by the literature, is to filter out particles and protect the wearer from inhaling them. They are not perfect, and do not protect 100%, but they are significantly better than other masks that could be worn by these health care workers.

This is quite different from the concept of the surgical or cloth mask. While the N95 mask is designed to protect the wearer, the real purpose of the surgical mask is to protect others from the person who is wearing the mask. For example, as our President has stated, as someone that has worn surgical masks for the past 20 years, sometimes for 12-16 hours at a time and has not experienced any significant negative health care events because of it, he wears a mask when he is operating not to protect him from the patient, but to protect the sterile field from what he is breathing out. Again, we do not expect anything to be 100%, but it has been shown that wearing a surgical/cloth mask significantly reduces transmission when you breathe out. As listed below with the CDC recommendations, this should be used in conjunction with good hand hygiene and physical distancing, to maximize the efficacy of prevention of transmission of disease. We have found that this is a very transmissible disease, and anything we can do to slow the process of its spread is important.

One could argue that the public has a vested interest in protecting their health care workers, since we are of a limited supply. It is already been shown that more exposure to the virus increases your risk of not only transmission of it, but potentially severity of symptoms as well. As we all want to be adequately protected, the good of the public outweighs the good of the individual at times. If the public wants to be sure that there is a health care worker available to take care of them if they get sick, you need to make sure that those health care workers are as protected as possible. With the nature of this pandemic, it is the responsibility of the patients to try to prevent as much transmission as possible. it has been shown that mass, used with other methods, help accomplish that goal.

This is further supported by recently published literature, which is listed below. One of those studies was done right here in Tempe at the Arizona State University, by the School of Mathematical and Statistical Sciences. Their research looked at the ability to have the public use masks to curtail the COVID-19 pandemic. Those references are listed below, followed by the detailed analysis of the provided literature, kept in the same format as it was sent.

Recent References:

1. Eikenberry SE, et al. *To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic.* Infect Dis Model. 2020; 5: 293-308. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7186508/
2. Clase CM, et al. *Cloth Masks May Prevent Transmission of COVID-19: An Evidence-Based, Risk-Based Approach.* Annals of Internal Medicine. 2020 May 22. Online ahead of print. https://www.acpjournals.org/doi/full/10.7326/M20-2567?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub++0pubmed&
3. Chu DK, et al. *Physical Distancing, Face Masks, and Eye Protection to Prevent Person-To-Person Transmission of SARS-CoV-2 and COVID-19: A Systematic Review and Meta-Analysis.* Lancet. 2020 Jun 1; S0140-6736 (20)31142-9. Online ahead of print. https://pubmed.ncbi.nlm.nih.gov/32497510/?from_term=masks+distancing+covid&from_pos=3

Literature Review of Supplied Articles

SARS-CoV-2

1. Cascella M, et al. *Features, Evaluation and Treatment Coronavirus (COVID-19).* StatPearls [Internet], StatPearls Publishing, 2020 Jan. Last Update April 6, 2020. Authors from Italy.

   Argument for Why This Supports Not Wearing A Mask:
   SARS-CoV-2 belongs to the betaCoVs category. It has round or elliptic and often pleomorphic form, and a diameter of ***approximately 60–140* μm**. Like other CoVs, it is sensitive to ultraviolet rays and heat.

   Summary of Article:
   Gave an overview of the COVID-19 virus, some brief highlights:
   - Large family of single-stranded RNA virus
   - CoVs are positive-stranded RNA viruses, have a crown-like appearance due to spike glycoproteins on the envelope of the virus
   - Seven human CoVs capable of infecting humans that have been identified, estimates suggest that 2% of the population are healthy carriers of a CoV and that these viruses are responsible for 5-10% of acute respiratory infections
   - SARS-CoV-2 is in the beta CoVs category – one of the subgenera family *Orthocoronavirinae* of the *Coronaviridae* family
     - Round or elliptical and often pleomorphic form, with a diameter of approximately 60-140 nm
     - Sensitive to ultraviolet rays and heat
     - Can also be inactivated by lipid solvents including ether (75%), ethanol, chlorine-containing disinfectant, peroxyacetic acid and chloroform except for chlorhexidine (which is commonly used to sterilize skin right before an operation begins)
   - Transmission – use of isolation is the best way to contain epidemic due to concerns of transmission via respiratory droplets, including the asymptomatic patients
   - Incubation time could be generally within 3-7 days and up to 2 weeks; on average, each patient transmits the infection to an additional 2.2 individuals
   - Admittedly, this was written when we had limited reports (and still do)
   - COVID-19 may present with mild, moderate or severe illness
     - Severe illnesses include severe pneumonia, ARDS, sepsis and septic shock
   - Preventive measures are the current strategy to limit the spread of cases

   Article's Role in Discussion Regarding Mask Use:

   What was highlighted was the size of the coronavirus, which is measured in nanometers, which masks are known to have pores in the micrometer size, making the pores larger than the virus. This is known and recognized. Like most things in medicine, nothing is 100%, and that goes for the protective nature of N95 masks for health care workers.

This should only strengthen the desire by the public to protect the health care workers, who are limited in number, so that they are spared from constant exposure to COVID-19, thereby increasing their risk of infection. The public should want to take whatever measure they can to help reduce exposure, thereby reducing positive patients, and reducing increased exposure for health care workers.

Wearing a cloth mask does not stop all the virus from exiting someone's mouth, but it does inhibit many of them, reducing viral load and reducing the risk of exposure to the virus by others, especially when a cloth mask is worn in conjunction with social distancing.

2. USA today article, May 20, 2020. *Coronavirus 'does not spread easily' by touching surfaces or objects, CDC says.* https://www.usatoday.com/story/news/health/2020/05/20/coronavirus-does-not-spread-easily-surfaces-objects-cdc/5232748002/

   Summary of Article:

   Quotes a study recently done in the New England Journal of Medicine that showed coronavirus lives on some surfaces up to 3 days and up to 3 hours in the air.

   Some specifics:

   - 4 hours – Copper
   - Up to 24 hours – Cardboard
   - 2-3 days – Plastic & Stainless Steel

   CDC is quoted saying that catching from boxes delivered by Amazon or on takeout unlikely "because of poor survivability of these coronaviruses on surfaces",

   Article's Role in Discussion Regarding Mask Use:

   Unsure of the relevance of this article, except there is less concern from the CDC that this can be caught from surfaces. That puts a bigger emphasis of the respiratory component of transmission, meaning that we need to take extra steps in protecting each other from the respiratory spread of the coronavirus.

3. CDC website – COVID-19 Section – "How It Spreads Page", updated May 22, 2020 – https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html

   Summary of Website Page:

   Brief highlights from this webpage:

   - Spreads easily between people – information suggests that this virus spreads more efficiently than influenza, but not as efficiently as measles, which is highly contagious

- May be possible to get it by touching surface or objects that have the virus on it and then touching their own mouth, nose or possibly eyes – but this is not thought to be main way of transmission, still learning though
- Section on protecting yourself and others:
    - Maintain good social distance – around 6 feet
    - Wash your hands often with soap and water, or hand sanitizer that contains at least 60% alcohol
    - Routinely clean and disinfect frequently touched surfaces
- At the bottom of this webpage, which was quoted and referenced, there is a hyperlink to another section of the CDC webpage on COVID-19, entitled "How to Protect Yourself & Others"; when this is clicked the following suggestions are listed, as per the CDC:
    - Wash your hands often
        - With soap and water for at least 20 seconds, especially after being in a public place or after blowing your nose, coughing or sneezing
        - Use hand sanitizer that contains at least 60% alcohol if soap and water not available
        - Avoid touching your eyes, nose and mouth with unwashed hands
    - Avoid close contact
        - With people who are sick, even inside your home – keep 6 feet distance if possible
        - Put distance between yourself and others outside your home
            - Asymptomatic people can spread the virus
            - At least 6 feet (about 2 arms' length) apart
            - Do not gather in groups
            - Stay out of crowded places and avoid mass gatherings
            - Especially important for people who are at higher risk of getting very sick
    - Cover your mouth and nose with cloth face cover when around others
        - Meant to protect other people in case you're infected
        - Do NOT use a facemask meant for a healthcare worker
        - Maintain social distance, cloth mask does not replace this
    - Cover coughs and sneezes
    - Clean and disinfect
    - Monitor your health

<u>Website's Role in Discussion Regarding Mask Use:</u>

Not sure why this is reference as to a reason as to not wear a mask. The CDC specifically states you should wear a cloth mask to combat spreading the virus to others, in combination with physical distancing and hand washing. These three should be done together. This only supports the concept that people should be wearing cloth masks.

<u>Cloth Mask vs. N95 Mask</u>

1. Neupane BB, et al. *Optical Microscopic Study of Surface Morphology and Filtering Efficiency of Face Masks.* PeerJ. 2019 Jun 26; 7:37142. From Nepal.

   Argument for Why This Supports Not Wearing A Mask:
   "Results: The pore size of masks ranged from 80 to 500 µm, which was much bigger than particular matter having diameter of 2.5 µm or less (PM2.5) and 10 µm or less (PM10) size. The PM10 filtering efficiency of four of the selected masks ranged from 63% to 84%. The poor filtering efficiency may have arisen from larger and open pores present in the masks. Interestingly, we found that efficiency dropped by 20% after the 4th washing and drying cycle. We observed a change in pore size and shape and a decrease in microfibers within the pores after washing. Stretching of CM surface also altered the pore size and potentially decreased the filtering efficiency. As compared to CMs, the less frequently used surgical/paper masks had complicated networks of fibers and much smaller pores in multiple layers in comparison to CMs, and therefore had better filtering efficiency. This study showed that the filtering efficiency of cloth face masks were relatively lower, and washing and drying practices deteriorated the efficiency. We believe that the findings of this study will be very helpful for increasing public awareness and help governmental agencies to make proper guidelines and policies for use of face mask."

   Summary of Article:
   The purpose of the article is to examine the concept used by many nations to use face masks to assist filtering particulate matter secondary to air pollution. It focused on the fact that particles of 2.5 micrometers in diameter or less can be deposited in the respiratory system and cause issues.

   These nations with bad air pollution use both cloth masks (CMs) and disposable surgical masks (SMs) to help filter these particles. This group looked at cloth masks available in Nepal and compared them with surgical face masks – looking at them under the microscope, measuring the efficacy of masks on filtering ambient outdoor aerosol particles by particle counting method and looked at washing and drying cycles and stretching on surface characteristics and filtering efficiency of CMs. They looked at 20 CMs and 7 brands of SMs purchased from local markets in Kathmandu.

   They found the pore size of the CMs ranged from 81 to 461 micrometer in size. The filtering efficiency was dependent on the number of pores per unit area (pore number density), finding a diverse number of pores ranging from 12 to 47 pores per microscopic field of view. It ranged in CMs from 63 to 84%, while compared to the SMs, which was around 94%.

   They found that stretching in CMs increased the pore size and change in shape of the pores. Washing and drying of CMs (up to four cycles) found a gradual decrease in filtering efficiency.

   The article concluded that medical masks may be more efficiency in blocking the particulate matter found in air pollution. SMs have a better filtering efficiency compared to CMs. This article is meant to help policymakers when crafting policy for face mask use for the public when dealing with air pollution.

   Article's Role in Discussion Regarding Mask Use:
   This article focused on air pollution, not infections. Also, the article focused on filtering particles through the mask into the patient, not the other way around. As mentioned in the summary, the point

of a surgical face mask is to prevent the wearer from spreading particles, not meant to completely protect the wearer from them. This article does nothing to discuss that fact.

2. Shakya KM, et al. *Evaluating the Efficacy of Cloth Facemasks in Reducing Particulate Matter Exposure.* J Expo Sci Environ Epidemiol. 2017 May; 27(3): 352-357. From University of Massachusetts.

   Argument for Why This Supports Not Wearing A Mask:
   "Standard N95 mask performance was used as a control to compare the results with cloth masks, and our results suggest that cloth masks are only marginally beneficial in protecting individuals from particles<2.5 μm."

   Summary of Article:
   This article compared the usefulness of protection of N95 masks versus cloth masks. They suggested that cloth masks are only marginally beneficial in protecting individuals from particles that are less than 2.5 micrometers, which is significantly bigger than the standard coronavirus particle.

   Article's Role in Discussion Regarding Mask Use:
   As stated earlier, the point of a surgical mask is different from that of a N95 mask. A N95 mask is to protect the wearer from particles. The surgical mask has two roles, one for the wearer and one for the public. The wearer is protected from fluids and splashes, while it also protects anyone else from the respiratory droplets coming out of the wearer's mouth. It does some filtering, but the goal of wearing such a mask is not protect from these particles but prevent them from spreading outwards. So, this article just confirms that health care workers, when dealing with any airborne/respiratory diseases, should be wearing a N95 mask rather than a surgical mask. The N95 masks should not be worn by the public. This continues to support the efforts that the public should be willing cloth masks or surgical masks, and not N95 masks.

3. Seto, WH. *Airborne Transmission and Precautions: Facts and Myths.* J Hosp Infect. 2015 Apr; 89(4): 225-8. University of Hong Kong.

   Argument for Why This Supports Not Wearing A Mask:
   "The prevention of such transmission is expensive, requiring N95 respirators and negative pressure isolation rooms."

   Summary of Article:
   This article was published pre-COVID-19. To briefly summarize, airborne transmission can be placed into three categories: obligate, preferential and opportunistic. Obligate infections are solely through aerosols (like TB). Preferential infections are through multiple routes, although predominantly by aerosols (like chicken pox, measles). The opportunistic infections are transmitted through other routes but under favorable conditions, especially when in aerosol-generating procedures like intubations, transmissions can occur. Examples include influenza and SARS (severe acute respiratory syndrome), which are not considered as airborne, because only needs droplet and contact precautions.

For airborne transmission precautions, you want to isolate the patient in a negative-pressure room and use N95 respirator masks.

This is what you would use for contagious diseases while treating in the hospital.

Article's Role in Discussion Regarding Mask Use:
COVID is not considered a true airborne disease, so unsure about the connection with the concern for masks. Regardless, this gives more of a plan on how to protect yourself when treating a patient with this disease. Again, this focuses on what the treating person has to wear to protect themselves, it does not talk about what can be done to prevent the patient to transmit to others.

4. Garcia Godoy LR, et al. *Facial Protection for Healthcare Workers During Pandemics: A Scoping Review.* BMJ Global Health. 2020 May; 5(5): e002553. Oregon Health and Science University.

Argument for Why This Supports Not Wearing A Mask:
"The COVID-19 pandemic has led to critical shortages of medical-grade PPE. Alternative forms of facial protection offer inferior protection."

Summary of Article:
This was a review of medical-grade facial protection for healthcare workers, looking also at safety and efficacy of decontamination methods and utility of alternative strategies in emergency shortages or resource-scarce settings. Meta-analysis was performed of the literature, leading to the review of 67 records. They showed that N95 masks performed better than surgical masks, providing superior protection in inpatient settings and performed equivalently in outpatient settings. This supported the use of N95 masks by hospital workers and examine the impact on alternatives of medical-grade facial protection.

Article's Role in Discussion Regarding Mask Use:
This article supports the concept that N95 masks should only be used for hospital workers due to the extra protection they provide in the inpatient setting. Furthermore, there is a chart in the article that supports the use of face masks as a general concept to protect others from the wearer, which is the basis of the CDC recommendations to wear face masks. The table is as listed below. So, when examining this article, it actually supports the concept of using face masks for the public when looking at it in its entirety.

From the BMJ Global Health Article – reference as above

Table – Types of Medical-Grade Facial Protection

Mask Types	**Function**
N95 respirator	*A respiratory protective device designated to achieve a close facial fit and efficient filtration of airborne particles, requires fit testing to be fully effective.* • Prevents inhalation of 95% of 0.3 µm particles. • Reduces person-to-person transfer of respiratory droplets. • Blocks blood and bodily fluids from reaching the wearer's mouth and nose.

	• Prevents inhalation of droplets and larger particles. • Filtration of all air reaching the mouth and nose is required for particles ≥5 µm. • Surgical N95 respirators are used in healthcare settings and are a subset of N95 filtering facepiece respirators.
Surgical mask	*A loose-fitting, disposable device that creates a physical barrier between the mouth and nose of the wearer and potential contaminants in the immediate environment.* • **Reduces person-to-person transfer of respiratory droplets.** • Blocks blood and bodily fluids from reaching the wearer's mouth and nose. • Prevents inhalation of droplets and larger particles. • Filtration of all air reaching the mouth and nose is required for particles ≥5 µm.
Face shield	*A face shield provides barrier protection to the facial area and related mucous membranes (eyes, nose, lips).* • Current Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines explicitly recommend wearing a face shield or goggles during all patient care for certain illnesses such as severe acute respiratory syndrome (SARS) and avian influenza.

5. Umer F, Haji Z, Zafar K. *Role of Respirators in Controlling the Spread of Novel Coronavirus (Covid-19) Among Dental Health Care Providers: A Review.* Into Endod J. 2020 May 1. From Aga Khan University Hospital, Karachi, Pakistan. (unable to access full article, only abstract)

   Argument for Why This Supports Not Wearing A Mask:
   "Therefore, it is vital to use respirators which have been proven to offer better protection against droplets, aerosols and fluid penetration and which form a tight seal around the mouth and nose. Various types of respirators are used in healthcare settings, such as half-mask filtering facepiece respirators (FFRs) and powered air-purifying respirators (PAPRs). The most commonly used FFR is the N95 disposable respirator, which is tight fitting and has a 95% or above particle filtering efficiency for a median particle size of 0.3 micrometer."

   Summary of Article Abstract:
   Again, supporting the concept that using respirators provides better protection against droplets, aerosols and fluid penetration. No new information when compared to above.

   Article's Role in Discussion Regarding Mask Use:
   Also reiterates that healthcare workers should have access to these masks since they are at higher risk for being exposed to these droplets. Does not comment at all on the ability of face masks to help reduce potential transmission, so this article really has no impact on the argument about mask use by the public.

6. Bin-Reza F, et al. *The Use of Masks and Respirators to Prevent Transmission of Influenza: A Systematic Review of the Scientific Evidence.* Influenza Other Respir Viruses. 2012 Jul; 6(4): 257-67. From Health Protection Agency, London, England. (Only able to access abstract)

   Argument for Why This Supports Not Wearing A Mask:
   "There were 17 eligible studies. Six of eight randomised controlled trials found no significant differences between control and intervention groups (masks with or without hand hygiene; N95/P2 respirators). One household trial found that mask wearing coupled with hand sanitiser use reduced secondary transmission of upper respiratory infection/influenza-like illness/laboratory-confirmed influenza compared with education; hand sanitiser alone resulted in no reduction. One hospital-based trial found a lower rate of clinical respiratory illness associated with non-fit-tested N95 respirator use compared with medical masks. Eight of nine retrospective observational studies found that mask and/or respirator use was independently associated with a reduced risk of severe acute respiratory syndrome (SARS). Findings, however, may not be applicable to influenza and many studies were suboptimal. None of the studies established a conclusive relationship between mask/respirator use and protection against influenza infection."

   Summary of Article:
   This study focused on the use of masks and respirators regarding transmission of influenza. They abstract admitted that findings may not be applicable to influenza and many studies were suboptimal with their results, meaning that they could not establish a conclusive relationship between mask/respirator use and protection against influenza infection.

   Although the end of the abstract does state that some evidence suggests that the use of masks is best as a part of a package of personal protection which includes hand hygiene and that the effectiveness of this is linked to early, consistent and correct usage.

   Article's Role in Discussion Regarding Mask Use:
   The abstract was used as the reason for including this information, but the last two sentences were cut off when quoting the abstract, not fully explaining its interpretation of the data. This study actually states that there may be some benefit of wearing face masks as part of an overall strategy.

   This study also discussed the influenza virus, which is a different virus than COVID-19, so it is not clear that one can use this study to project results on a completely different virus.

Facemask as potential risk of infection

1. Fisher EM, et al. *Validation and Application of Models to Predict Facemask Influenza Contamination in Healthcare Settings.* Risk analysis: an official publication of the Society of Risk Analysis. 2014 Aug; 34(8): 1423-34.

   Argument for Why This Supports Not Wearing A Mask:
   "Two types of facemasks used by healthcare workers are N95 filtering facepiece respirators (FFRs) and surgical masks (SMs). These can become contaminated with respiratory pathogens during use, thus serving as potential sources for transmission."

Summary of Article:
Discussed that there are N95 masks (FFRs) and surgical masks (SMs). They stated that these facemasks can become contaminated with respiratory pathogens during use, potentially serving as a source of transmission. They were exploring the hazard associated with pathogen-exposed facemasks. They used a mathematical model to calculate potential influenza contamination of facemasks from aerosol sources in various exposure scenarios.

They used models to estimate facemask influenza contamination via aerosol deposition for three scenarios and deposition via direct spray (cough). The models suggest influenza contamination levels from a single cough are much less when compared to aerosol sources. Even with aerosols, there was a wide variation in levels, dependent on the input values selected. The purpose of these models can help to inform currently infection control practice and future research related to the development of better facemasks, to better characterize airborne contamination levels and to assist in the risk assessment from re-aerosolization and fomite transfer from handling and reuse of contaminated facemasks.

The article recognized its own limitations. The cough model was not validated. The aerosol and cough models do not represent all aspects affecting facemask contamination in the healthcare environment. The model was not validated with data from actual healthcare facilities or with other infectious aerosols. They admitted that the data for model inputs were limited and may not accurately depict the typical conditions seen in all healthcare facilities.

Article's Role in Discussion Regarding Mask Use:
This article was used under the heading "facemask as potential risk of infection." Only the first few sentences of the abstract were used to justify its use, even though the results do not support the above statement. This model does not support the statement that facemasks are a potential risk of infection and in fact encourage further, validated research to accomplish this. This article is just the first step in exploring this issue, so no conclusions can be made and it does not support the idea that facemasks are a potential risk of infections.

Hypoxia

1. Kao TW, et al. *The Physiological Impact of Wearing a N95 Mask During Hemodialysis as a Precaution Against SARS in Patients With End-Stage Renal Disease.* J Formos Med Assoc. 2004 Aug; 103(8): 624-8. From National Taiwan University Hospital, Taipei, Taiwan.

Argument for Why This Supports Not Wearing A Mask:
" Seventy percent of the patients showed a reduction in partial pressure of oxygen (PaO2), and 19% developed various degrees of hypoxemia."
Conclusion: Wearing an N95 mask for 4 hours during HD significantly reduced PaO2 and increased respiratory adverse effects in ESRD patients.

Summary of Article:

This article looked at end-stage renal disease (ESRD) patients who came to the hospital for hemodialysis treatment during the SARS outbreak wearing a N95 mask. They studies the physiological impact of wearing a N95 mask during dialysis on ESRD patients. They showed 70% of patients showed a reduction in partial pressure of oxygen (PaO2) and 19% developed various degrees of hypoxemia. They concluded wearing a N95 mask for four hours during dialysis significantly reduced PaO2 and increased respiratory adverse effects in ESRD patients.

Article's Role in Discussion Regarding Mask Use:
This article focused on a single set of patients, with a significant comorbidity, undergoing dialysis, where there are numerous physiologic changes at that time. This article supports the concept that outside of health care workers, the public and patients should not be wearing N95 masks. This does not dissuade the public from wearing cloth masks, in fact, there is no mention nor correlation.

All this article shows is that patients with other medical issues should not wear the restricting N95 masks, which is not currently recommended anyways.

2. Leke J, et al. *Hypertension caused by chronic intermittent hypoxia – influence of chemoreceptors and sympathetic nervous system.* Journal of Hypertension. December 1997. Vol 15, Issue 12, pgs. 1593-1603.

Argument for Why This Supports Not Wearing A Mask:
"Our data imply that repetitive hypoxemia in SAS is probably the cause of the high prevalence of systemic hypertension in this population and that peripheral chemoreceptors and the sympathetic nervous system play important roles in this pathophysiologic process."

Summary of Article:
This study focused on sleep apnea syndrome (SAS) and looked at its 30% prevalence among patients with so-called essential hypertension. Using an animal model, they found that repetitive hypoxemia in SAS is likely the cause of the higher prevalence of systemic hypertension in that population and that peripheral chemoreceptors and the sympathetic nervous system play important roles in this process.

Article's Role in Discussion Regarding Mask Use:
Unsure of the use of this article since it discusses sleep apnea syndrome, at a time when a patient is asleep and unable to protect their airway consciously. My assumption is that there is an attempt to link other articles which discuss potential reduction in oxygen concentration with N95 use, stating it could lead to other health issues. Under any scientific method you cannot connect the issues in that manner. There would need to be a study directly examining N95 mask use and issues with hypoxemia and tissue evaluation to see if the same chemoreceptor changes occur.

Plus, this model was used for 7 hours a day for 30 days on animals. If anything, this article is being used to support the concern for our healthcare workers and has nothing to do with the public wearing masks because the public should not be wearing a N95 mask anyways.

3. Beder A, et al. *Preliminary report on surgical mask induced deoxygenation during major surgery.* Neurocirgía 2008. 19: 121-126. From Bayindir Medical Center, Department of Neurosurgery, Ankara, Turkey.

   Argument for Why This Supports Not Wearing A Mask:
   "Conclusions. Considering our findings, pulse rates of the surgeon's increase and SpO2 decrease after the first hour."

   Summary of Article:
   They evaluated whether a surgeon's oxygen saturation of hemoglobin was affected by the surgical mask or not during major operations. Considering their findings, surgeon pulse rate increased and SpO2 decreased after the first hour. This early change in SpO2 may be either due to the facial mask or operational stress. There may be some clinical value since there is a small decrease in saturation with a larger decrease in PaO2.

   They admit the limitations of this study, as quoted in the last paragraph of the article: "Considering our findings, this is the first clinical investigation reporting a decrease in blood O2 saturation and an increase in pulse rates of the surgeons after the operations due to surgical mask usage. This change in SpO2 may be either due to the facial mask or the operational stress, since similar changes were observed in the group performing surgery without a mask. However, it cannot be decided whether stress plays any role on the late changes, namely pulse rate increase and SpO2 level decrease; since surgeons are not allowed to perform major surgery without a facial mask in most institutions. In order to better elucidate the effects of stress, a randomized control study should have been conducted in a more controlled environment with different sorts of workers from different gender who are or are not used to wearing face masks on (such as anesthesiologists, nurses) also working the same durations. Thus, it is important not to generalize the results of this preliminary study, and further studies involving measurement of gas tensions over time, both from blood and from samples obtained under the mask (in order to show a presumed build-up of CO2 under the mask) have to be carried out to elucidate this issue."

   Article's Role in Discussion Regarding Mask Use:
   The use of this article was to try and show that surgical mask use can lead to deoxygenation. There showed a slight decrease in saturation with a bigger decrease in SpO2. The authors could not conclude as to the exact cause since all surgeons must wear masks during stress, large operations. It leads to an interesting discussion that should be further examined but does not support that people should not wear masks. There is no conclusive evidence that surgical mask use has any effect on oxygenation based on this article. The authors even state this by stating that you cannot generalize the results of their preliminary study and that further studies are needed.

   This article does not provide evidence against the use of the public wearing cloth or surgical masks.

4. Abe H, Semba H, Takeda N. *The Roles of Hypoxia Signaling in the Pathogenesis of Cardiovascular Diseases.* J Atheroscler Thromb 2017 Sep 1; 24(9): 884-894. From The University of Tokyo, Tokyo, Japan.

   Argument for Why This Supports Not Wearing A Mask:
   "The circulatory system distributes blood flow to each tissue and transports oxygen and nutrients. Peripheral circulation is required to maintain the physiological function in each tissue. Disturbance of circulation, therefore, decreases oxygen delivery, leading to tissue hypoxia which takes place in several cardiovascular disorders including atherosclerosis, pulmonary arterial hypertension and heart failure."

   Summary of Article:
   This article meant to summarize and show how decreased circulation, which leads to decrease oxygen delivery, leading to tissue hypoxia which is in several cardiovascular disorders. They focused more that hypoxia signaling can modulate tissues as well. Their conclusion was that hypoxia signaling has a potential to become a therapeutic target in managing cardiovascular remodeling, but that further study is needed to understand its pathological process in more detail.

   Article's Role in Discussion Regarding Mask Use:
   As earlier, this article is used to attempt to show how hypoxia can affect the body. Except that is not what the authors are showing, since they have not mapped out a process, just showed that a factor may influence tissue remodeling. There is no clinical use of this article and has no impact on whether or not a cloth mask should be worn. There is no clinical value of this article because it uses the word "hypoxia."

5. Same article as Article 1 in this section, does not need to be repeated

6. Kyung SY, Jeong SH. *Particulate-Matter Related Respiratory Diseases.* Tuberc Respir Dis (Seoul). 2020 Apr; 83(2): 116-121. From Gachon University, Incheon, Korea.

   Argument for Why This Supports Not Wearing A Mask:
   "However, the use of N95 or KF94 masks can interfere with respiration in patients with chronic respiratory diseases who exhibit low pulmonary function, leading to an increased risk of respiratory failure."

   Summary of Article:
   This article reviewed respiratory diseases associated with particulate matter. In areas of high particulate matter concentration, they recommend wearing a face mask to filter out the particulate matter. They looked at the use of N95 and KF94 masks, but that can interfere with respiration in patients with chronic respiratory distress who show low pulmonary function, leading to an increased risk of respiratory failure.

   Article's Role in Discussion Regarding Mask Use:
   This article continues to support the concept that N95 masks should only be used by health care workers, not by the public and patients, especially those with other medical issues. This continues to support that those advanced masks should not be used by the public but does not address any issues with cloth masks being used by the public.

7. Harber P, et al. *Subjective Response to Respirator Type: Effect of Disease Status and Gender.* J Occup Environ Med. 2010 Feb; 52(2): 150-4. UCLA.

   Argument for Why This Supports Not Wearing A Mask:
   "Results: Half face mask produced more adverse subjective response than the N95 for most scales. There were significant interactions such that disease status modified the effect of respirator type. In general, women reported greater adverse ratings than did men.

   Conclusions: The effect of respirator type depends on disease status. Respirator design evaluation panels should include persons with mild respiratory disease."

   Summary of Article:
   They assess the effect of respiratory type and user characteristics (like health status) on the subjective response to respirator use. This was done in a simulated work environment. Each used a dual cartridge half face mask and a filtering facepiece (N95) respirator. They found that the effect of respiratory type depends on disease status and they suggest when designing respirators, they should include those with mild respiratory diseases.

   Article's Role in Discussion Regarding Mask Use:
   This was not set in the healthcare field but just wearing different types of mask while performing work. Cloth masks were not an option, just the N95 or dual cartridge half face mask. Again, this supports that these more complex masks be reserved for healthcare workers, and the public can use cloth masks. There is no evidence against that here.

Skin Damage

1. Foo CC, et al. *Adverse Skin Reactions to Personal Protective Equipment Against Severe Acute Respiratory Syndrome – A Descriptive Study in Singapore.* Contact Dermatitis. 2006 Nov; 55(5): 291-4. Republic of Singapore.

   Argument for Why This Supports Not Wearing A Mask:
   "The use of PPE is associated with high rates of adverse skin reactions."

   Summary of Article:
   The study provides evidence of high frequency of adverse skin reactions with prolonged PPE use, especially N95 masks and rubber gloves. These reported skin reactions could not be verified and documented; they were solely subjective assessment by the health care staff themselves. They also could not determine the severity just through the self-administered questionnaires. Lays the groundwork for a study but has no strong conclusions due to the lack of validity and confirmation.

   Article's Role in Discussion Regarding Mask Use:
   This is a subjective study that could not be verified. It is not a surprise that prolong wearing of PPE, like N95 and gloves, can have skin reactions. That is why they should be reserved for health care workers, and not the public. There is no data about cloth masks, which is what the public is asked to wear. This study does not support the argument against wearing a cloth mask in public.

2. Lan J, et al. *Skin damage among health care workers managing coronavirus disease – 2019.* Journal of the American Academy of Dermatology. May 2020; Volume 82, Issue 5, Pages 1215-1216.

   Argument for Why This Supports Not Wearing A Mask:
   "The general prevalence rate of skin damage caused by enhanced infection-prevention measures was 97.0% (526 of 542) among first-line health care workers."

   Summary of Article:
   Self-administered questionnaires sent to physicians and nurses from all over China who were involved with treating coronavirus. They focused on condition of skin damage and frequency or duration of several infection-prevention measures.

   To quote the article, "Our study has some limitations. Firstly, we only studied 1 site with a single exposure factor, but some sites could be related to more than 1 factor. The nasal bridge, for example, could be compressed by the N95 mask and goggles simultaneously, although goggles were the main factor. Secondly, possible risk factors such as participants wearing the N95 mask after work in daily life were not included.

   In conclusion, our study demonstrated that the prevalence of skin damage of first-line health care workers was very high. Moreover, we found that longer exposure time was a significant risk factor, which highlights that the working time of first-line staff should be arranged reasonably. Besides, prophylactic dressings could be considered to alleviate the device-related pressure injuries, according to a prior study.[5]"

   Article's Role in Discussion Regarding Mask Use:
   This article focused on wearing complex PPE by health care workers and their reactions. This again, supports the concept that the public should not wear N95 masks, etc. This has no support against the argument to wear a cloth mask by the public.

   In fact, as with an earlier evaluation of an article, this article supports the concept that the public should want to do as much as possible to protect the health care workers by reducing virus transmission so that they are not forced to wear such masks like the N95 to protect themselves. By that logic, this article supports the need to have the public wear cloth masks to help reduce transmission.

3. This article was the same one as the first article in this section.

Headaches

1. Ong JY, et al. *Headaches Associated With Personal Protective Equipment – A Cross-Sectional Study Among Frontline Healthcare Workers During COVID-19.* Headache. 2020 May; 60(5): 864-877. From Singapore.

   Argument for Why This Supports Not Wearing A Mask:

Conclusion: Most healthcare workers develop de novo PPE-associated headaches or exacerbation of their
pre-existing headache disorders.

Summary of Article:
Looking at those healthcare workers who needed to wear N95 masks and protective eyewear while treating COVID-19. All filled out a self-administered questionnaire. Most health care workers developed de novo PPE-associated headaches or exacerbation of their pre-existing headache disorders. They recognize the limitations of their study – sample size, working in a frontline high-risk area and predisposing factors like stress and sleep disturbances play a role. They also did not take into account ambient room temperature and humidity. They also did not take into account the anthropometric factors including head and neck muscle tension.

Article's Role in Discussion Regarding Mask Use:
Just like the previous article, this focused on health care workers wearing PPE and the effect it has on them. The same analysis applies as the article before, that in no way negatively impacts the concept that the public can safely wear cloth masks to help reduce the transmission of COVID-19.

2. Lim ECH, et al. *Headaches and the N95 Face-Mask Amongst Healthcare Providers.* Acta Neurol Scand 2006 Mar; 113(3): 199-202. Singapore.

Argument for Why This Supports Not Wearing A Mask:
"Conclusions: Healthcare providers may develop headaches following the use of the N95 face-mask."

Summary of Article:
During the 2003 SARS outbreak, health care workers were mandated to wear N95 face masks. A survey was administered to healthcare workers to determine risk factors associated with the development of headaches and the impact of them. Their study showed they may develop headaches following N95 face mask use. Shorter duration of use may help reduce frequency and severity of headaches.

This study did have limitations, as per the authors, "Our study has several limitations. As the study was performed amongst healthcare providers based in high-risk areas, the study sample may not have included healthcare providers who had avoided or been excused from working in such areas because of headaches. Factors other than use of the N95 face-mask, such as psychological stress and sleep disturbances, which could have influenced the development of headaches, were not included in this study. Although the study was performed a year following the first-reported case of SARS in our country, recall biases were limited as the respondents were still wearing the N95 face-masks during the study period. Future studies of N95 face-mask-associated headaches should preferably be prospectively designed, with study controls, and should include the assessment of psychological stress and sleep disturbances.

Although the SARS epidemic appears to be contained, and infection control measures have been relaxed in affected countries, the threat of new epidemics such as the avian influenza outbreak in

Vietnam and Thailand (17) remind us of the need for constant vigilance, and make the wearing of personal protective equipment, including close-fitting N95 face-masks, a necessity. This study highlights the relatively high prevalence of headaches with the use of the N95 face-mask amongst healthcare workers working in high-risk areas. Shorter duration of face-mask wear may reduce the frequency and severity of these headaches. Further studies should be performed to confirm this observation and elucidate the mechanisms underlying this association."

Article's Role in Discussion Regarding Mask Use:

The same argument listed above is the one used for this article. This was about hospital workers and N95 facemasks, this has nothing to do with cloth masks and public use.