

# A Framework for Personal Respiratory Ethics

Ian Williams Goddard\*

The Covid-19 pandemic raises the need for an ethical framework addressing unique questions of airborne infectious disease. In particular, are you ethically obliged to wear a face mask? If so, why and when? The Respiratory Ethics Framework (REF) herein derives answers from ethical norms. Always covering coughs and sneezes just in case you might be infectious is an ethical norm. But if you *are* infectious with an airborne illness, you are probably spreading germs even with every breath and vocalization. Therefore, given that respiratory covering should be done to prevent spreading germs, you should wear a mask if you believe you are infectious because it also provides covering while breathing and vocalizing. REF is grounded in the non-harm principle. Why should we avoid spreading infections to others? Because they can cause bodily physical harm and we should act to prevent causing such harm to others without justifiable reason. Under REF, the magnitude of your obligation to mask is proportional to the magnitude of risk you pose to others by way of airborne germs. This functional relationship is logically modeled and visually mapped with a decision matrix in this essay.

## Contemporary Context

As the Covid-19 pandemic swept the globe in 2020, respiratory hygiene became a centerpiece of daily life because the risk of harm from respiratory effluent increased with the novel SARS-2 virus. Given the ethical norm that harming others is impermissible, the ethical significance of respiratory hygiene increased correspondingly. Advocates of respiratory hygiene therefore invoked ethical themes. Appealing to the ethics of personal rights, New York Governor Andrew Cuomo told those who would refuse to wear a face mask, “You don’t have a right to infect me.”<sup>[1]</sup> Invoking ethics of reciprocity and solidarity, a popular slogan asserted, “My mask protects you, your mask protects me.”<sup>[2]</sup> Or as the Oklahoma Department of Health phrased it: “I wear my mask to protect you. Will you wear yours to protect me?”<sup>[3]</sup> In other words, wear a mask or commit the ethical faux pas of failing to reciprocate in kind.

Such ethical appeals were not universally persuasive. Early in 2020 opponents of respiratory hygiene mandates began galvanizing public opinion.<sup>[4-7]</sup> They claimed face masks will not work, despite evidence of their efficacy against the SARS-1 virus many years prior.<sup>[8]</sup> They also claimed that mask mandates are unethical because they violate individual liberty.<sup>[9, 10]</sup> Yet a basic tenant of liberty is that it is not a license to harm others. As the libertarian philosopher John Stuart Mill put it: “the only purpose for which power can be rightly exercised over any member of a civilized community, against his will, is to prevent harm to others.”<sup>[11]</sup> One way to prevent harm to others is to avoid infecting them with harmful pathogens. Public-health ethics likewise recognizes that personal liberty must be balanced against other ethical principles such as *nonmaleficence*,<sup>[12]</sup> especially during a pandemic.<sup>[13]</sup>

---

\* Contact author via ‘iamgoddard’ at yahoo or gmail or via <https://www.researchgate.net/profile/Ian-Goddard>

While appeals to ethics are often invoked in defense of respiratory hygiene, little attention is given to respiratory hygiene ethics in the literature, with some exceptions<sup>[14-18]</sup> but no explicit respiratory ethics framework that this author can find other than an outline written during the 1918 pandemic that we shall examine shortly. More recently, Margaret Battin and colleagues have described a conspicuous absence of ethical frameworks for infectious diseases.

[D]uring the formative period of bioethics, infectious disease played virtually no role. As concern with infectious disease seemed to be waning, interest in bioethics was growing apace; the two never really met, to the disadvantage of bioethics.<sup>[19]</sup>

Battin and colleagues published a bioethics framework for infectious disease that centers on understanding that infectious disease patients are both victims and potential vectors.<sup>[20]</sup> While their framework takes the standpoint of medical professionals treating patients, the personal ethics framework presented herein takes the standpoint of the common person and their ethical obligations to their fellows. The framework herein also centers *airborne* infectious diseases due to unique ethical issues arising from their mitigation. But let us first examine ethical arguments for respiratory hygiene over time to look for signs of a common ethical framework.

### Historic Context

Discovery of the microbial causes of infectious diseases in the late 1800s is among the important achievements in human history because it allowed for the effective mitigation of diseases that had plagued humanity since the dawn of time. Knowing that infectious diseases are caused by microscopic germs carried by water, air and food informed the First Public Health Revolution (1880-1920), which improved human health and lifespan through public sanitation measures such as water treatment, refuse management, food inspection, ventilation standards and the promotion of personal hygiene practices.<sup>[21,22]</sup>

Informed by germ theory, early advocates of public health made ethical appeals that revealed moral foundations for infectious disease mitigation. For example, in the 1890s, physician George Vivian Poore advocated for public sanitation and other measures to control the spread of germs and in so doing appealed to a moral obligation to not endanger the health of others.

It is the duty of each of us to take care that we do not, by apathetic carelessness or culpable ignorance, endanger the health of others, and we must remember that it is no excuse for the adoption of bad and dangerous methods of sanitation to urge that they are 'convenient.' [...] We are individually under a moral obligation to see the refuse of our dwellings safely bestowed, so as not to endanger the health of others. [...] by merely 'passing on' our refuse to be a nuisance elsewhere than on our own premises, we show a forgetfulness of our duty towards our neighbour and we do unto others that which we are unwilling that others should do unto us.<sup>[23]</sup>

Poore appealed to preventing harm to others and to the timeless Golden Rule, do unto others as you would have them do unto you. Poore also advocated for sanitation of the air stating: “our moral responsibilities with regard to the air we breathe are very great. Our first duty is not to foul the air more than we can help, to keep all about us clean and pure.” He therefore advocated for indoor ventilation to reduce concentrations of infectious airborne germs.<sup>[24]</sup>

Over the next decade, Poore’s moral duty to keep the air around oneself clean evolved into specific personal methods of *respiratory hygiene*. During the 1918 influenza pandemic, community use of face masks arose and was even mandated in some U.S. cities to mitigate the airborne transmission of influenza.<sup>[25]</sup> During that pandemic a framework for respiratory hygiene ethics was outlined by physician Donald Armstrong in the following passage.

It was Professor Sedgwick who reduced prevention of typhoid to its simplest expression by saying, that it is merely necessary “to keep the bowel discharges of A out of the mouth of B.” In influenza it is likewise true that prevention will find a most substantial foundation if the oral discharges of A can be kept out of the throat of B. If this is to be done at all, it must be largely through the care taken by the individual in what is termed, “respiratory hygiene.” The responsibility lies with the individual. It is his duty towards his neighbor, on the part of the infected man, to prevent the scattering of his germs among his fellow men; it is his duty to himself on the part of everybody, to guard the portals of entry of his body against the microbes of others.<sup>[26]</sup>

In this passage Armstrong outlines a framework for respiratory ethics centered on individual responsibility and an obligation to prevent infecting others with one’s own germs. He articulates two goals of respiratory hygiene, (1) do not become infected and (2) do not infect others. And he seems to be saying both goals have as their aim the protection of others. The infectious disease ethics of both Poore and Armstrong appeal to the individual and our personal duty to take action so as to prevent becoming vectors of physical harm to others around us.

After the 1918 pandemic, respiratory hygiene became a part of daily life. Public health slogans such as “coughs and sneezes spread diseases” encouraged the use of handkerchiefs.<sup>[27]</sup> Handkerchiefs are face coverings used to cover coughs and sneezes so as to capture outbursts of respiratory effluent and any germs therein before they reach others. Their use to mitigate infectious diseases like the common cold was taught in schools for decades after the pandemic. This vignette of school life in 1935 reveals that the use of handkerchiefs was encouraged by appealing to an ethical duty to avoid harming the health of others.

In a class of girls, one came to school with a very bad cold. Soon the girls near her caught the cold, and as a result a discussion of cold prevention came up in the roll-room meeting. It was found that the first girl had been careless in the use of her handkerchief to cover sneezes and coughs. The roll-room president appointed a committee to see that each girl had a clean handkerchief daily. The discussion also brought out the fact that girls who spread colds when they can prevent doing so are thoughtless and selfish.<sup>[28]</sup>

The admonishment of students who fail to practice respiratory hygiene as thoughtless and selfish invoked an ethical duty to not endanger the health of others and to thus take action to utilize available means to prevent infecting them with your germs, even mere common-cold germs.

These examples make clear that since the dawn of germ theory respiratory hygiene has been grounded in an ethical obligation to take actions to prevent oneself from harming others with one's own germs. The examples also demonstrate that respiratory hygiene is not obligatory due to legal mandate — in fact, no laws require that we cover coughs and sneezes — and respiratory hygiene is not obligatory simply because it became common etiquette. Respiratory hygiene is obligatory because it is unethical to endanger others with the physical harms that infectious respiratory effluent can cause.

Consulting the wisdom of our ancestors we see clear outlines of a framework for respiratory ethics centered on the ethical principles of *nonmaleficence* and the *beneficence* of taking actions for the benefit of others, specifically acting to practice respiratory hygiene in order to prevent oneself from becoming a vector of airborne infectious disease to others.

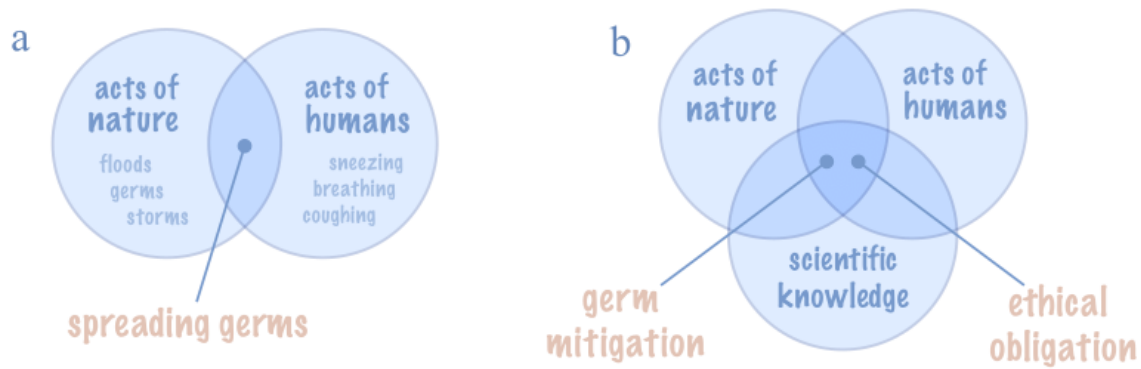
### The Ethical Context of Respiratory Hygiene

While most ethics pertain to interactions between at least two people, respiratory hygiene exists within the context of at least three de facto actors, (1) an infector, (2) an infectee, and (3) an infectious pathogen that infected the infector causing them to act as a vector by way of which the pathogen then additionally infected the infectee. This third-actor factor and the third actor's victimization of the infector absolves unwitting infectors of moral culpability even when people die as a result of pathogens they unwittingly spread. However, the degree of an infector's unwittingness is an important variable in the assessment of their moral culpability. Those who know they are infectious, take no precautions and thereby infect others are morally culpable.

Given the presumed moral innocence of an unwitting infector, the spread of infectious disease is often seen as an *act of nature* rather than an act of humans. However, the 'acts of germs' are inseparable from human actions because germs require our activity to spread, activities we are free to choose to modify so as to prevent spreading them. Therefore, spreading germs lies at the intersection of acts of nature and acts of humans as illustrated in Figure 1a.

The ethics of respiratory hygiene arises in the intersection of acts of nature, acts of humans and scientific knowledge about how germs spread disease, as depicted in Figure 1b. When we discover something that harms people and discover actions we can take to mitigate that harm, we also discover new ethical obligations to take those mitigative actions. So when we discovered that respiratory effluent can harm people and that respiratory hygiene can mitigate that harm, we discovered an ethical duty to practice respiratory hygiene.

Knowledge is morally transformative not only in the broader context of the discovery of germs but also in the narrow context of individuals being personally aware that they might be vectors of



**Figure 1:** (a) Spreading germs exists in the intersection of nature’s and our actions, nature does not act alone to spread germs. (b) Scientific knowledge revealing how our actions spread harmful germs to others brings about an ethical obligation to modify our actions to avoid spreading harmful germs to others.

harmful germs. The moral innocence of someone who is a vector is contingent on the degree of their unwittingness about being a vector. Anyone who knows they can be asymptomatic and also a vector of infectious disease can hardly claim perfect unwittingness even if they feel fine, for they *know* they could nevertheless be a vector of harm to others. Therefore, respiratory hygiene is always obligatory at least in so far as you should adhere to its basics such as covering coughs and sneezes, not spitting in public and wearing a mask during a pandemic.

### A Respiratory Ethics Framework

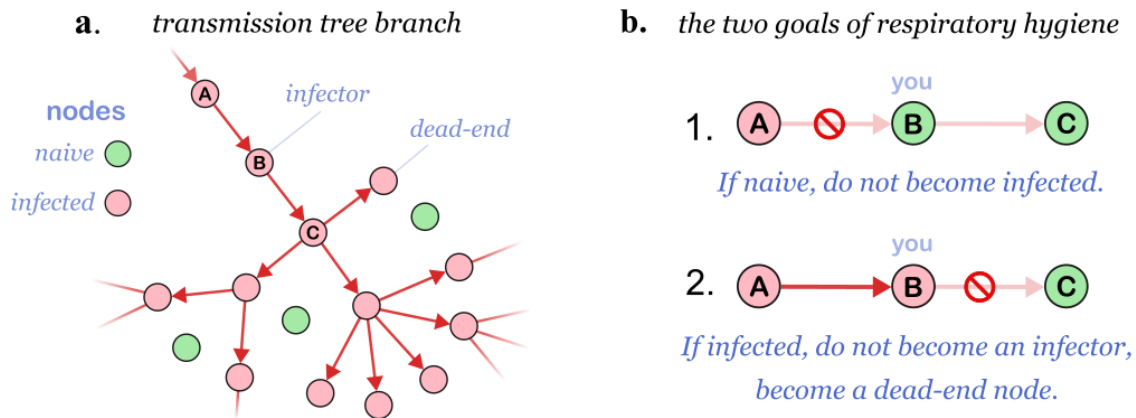
This Respiratory Ethics Framework (REF) can be mnemonically envisioned as an edifice buttressed by four pillars that inform us *what* respiratory hygiene is and *how*, *why* and *when* we should practice it, as depicted in Figure 2.



**Figure 2:** The four columns of this Respiratory Ethics Framework: *what*, *how*, *why* and *when*.

## What is Respiratory Hygiene?

Respiratory hygiene prescribes a set of personally initiated practices intended to reduce the likelihood of transmitting a contagious respiratory infection to others by way of respiratory effluent. Respiratory effluent is composed of droplets of saliva and other secretions and is emitted from the mouth and nose into the air while coughing, sneezing, spitting, vocalizing or breathing. Larger droplets of effluent fall onto surfaces within a few feet while smaller droplets float in the air as aerosols that remain airborne for longer periods of time during which they can travel further distances. Respiratory droplets can spread pathogens enclosed within them when they are inhaled by others or when others touch surfaces upon which they fell. Respiratory hygiene is an effort by individuals to prevent their respiratory effluent from entering the bodies of other people so as to reduce the spread of infectious pathogens between people.



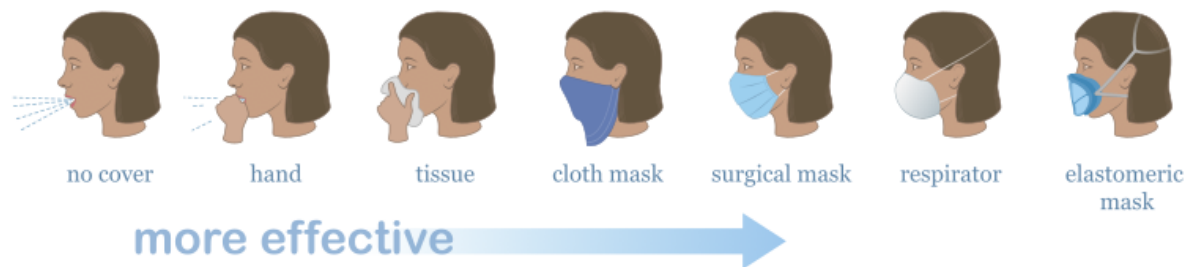
**Figure 3:** (a) This phylogenetic tree branch depicts the transmission paths of an infectious airborne pathogen with red arrows starting from person **A** and spreading to person **C** and others depicted as red dots, or nodes. Green dots are people who were not infected. (b) Here are the two goals of respiratory hygiene per person, first, do not become infected, and second, do not infect others if you are infected.

The spread of contagious respiratory pathogens can be visualized as a phylogenetic transmission tree, as seen in Figure 3a wherein each infected person is a red dot, or node, on a branch of the tree and green dots are people outside the tree who were not infected. Figure 3b illustrates the two goals of respiratory hygiene per person, which is to prevent becoming (1) an *infected node* and/or (2) an *infector node*. Given you could be infected with a respiratory pathogen and not know it, both goals are simultaneously aimed for. For example, even as you avoid close contact with someone who is infected (goal one) at the same time you cover your coughs to protect others from an infection you might unwittingly have (goal two). And even if you are infected with one pathogen (the antecedent condition of goal two), you would simultaneously avoid someone infected with another pathogen (goal one). So both goals can be in play at once.

The passage we previously read from Donald Armstrong, written back in 1919,<sup>[26]</sup> described the same two-phased goals of respiratory hygiene depicted in Figure 3b.

## How is Respiratory Hygiene Implemented?

It is one thing to have the goal of preventing the spread of airborne respiratory pathogens and another to know *how* to achieve that goal. Aside from quarantine, ventilation and vaccination the most effective method of respiratory hygiene is covering your respiratory outlets, mouth and nose, in order to capture and thereby reduce the volume of respiratory effluent you emitted into your external environment. As depicted in Figure 4, there is a spectrum of such face coverings from the least effective on the left to progressively more effective coverings to the right.



**Figure 4:** spectrum of respiratory covering from less (on left) to more effective (on right).

There are two modes of face-covering efficacy, *self-protection* and *source control*, which correspond respectively to the first and second goals of respiratory hygiene (see Fig. 3). Self-protection is achieved by filtration of inhaled air with a mask to block airborne respiratory effluent from others before it is inhaled by the wearer, thereby protecting the wearer. Source control is the capture of infectious respiratory effluent at the source — mouth or nose — before it spreads to others. While covering coughs and sneezes with a hand, elbow or tissue can implement source control, only masking can implement both goals of respiratory hygiene.

Masks primarily capture pathogens by capturing respiratory droplets containing them. Masks can also capture free-floating germs smaller than the gaps between mask fibers by direct interception, Brownian-motion diffusion and electrostatic attraction.<sup>[29]</sup> For over a hundred years masks have been shown in laboratories to filter germs,<sup>[30,31]</sup> and more recently have been shown to filter SARS-2 virions expired by infectious subjects.<sup>[32,33]</sup> While the filtration efficacy of masks is typically imperfect, meta-analyses of studies of mask use in real-world settings favor the likelihood that they reduce the spread of airborne germs,<sup>[34-36]</sup> including the beta-coronaviruses.<sup>[8]</sup> Null results in randomized trials are attributed to the trials being statistically underpowered, so much so they would be unable to detect even a large beneficial effect of masking.<sup>[37]</sup>

By reducing the volume of virus shed by infectors and inhaled by others, masks may reduce both the number of infections and the severity of the infections they fail to prevent.<sup>[38]</sup> Not all exposures to a pathogen produce an infection. The *infective dose* of a virus is the estimated number of virions needed to infect 50% of susceptible individuals. So being exposed to low doses of germs may not lead to an infection. Furthermore, being exposed to larger doses of

germs may lead to more severe disease. A dose-response relation between higher exposure doses and more severe illness has been reported for many infectious diseases including influenza, measles, tuberculosis, streptococcus, HIV, human coronavirus, SARS-1<sup>[39]</sup> and SARS-2.<sup>[40-42]</sup> It has also been reported that filtration of SARS-2 virions with masks reduced both the number and severity of airborne-spread infections in an animal model.<sup>[43]</sup>

While face covering is the most direct method of reducing emission and inhalation of respiratory effluent, respiratory hygiene includes indirect measures such as hand washing, cleaning common surfaces, staying home when sick, opening windows for ventilation, vaccination, etc. A measure of respiratory hygiene is any measure intended and able to reduce interpersonal exposures to infectious respiratory effluent. Given that you could be asymptomatic and infectious, under our normative ethos everyone is always obligated to practice at least minimal respiratory hygiene measures such as covering coughs and sneezes just in case you happen to be infectious.

### Why Should Respiratory Hygiene be Practiced?

The ethical core of REF resides here in its *why* column. This core is an axiomatic model resting upon the non-harm principle, or the *principle of nonmaleficence*. Causing harm to others is not always unethical. For example, causing financial harm to a business by posting truthful negative reviews is not unethical. The primary type of harm respiratory hygiene seeks to mitigate is *bodily physical harm* ranging from mild to catastrophic caused by germs carried in respiratory effluent. Whether by intent or accident, causing bodily physical harm to others is one of the least ethically ambiguous types of harm. It is only permissible in a few circumstances like self-defense and least-harm tradeoffs such as amputating your leg to save your life.

The axiomatic model forming the ethical core of REF is composed of the following two informal stepwise annotated arguments built from an axiom that captures the ethical duty resident in the non-harm principle. Warrant for each step is annotated to its right.

**Argument 1** derives from the negative non-harm principle its implicit positive duty to initiate precautionary actions required to *prevent* causing harm to others in the future.

|  |       |
|--|-------|
| (P1) Do not cause harm to others without justifiable reason.                                     | axiom |
| (C) Take precautions to prevent yourself from causing harm to others without justifiable reason. | by P1 |

The negative duty to not cause harm to others requires that you take *positive* actions to prevent *your* actions from possibly causing harm to others. For example, if you should not harm others, then you should carefully secure a heavy load strapped atop your vehicle to prevent it from tumbling off into traffic and thereby harming others. While often seen as a negative duty, the non-harm principle is a positive duty insofar as it requires that you take actions for the benefit of others, specifically actions to prevent yourself from causing harm to them.



**Argument 2** implements the conclusion of Argument 1 within a factual context that is relevant to the goals of respiratory hygiene.

|   |               |
|---|---------------|
| (P1) Take precautions to prevent yourself from causing harm to others without justifiable reason.                 | by Argument 1 |
| (P2) Being a vector of an infectious disease can cause mild to catastrophic bodily physical harm to others.       | fact          |
| (C) Take precautions to prevent yourself from becoming a vector of infectious disease without justifiable reason. | by P1, P2     |

Probably most people agree with this conclusion because it already resides in consensus ethics. Everyone knows you should try to avoid infecting others, even with the common cold. Anyone who knowingly infects others without warning them is normally seen as morally reprobate. However, where people disagree is over *the lengths* we should go to avoid being a vector. If those lengths are too far, we effectively activate the ‘justifiable reason’ clause, or the *just-cause clause*, which resides in the non-harm principle. So then what is a justifiable reason?

People differ over what constitutes ‘just cause’ to forego respiratory hygiene measures. Some will say a just cause for going to work while sick is being able to pay the rent. Others will say a just cause for not wearing a mask during a pandemic is simply not wanting to. Yet these examples of just cause do not hold for other ways of causing physical harm to others. You cannot justify allowing your actions to cause bodily physical harm to others on the basis that it pays the bills or because you simply do not care. Members of an ethical community are not at liberty to inflict bodily physical harm upon other members for money or convenience.

Nevertheless, we have all used the just-cause clause. For example, should we have worn hazmat suits during the Covid-19 pandemic if doing so would reduce harmful transmissions? Everyone agrees the answer is *no*. Why? Because living in hazmat suits would impose an extreme reduction in the quality of life for everyone, and that is also a type of harm. But suppose a new lethal virus emerges tomorrow and only two people have it. In that context, isolating them and having only the few people in close proximity to them wearing hazmat suits could save millions of lives. So there are thresholds for *when* to activate various measures in the respiratory hygiene toolkit, and the just-cause clause is a dial with which we can scale up and down the range of those tools, fine-tuning our mitigation measures to match various contexts. We shall further refine the context-dependent nature of respiratory ethics in REF’s *when* column.

### When Should Respiratory Hygiene be Implemented?

Under contemporary western ethos, basic measures of respiratory hygiene are *always* obligatory as means to prevent the spread of germs. Covering coughs and sneezes is always at least weakly obligatory. Even if you do not believe you are infectious you should, by common ethos, cover respiratory events just in case you are. Staying home when you have a respiratory infection is also at least weakly obligatory. Since the Covid-19 pandemic the ethos in some eastern countries like Japan has expanded to include wearing a face mask as always at least weakly obligatory even in the absence of mandates.<sup>[44]</sup> In the west, however, masking is almost always not obligatory and the perception of it ever being obligatory is associated with it being obligated by legal mandate rather than by pre-legal natural ethics.

But why should we scale up respiratory covering with hands, elbows or tissues to wearing a face mask? By the non-harm principle, we should improve the efficacy of our respiratory covering when the likelihood that our respiratory effluent could harm others increases. That likelihood increases dramatically when we are actively infectious with an airborne pathogen. Face masks not only capture more respiratory effluent than a hand or elbow,<sup>[45]</sup> unlike a tissue they provide continuous covering so that infectious respiratory effluent emitted while breathing and vocalizing is also captured.<sup>[46]</sup> Therefore, if you believe you are probably infectious, you should scale up your respiratory covering by wearing a mask. This reasoning is organized in Argument 3.

**Argument 3** is an annotated stepwise informal argument that derives from the ethical norm of covering coughs and sneezes an obligation to wear a mask when you are infectious. Herein, ‘you’ refers to anyone, ‘infectious’ regards airborne pathogens and obligations apply to settings where germ transmissions could occur, especially indoor congregate settings.

|  |                       |
|--|-----------------------|
| (P1) To stop germs, cover coughs and sneezes even if you are probably not infectious just in case you are.         | ethical norm          |
| (P2) If you probably <i>are</i> infectious, you are probably shedding the germs with every breath or vocalization. | fact <sup>[46]</sup>  |
| (P3) If you are continuously shedding infectious germs, you should exercise continuous respiratory covering.       | scaling P1 to context |
| (P4) If worn properly, face masks provide continuous respiratory covering even while breathing and vocalizing.     | fact <sup>[33]</sup>  |
| (C) If you probably are infectious, you should wear a mask.  | by P2, P3 and P4      |

The work here occurs in P3 wherein the ethical norm in P1 is scaled up to match a circumstance wherein you are probably spewing harmful germs into other people with any breath or spoken word. Your ethical obligation to mask is a function of your likelihood of being a vector of harm to others. So when that likelihood increases, your ethical obligation does as well. This up-scaling

is recognized across risk domains. For example, to carry a small load on a truck lower gauge straps may be sufficient but a large load may require a higher gauge to prevent the cargo from tumbling off into traffic and harming others. When your risk of causing harm to others increases, your mitigative actions should scale up as required to counter than increase. In short, your obligation to mask is proportional to your likelihood of being infectious.

Therefore, the question of *when* are you ethically obliged to wear a mask can be answered computationally within a model  $REF_M^1$  with a function  $Infectious(x) = y$  that maps a set of degrees of likelihood that you are infectious  $\{no, maybe, yes\}$  into a set of degrees of ethical obligation  $\{none, weak, strong\}$ , such that these outputs answer the question,

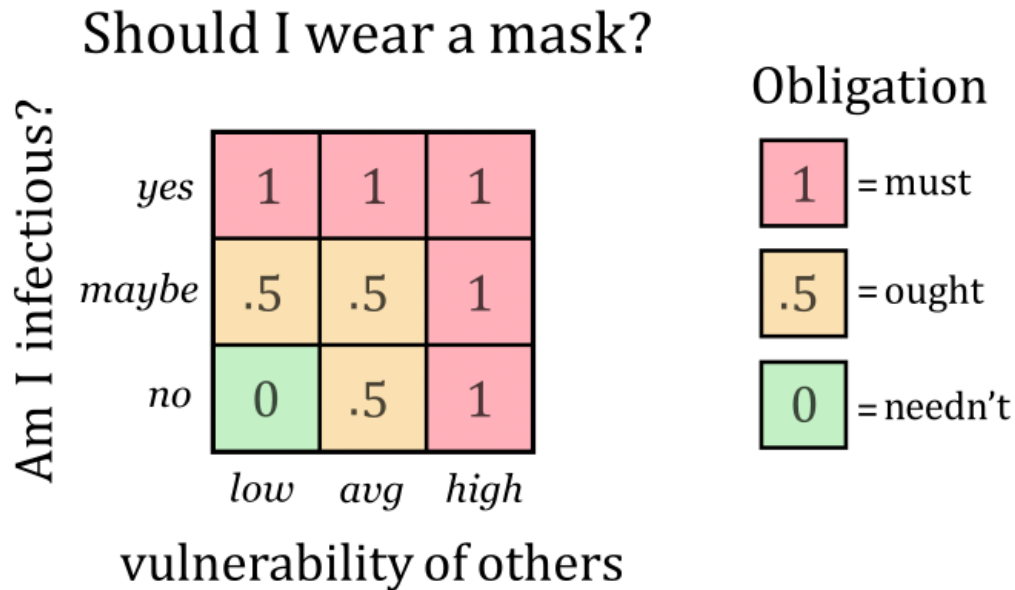
| “Should I wear a mask?”    | Answers                                      |
|----------------------------|--|
| $Infectious(yes) = strong$ | > You <i>must</i> wear a mask.               |
| $Infectious(maybe) = weak$ | > You <i>ought</i> to wear a mask.           |
| $Infectious(no) = none$    | > You are <i>not obliged</i> to wear a mask. |

A higher likelihood of harm to others entails a stronger obligation to mitigate that harm. These degrees of obligation are used in deontic logic and medical ethics<sup>[12,47]</sup> and reflect ethical obligation in natural reasoning and language, which expresses degrees of obligation such as in the answers above. This model,  $REF_M^1$ , is a simple decision model for many circumstance. However, there is another important variable to consider when values for it are known.

### A second ethical variable, *vulnerability*

In addition to your probability of being infectious, another important variable is the *vulnerability* of others to harm from infection. Suppose you believed you are not infectious and you are planning to visit a nursing home whose residents have higher risk of significant harm from infections. In that case you may decide that you should wear a mask to protect them even though by  $REF_M^1$  you are not so obliged. You may reason that the increased vulnerability of the residents increases the likelihood that you could cause serious harm if your belief that you are not infectious happens to be wrong. So erring on the side of non-harm becomes a more ethical decision than disregarding the elevated risk and ending up causing great harm to others.

When your risk of harm to others increases, you should increase your mitigative vigilance to prevent that harm. So the two variables, infectiousness and vulnerability, are calculated in the matrix illustrated in Figure 5, which forms the two-dimensional model  $REF_M^2$ , wherein three degrees of obligation are represented by the three gradient values, 0 for *no* obligation, 0.5 for *weak* obligation and 1 for *strong* obligation. Suitable English terms expressing these degrees of obligation are *must* for 1, *ought* for 0.5 and *needn't* for 0. These obligate values and the values for infectiousness (no, maybe, yes) and vulnerability (low, avg, high) could be subdivided into a spectrum of further sub-values, but for simplicity we reduce those spectra of values to three.



**Figure 5:** This decision matrix coordinates your beliefs about your likelihood of being infectious and the vulnerability of others to answer the question: “Should I wear a mask?” If the intersection of your beliefs is 1, you *must* wear a mask, if it is 0.5, you *ought* to wear a mask but do not have to, and if it is 0, you *need not* wear a mask.

In this matrix, the ‘Am I infectious?’ axis is your estimation of the probability that you are infectious and the ‘vulnerability of others’ axis is your estimation of the vulnerability of others immediately around you to suffering adverse outcomes of infection. The elderly and immune compromised are examples of people who are vulnerable to severe adverse outcomes of infection and thus around whom it is more ethically obligatory to mask. Conversely, a group of healthy young people may be a group you may believe has no vulnerability. However, most groups fall somewhere in between and thus in general you probably you ought to wear a mask, but that weak obligation does not mean you definitely should or must mask. In some Asian countries like Japan, since Covid-19 most people recognize that ‘ought’ for about any group and they act on it by deciding to mask in any public setting even in the absence of any mandate.<sup>[44]</sup>

A REF-derived decision that you must mask when infections does not mean going to work with a mask is preferable to staying home. Staying home when sick is preferable to going to work with a mask. However, these two decisions are not mutually exclusive. Many workers who believe they are probably infectious live with roommates or family members, so even at home they must wear a mask to protect others around them from their infectious respiratory effluent that can pose a viable risk of infection for many hours after being shed. So, by REF, the worker dutifully staying home when sick must wear a mask in their private residence anywhere others may be during a day, unless those others consent to the risks of their going maskless. But even if an infectious person’s family members do so consent, the ethical decision remains to mask nevertheless (if someone tells you they consent to you intentionally inflicting physical injury on

them, the ethical decision remains to act so as to prevent injury to them just as to anyone). The infectious person must wait for their infection to clear to ethically unmask.

The objection might be raised that because the matrix relies on wide variations in personal determinations it is too imprecise such that almost any decision can be reached with it. After all, its term ‘maybe’ is defined on the whims of individuals. However, this flexibility is a feature, not a bug, of common parameters. If everyone shares the common parameter that only self-defense justifies homicide, while some may quibble over what constitutes ‘self-defense’ just as they may quibble over what constitutes ‘maybe’, that is nevertheless preferable to a world with no common parameters. REF is a personal ethics framework and that aims to model the reasoning available to anyone acting in realtime with imperfect knowledge. Most circumstances may be defined by some as falling within the no obligation square while by others as falling outside it. However, they should all agree that an infectious person must wear a face mask in proximity to others. To the extent that REF captures common ethical parameters shared by all or most, REF is a meta-ethical framework used by people who come to widely different conclusions simply because they assign different values for the variables in REF’s computational models.

## Summary & Discussion

Motivated by ethical questions arising from the Covid-19 pandemic, the Respiratory Ethics Framework (REF) presented above addresses the questions of why and when we should wear a face mask for respiratory hygiene. REF builds answers for those questions from assuming the classic non-harm principle as an ethical axiom, which reflects consensus ethics, and deriving therefrom an ethical obligation to practice respiratory hygiene. In Argument 3, based on the ethical norm of covering coughs and sneezes, REF establishes an ethical obligation for anyone to wear a face mask when they believe they are probably infectious. That argument actually clears a low bar because it is obvious that if you are spewing harmful airborne germs into the lungs of others with any breath or vocalization, the only plausible ethical decision is to take immediate action as required to *stop* exposing others. The best way to stop is self-quarantine, in other words, stay home. Where quarantine is imperfect or impossible, masking is the second best method to stop spreading germs to others. Then, with two simple computational models, REF provides context-mapped tools for ethical decision making. REF<sub>M</sub><sup>1</sup> is a one-dimensional model for REF based on your belief about the probability that you are infectious. It is useful when you do not have specific information about those who will be around you. REF<sub>M</sub><sup>2</sup> is a two-dimensional model for REF based your beliefs about your infectiousness and the vulnerability of others around you to adverse outcomes from infection. This model, supplemented with a visual decision matrix, is useful when you have specific information about the vulnerabilities of those you who are expecting to in close proximity to.

Contentious disputes over face masks that arose during the Covid-19 pandemic, as well as during the 1918 influenza pandemic,<sup>[48]</sup> were motivated by opposition to masks being *legally* obligated. Lost in the heat and noise of that battle are more subtle questions about to what extent masks might be *ethically* obligated. Ethical obligation and legal obligation are two different things that

can be decoupled. For example, we are ethically but not legally obliged to cover coughs and sneezes. But spitting in public became illegal in many jurisdictions after its propensity to spread germs was discovered.<sup>[49]</sup> So not spitting in public is a measure of respiratory hygiene<sup>[50]</sup> that is both ethically and legally obligatory. Therefore, measures of respiratory hygiene can be ethically obligatory whether or not they are legally obligatory. REF stands outside the legal debate because it is a personal ethics about your obligations to others under the non-harm principle irrespective of any legal mandates that may or may not be in place. That said, if there is a mask mandate in place and REF guides you to not mask, it is reasonable to err on the side of non-harm and abide by the mandate.

The thoughtful reader has probably noticed REF's *when* column gives no explicit guidance on decision making during a pandemic. REF is intended to be applicable at any time irrespective of pandemics. During a pandemic the honest person increases their values for being infectious and for the vulnerability of others to harm. The risk of being wrong about believing you are not infectious increases during a pandemic. These increased risks entail an ethical obligation to increase the efficacy of respiratory-hygiene measures as required to counter that increase, and masking is about the only next-level up from using hands, elbows or tissue papers for respiratory covering. So REF does implicitly provide guidance for decisions under pandemic conditions. REF's decision matrix provides guidance under a wide range of circumstances.

REF is based on honestly held beliefs that may be concealed. Someone who actually believes they are probably infectious but outwardly denies it to justify taking no mitigative actions around others is behaving unethically despite their professed belief. If their concealment should be uncovered, they are due moral censure. But if they do successfully conceal their true beliefs, they may get away with wrongfully infecting others. Similarly, if someone successfully conceals their connection to a murder they committed, they will get away with that. And someone who believes they are infectious and then infects another who thereby dies could be subject to legal consequences in some jurisdictions,<sup>[51]</sup> with a pivotal factor being whether or not they *believed* they were infectious. Believing that you engaged in actions with a high risk of injury to others is sufficient to transform civil negligence into criminal negligence.<sup>[52,53]</sup> So, while it might seem that an ethics based on one's beliefs is too subjective, ethics and law are very much grounded in what a person believes. Belief and knowledge are morally transformative.

An important question is to what extent masks themselves may cause harm. If masks cause harm we may have reason to change decisions derived from REF's models. The *justifiable reason clause* in REF Arguments 1 and 2 is how decisions from REF<sub>M</sub><sup>1</sup> and REF<sub>M</sub><sup>2</sup> can be modified against other mitigating factors. For example, if masking harms speech and language development among toddlers, as some propose,<sup>[54,55]</sup> then by the non-harm principle we have an ethical obligation to prevent that harm. If that harm is caused by masking and we believe that it outweighs the goals of masking, we would activate REF's justifiable reason clause such that we permit risk of unmitigated disease spread insofar as necessary to protect the development of the youngest humans. This would be an example of a least-harm tradeoff, the application of which

within REF is facilitated by way of the justifiable reason clause, which allows decisions from models  $REF_M^1$  and  $REF_M^2$  to be overridden in light of a least-harm tradeoff.

There are see-through masks on the market that have a clear non-fogging plastic piece through which a wearer's mouth is visible.<sup>[56,57]</sup> So disease control and speech and language development may not be mutually exclusive. See-through masks also allow lip readers to communicate, the impairment of which by opaque masks is an inherent harm of masks. These harms are largely particular to common or universal masking situations. The only certainly of mouths being covered by masks under REF is when people *are infectious*. If the only time mouths are covered (if not by see-through masks) is during a few days when someone believes they are probably infectious, impacts on child development would probably be nil and on lip readers would be negligible compared to during universal masking, which could also be decided under REF if everyone shared the same values for the variables that output an obligation to mask.

Some may object that REF is too permissive against asymptomatic spread. Deciding to not mask based on the belief that you are not infectious is a recipe for failing to prevent asymptomatic spread. While those with asymptomatic SARS-2 infections are probably less infectious,<sup>[58]</sup> asymptomatic spread is believed to have been an important driver of the Covid-19 pandemic.<sup>[59]</sup> These facts give reason for you to believe maybe you are infectious even if you feel fine and thus you ought to mask. So REF does in fact accommodate these considerations regarding asymptomatic spread. However, REF leaves it to individuals to assess what values they will ascribe to the infectiousness and vulnerability variables. Leaving the decision to individuals is the default in the absence of mask mandates. REF offers at least a greater likelihood that more people will decide to mask when they are symptomatic. If only those who are symptomatically infectious chose mask, such pervasive source control would assuredly reduce of the morbidity and mortality inflicted on humanity by airborne infectious diseases.

## References

---

1. New York State. (2020, April 15). Amid Ongoing COVID-19 Pandemic, Governor Cuomo Issues Executive Order Requiring All People in New York to Wear Masks or Face Coverings in Public [speech transcript]. <https://www.governor.ny.gov/news/video-audio-photos-rush-transcript-amid-ongoing-covid-19-pandemic-governor-cuomo-issues-1>
2. Howard, J. (2020, March 28). Simple DIY masks could help flatten the curve. We should all wear them in public. *The Washington Post*. <https://www.washingtonpost.com/outlook/2020/03/28/masks-all-coronavirus/>
3. Oklahoma Department of Health [@healthyoklahoma]. (2020, June 22). *I wear my mask to protect you. Will you wear yours to protect me?* [Tweet]. Twitter. <https://twitter.com/healthyoklahoma/status/1275186989567037440>

4. Maqbool, A. (2020, April 27). Coronavirus: The US resistance to a continued lockdown. *BBC News*. <https://www.bbc.com/news/world-us-canada-52417610>
5. Campbell, J. (2020, May 1). Tucker Carlson’s dangerous claims that social distancing doesn’t work to stop the spread of coronavirus. *Media Matters for America*. <https://www.mediamatters.org/tucker-carlson/tucker-carlsons-dangerous-claims-social-distancing-doesnt-work-stop-spread>
6. Andrey Simonov, Szymon K. Sacher, Jean-Pierre H. Dubé & Shirsho Biswas. (2020) The Persuasive Effect of Fox News: Non-Compliance with Social Distancing During the Covid-19 Pandemic [Working paper]. *NBER*. <https://doi.org/10.3386/w27237>
7. Graham, A., Cullen, F. T., Pickett, J. T., Jonson, C. L., Haner, M., & Sloan, M. M. (2020). Faith in Trump, Moral Foundations, and Social Distancing Defiance during the Coronavirus Pandemic. *Socius*, 6. <https://doi.org/10.1177/2378023120956815>
8. Chu, D. K., Akl, E. A., Duda, S., Solo, K., Yaacoub, S., Schünemann, H. J., & COVID-19 Systematic Urgent Review Group Effort. (2020). 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*, 395(10242), 1973–1987. [https://doi.org/10.1016/S0140-6736\(20\)31142-9](https://doi.org/10.1016/S0140-6736(20)31142-9) [See the SARS subtotal in Figure 2 for statistically significant meta-analytical result for studies of masking against the SARS-1 virus years before SARS-2]
9. Nexstar Media (2020, July 20). AG Jeff Landry sends letter to governor further criticizing Louisiana’s mask mandate. *KLFY 10 News*. <https://www.klfy.com/louisiana/ag-jeff-landry-responds-with-additional-opinion-on-louisianas-mask-mandate/>
10. Aratani, L. (2020). How Did Face Masks Become a Political Issue in America? *Guardian*, June 29. <https://www.theguardian.com/world/2020/jun/29/face-masks-us-politics-coronavirus>
11. Mill, J. S. (1869). *On Liberty*. London : Longmans, Green, Reader, and Dyer, page 22. <https://catalog.hathitrust.org/Record/011603348>
12. Beauchamp, T. L., & Childress, J. F. (2019). *Principles of Biomedical Ethics*. 8th ed. Oxford University Press. <https://global.oup.com/ushe/product/principles-of-biomedical-ethics-9780190640873>
13. Aliyu, A. A. (2021). Public health ethics and the COVID-19 pandemic. *Annals of African Medicine*, 20(3), 157–163. [https://doi.org/10.4103/aam.aam\\_80\\_20](https://doi.org/10.4103/aam.aam_80_20)
14. Miller, F. G. (2021). Liberty and Protection of Society During a Pandemic: Revisiting John Stuart Mill. *Perspectives in Biology and Medicine*, 64(2), 200-210. <https://doi.org/10.1353/pbm.2021.0016>



15. Chen, H., Yu, L., & Huang, L. T. (2021). To Mask or Not to Mask. *Techné: Research in Philosophy and Technology*, 25(3), 503-512. <https://philarchive.org/rec/CHETMO-22>
16. Granath, A. A. (2021, April). *Face masks during covid-19*. PhilArchive. <https://philarchive.org/rec/GRAFMD>
17. Kowalik, M. (2021, May). *An ontological argument against mandatory face-masks*. PhilArchive. <https://philarchive.org/rec/KOWAHC>
18. Park, Wesley J. (2022). Relaxing Mask Mandates in New Jersey: A Tale of Two Universities. *Voices in Bioethics* 8. <https://philarchive.org/rec/PARRMM-2>
19. Battin, M. P., Francis, L.P., Jacobson, J. A., & Smith, C. .B. (2021). *The Patient as Victim and Vector: Ethics and Infectious Disease*. Oxford University Press. <http://dx.doi.org/10.1093/acprof:oso/9780195335842.001.0001>
20. Francis, L. P., Battin, M. P., Jacobson, J. A., Smith, C. B., & Botkin, J. (2005). How infectious diseases got left out--and what this omission might have meant for bioethics. *Bioethics*, 19(4), 307–322. <https://doi.org/10.1111/j.1467-8519.2005.00445.x>
21. Ninde, C. (2017). 200 years of public health has doubled our life expectancy. San Juan Basin Public Health. <https://sjbpublichealth.org/200-years-public-health-doubled-life-expectancy/> [ date cited @ <https://sjbpublichealth.org/category/national-public-health-week> ]
22. Billings, J. S. (1884). *The principles of ventilation and heating, and their practical application*. The Sanitary Engineer. <https://catalog.hathitrust.org/Record/012309711>
23. Poore, G. V. (1893). *Essays on rural hygiene*. Longmans, Green & Co., pages 6, 9. <https://catalog.hathitrust.org/Record/009261219>
24. Ibid, pages 152-3.
25. Adkins, A. (2020, August 19) Virginia Tech historians uncover the facts about masks. Virginia Tech College of Liberal Arts and Human Sciences, News and Features. <https://liberalarts.vt.edu/news/articles/2020/08/virginia-tech-historians-uncover-the-facts-about-masks.html>
26. Armstrong, D. B. (1919). Public health depends on you and me. *American Journal of Public Health*, 9(2), 127–127. <https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.9.2.127>
27. Framingham (Mass.) Community health station. (1920). *Health letters*. National Tuberculosis Association. <https://catalog.hathitrust.org/Record/100761646>

28. Seattle Public Schools. (1935). *Successful living*. Seattle Public Schools, page 111. <https://catalog.hathitrust.org/Record/001449723>
29. Ju, J., Boisvert, L. N., & Zuo, Y. Y. (2021). Face masks against COVID-19: Standards, efficacy, testing and decontamination methods. *Advances in Colloid and Interface Science*, 292, 102435. <https://doi.org/10.1016/j.cis.2021.102435>
30. Doust, B. C., & Lyon, A. B. (1918). Face Masks in Infections of the Respiratory Tract. *JAMA*, 71, 1216-19. <https://quod.lib.umich.edu/f/flu/7350flu.0016.537/1/>
31. Jones, M. A., Johnson, J. C., French, M. L., Hart, J. B., & Ritter, M. A. (1972). Unidirectional air flow and surgical face mask exhaust system in the prevention of airborne surgical infection. *American Journal of Surgery*, 124(1), 49-51. [https://doi.org/10.1016/0002-9610\(72\)90165-1](https://doi.org/10.1016/0002-9610(72)90165-1)
32. Ueki, H., Furusawa, Y., Iwatsuki-Horimoto, K., Imai, M., Kabata, H., Nishimura, H., & Kawaoka, Y. (2020). Effectiveness of Face Masks in Preventing Airborne Transmission of SARS-CoV-2. *mSphere*, 5(5), e00637-20. <https://doi.org/10.1128/mSphere.00637-20>
33. Adenaiye, O. O., Lai, J., Bueno de Mesquita, P. J., Hong, F., Youssefi, S., German, J., Tai, S., Albert, B., Schanz, M., Weston, S., Hang, J., Fung, C., Chung, H. K., Coleman, K. K., Sapoval, N., Treangen, T., Berry, I. M., Mullins, K., Frieman, M., Ma, T., ... Milton, D. K. (2022). Infectious Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in Exhaled Aerosols and Efficacy of Masks During Early Mild Infection. *Clinical Infectious Diseases*, 75(1), e241–e248. <https://doi.org/10.1093/cid/ciab797>
34. Chen, Y., Wang, Y., Quan, N., Yang, J., & Wu, Y. (2022). Associations Between Wearing Masks and Respiratory Viral Infections: A Meta-Analysis and Systematic Review. *Frontiers in Public Health*, 10, 874693. <https://doi.org/10.3389/fpubh.2022.874693>
35. Li, H., Yuan, K., Sun, Y. K., Zheng, Y. B., Xu, Y. Y., Su, S. Z., Zhang, Y. X., Zhong, Y., Wang, Y. J., Tian, S. S., Gong, Y. M., Fan, T. T., Lin, X., Gobat, N., Wong, S., Chan, E., Yan, W., Sun, S. W., Ran, M. S., Bao, Y. P., ... Lu, L. (2022). Efficacy and practice of facemask use in general population: a systematic review and meta-analysis. *Translational Psychiatry*, 12(1), 49. <https://doi.org/10.1038/s41398-022-01814-3>
36. Li, Y., Liang, M., Gao, L., Ayaz Ahmed, M., Uy, J. P., Cheng, C., Zhou, Q., & Sun, C. (2021). Face masks to prevent transmission of COVID-19: A systematic review and meta-analysis. *American Journal of Infection Control*, 49(7), 900–906. <https://doi.org/10.1016/j.ajic.2020.12.007>

37. Kollepara, P. K., Siegenfeld, A. F., Taleb, N. N., & Bar-Yam, Y. (2021). Unmasking the mask studies: why the effectiveness of surgical masks in preventing respiratory infections has been underestimated. *Journal of Travel Medicine*, 28(7), taab144. <https://doi.org/10.1093/jtm/taab144>
38. Spinelli, M. A., Glidden, D. V., Gennatas, E. D., Bielecki, M., Beyrer, C., Rutherford, G., Chambers, H., Goosby, E., & Gandhi, M. (2021). Importance of non-pharmaceutical interventions in lowering the viral inoculum to reduce susceptibility to infection by SARS-CoV-2 and potentially disease severity. *The Lancet. Infectious Diseases*, 21(9), e296–e301. [https://doi.org/10.1016/S1473-3099\(20\)30982-8](https://doi.org/10.1016/S1473-3099(20)30982-8)
39. Van Damme, W., Dahake, R., van de Pas, R., Vanham, G., & Assefa, Y. (2021). COVID-19: Does the infectious inoculum dose-response relationship contribute to understanding heterogeneity in disease severity and transmission dynamics?. *Medical Hypotheses*, 146, 110431. <https://doi.org/10.1016/j.mehy.2020.110431>
40. Guallar, M. P., Meiriño, R., Donat-Vargas, C., Corral, O., Jouvé, N., & Soriano, V. (2020). Inoculum at the time of SARS-CoV-2 exposure and risk of disease severity. *International Journal of Infectious Diseases*, 97, 290–292. <https://doi.org/10.1016/j.ijid.2020.06.035>
41. Dabisch, P. A., Biryukov, J., Beck, K., Boydston, J. A., Sanjak, J. S., Herzog, A., Green, B., Williams, G., Yeager, J., Bohannon, J. K., Holland, B., Miller, D., Reese, A. L., Freeburger, D., Miller, S., Jenkins, T., Rippeon, S., Miller, J., Clarke, D., Manan, E., ... Hevey, M. (2021). Seroconversion and fever are dose-dependent in a nonhuman primate model of inhalational COVID-19. *PLoS Pathogens*, 17(8), e1009865. <https://doi.org/10.1371/journal.ppat.1009865>
42. Guallar, M. P., Meiriño, R., Donat-Vargas, C., Corral, O., Jouvé, N., & Soriano, V. (2020). Inoculum at the time of SARS-CoV-2 exposure and risk of disease severity. *International Journal of Infectious Diseases*, 97, 290–292. <https://doi.org/10.1016/j.ijid.2020.06.035>
43. Chan, J. F., et al. (2020). Surgical Mask Partition Reduces the Risk of Noncontact Transmission in a Golden Syrian Hamster Model for Coronavirus Disease 2019 (COVID-19). *Clinical Infectious Diseases*, 71(16), 2139–2149. <https://doi.org/10.1093/cid/ciaa644>
44. Motoko, R., & Ben Dooley (2022, July 2). Japan's Secret to Taming the Coronavirus: Peer Pressure. *The New York Times*. <https://www.nytimes.com/2022/07/02/world/asia/japan-covid.html>
45. Wood, M. E., Stockwell, R. E., Johnson, G. R., Ramsay, K. A., Sherrard, L. J., Jabbour, N., Ballard, E., O'Rourke, P., Kidd, T. J., Wainwright, C. E., Knibbs, L. D., Sly, P. D., Morawska, L., & Bell, S. C. (2018). Face Masks and Cough Etiquette Reduce the Cough Aerosol Concentration of *Pseudomonas aeruginosa* in People with Cystic Fibrosis. *American Journal of Respiratory and Critical Care Medicine*, 197(3), 348–355. <https://doi.org/10.1164/rccm.201707-1457OC>

46. Coleman, K. K., Tay, D., Tan, K. S., Ong, S., Than, T. S., Koh, M. H., Chin, Y. Q., Nasir, H., Mak, T. M., Chu, J., Milton, D. K., Chow, V., Tambyah, P. A., Chen, M., & Tham, K. W. (2022). Viral Load of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in Respiratory Aerosols Emitted by Patients With Coronavirus Disease 2019 (COVID-19) While Breathing, Talking, and Singing. *Clinical Infectious Diseases*, 74(10), 1722–1728. <https://doi.org/10.1093/cid/ciab691>
47. Young M, Wagner A. Medical Ethics. (2022 Jan, updated Sep). In: StatPearls. Treasure Island (FL): StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK535361/>
48. Wikipedia contributors. (2022, October 7). Anti-Mask League of San Francisco. In *Wikipedia, The Free Encyclopedia*. [https://en.wikipedia.org/w/index.php?title=Anti-Mask\\_League\\_of\\_San\\_Francisco&oldid=1114712515](https://en.wikipedia.org/w/index.php?title=Anti-Mask_League_of_San_Francisco&oldid=1114712515)
49. Tenement Museum. (2020, August 12). A long battle against public spitting: New York City’s 1896 anti-expectoration law. <https://www.tenement.org/blog/a-long-battle-against-public-spitting/>
50. Fall River, MA. (1918). Annual Report of the Board of Health, p. 41. <https://catalog.hathitrust.org/Record/100565924>
51. Quirk, H., & Stanton, C. (2016). Disease Transmission and the Criminal Law: A Growing Concern? In C. Stanton & H. Quirk (Eds.), *Criminalising Contagion: Legal and Ethical Challenges of Disease Transmission and the Criminal Law* (Cambridge Bioethics and Law, pp. 1-17). Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9781316135631.002>
52. Shouse California Law Group. Criminal Negligence – Definition, Application & Defenses. Accessed Nov 6, 2022 <https://www.shouselaw.com/ca/defense/laws/criminal-negligence/>
53. United States v. Simmons. 917 F.3d 312 (U.S. 4th Cir. 2019). <https://casetext.com/case/united-states-v-simmons-232>
54. Charney, S. A., Camarata, S. M., Chern, A. (2021). Potential Impact of the COVID-19 Pandemic on Communication and Language Skills in Children. *Otolaryngology–Head and Neck Surgery*, 165(1):1-2. <https://doi.org/10.1177/0194599820978247>
55. D. J., Lewkowicz (2021, Feb 11). Masks Can be Detrimental to Babies’ Speech and Language Development [Opinion]. *Scientific American*. <https://www.scientificamerican.com/article/masks-can-be-detrimental-to-babies-speech-and-language-development1/>

56. Coyne, M. (2020, Apr 4). This see-through mask lets the deaf communicate while staying safe. *Forbes* [Online]. <https://www.forbes.com/sites/marleycoyne/2020/04/04/this-see-through-mask-lets-the-deaf-communicate-while-staying-safe/?sh=50e43dd15257>
57. Black, J. (2020, Oct 28). See-through masks help communication. *Duke Today*. <https://today.duke.edu/2020/10/see-through-face-masks-help-communication>
58. Sayampanathan, A. A., Heng, C. S., Pin, P. H., Pang, J., Leong, T. Y., & Lee, V. J. (2021). Infectivity of asymptomatic versus symptomatic COVID-19. *Lancet*, 397(10269), 93–94. [https://doi.org/10.1016/S0140-6736\(20\)32651-9](https://doi.org/10.1016/S0140-6736(20)32651-9)
59. Li, R., Pei, S., Chen, B., Song, Y., Zhang, T., Yang, W., & Shaman, J. (2020). Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). *Science*, 368(6490), 489–493. <https://doi.org/10.1126/science.abb3221>