A Framework for Personal Respiratory Ethics

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ABSTRACT

The Covid-19 pandemic raises the need for an ethical framework that addresses the unique ethical challenges and questions arising from airborne infectious diseases. For example, are we ever ethically obliged to wear a face mask? If so, why and when? The Respiratory Ethics Framework (REF) herein proposes pathways to answers grounded in ethical norms and the moral principles of non-harm, beneficence and respect for personal autonomy. REF is a personal ethics wherein your ethical duty to increase your respiratory hygiene efforts—such as by donning a mask—is proportional to your estimation of an increase in the likelihood that your respiratory effluent poses a risk of harmful infection to others. REF includes illustrated decision models that instantiate a framework of proportionality between levels of risk, ethical duty and mitigation that shapes risk mitigation across domains.

Keywords: Computational Ethics; Respiratory Hygiene; Risk Mitigation; Decision Making

INTRODUCTION

As the Covid-19 pandemic swept the globe in 2020, respiratory hygiene became a focus of daily life because the risk of harm from respiratory effluent increased due to the novel SARS-CoV-2 virus and its airborne transmission (Wang et al, 2021). Given that increased risk of harm, advocates of mitigation efforts often 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" (New York State, 2020). Invoking ethics of reciprocity, the Oklahoma Department of Health asked: "I wear my mask to protect you. Will you wear yours to protect me?" (Oklahoma Department of Health, 2020).

While appeals to ethics were invoked to defend improved respiratory hygiene, the ethics of respiratory hygiene has received little attention in the literature. While there are exceptions (Armstrong, 1919; Chen et al, 2021; Granath, 2021; Kowalik, 2021; Miller, 2021; Akabayashi, 2022; Park, 2022), there may be no formal ethical framework for respiratory hygiene. That may be due to a general neglect of infectious disease in the fields of ethics that Battin and colleagues (2021) have examined in detail, noting: "during 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."

Battin and colleagues published the first ethical framework for infectious disease, which is centered on understanding that infectious disease patients are both victims and potential vectors (Francis et al, 2005). While their framework takes the standpoint of medical professionals treating patients, the standpoint of the framework in this essay is that of the common person and our moral obligations to our fellows. This framework is also uniquely about *airborne* infectious disease. Grounded in pre-legal natural morality, this framework invokes no institutional policy, mandate or enforcement and is not contingent upon the existence of any public health authority.

A Respiratory Ethics Framework

Respiratory hygiene is an effort among individuals to prevent the transmission of infectious pathogens between them by way of respiratory effluent that is routinely emitted into the air with breathing, vocalizing, coughing and sneezing (Pöhlker et al, 2021; Stadnytskyi et al 2021; Coleman et al, 2022). Infectious respiratory effluent can linger in the air for hours and fallout onto surfaces (United States Environmental Protection Agency, 2022). Measures of respiratory hygiene include hand washing, cough etiquette, masking, social distancing, ventilation, staying home when sick and vaccination. A measure of respiratory hygiene is any measure that aims to reduce interpersonal exposures to infectious respiratory effluent.

Why Should We Practice Respiratory Hygiene?

Respiratory hygiene aims to prevent the transmission of germs between people because spreading an infectious respiratory illness can cause people to suffer bodily physical harms and secondary harms such as taking sick leave and incurring medical costs. If you are infectious with an airborne pathogen and spread your infection to even one other person, they could in turn infect others who infect others and so forth, ultimately infecting tens, hundreds or thousands and causing untold instances and magnitudes of harms among them. Anyone who, while knowing this, fails to act to prevent spreading a contagious infection they believe they have is morally blameworthy for any such consequent harms to others. They reveal that they have little regard for the health and welfare of others. Conversely, if they do take precautions to protect others when they believe they are infectious, their actions are morally praiseworthy.

Argument 1 is an informal argument that, from the non-harm principle in premise 1 (P1), derives a duty to act as required to *prevent* causing harm to others in conclusion 1 (C1). Then, within a factual context relevant to respiratory hygiene in P2, a duty to prevent oneself from spreading infectious disease to others without justifiable reason is derived in C2.

(P1) Do not cause harm to others without justifiable reason.	axiom
(C1) Take precautions to prevent yourself from causing harm to others without justifiable reason.	by P1
(P2) Being a vector of an infectious pathogen can cause mild to catastrophic bodily physical harm to others.	fact
(C2) Take precautions to prevent yourself from becoming a vector of infectious pathogens without justifiable reason.	by C1, P2

The negative duty to not cause harm to others requires that you take positive actions to *prevent your actions* from causing harm to others. While usually 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 protect them from risks *you* may pose to them. So REF's ethical core is grounded in the moral principles of nonmaleficence and beneficence, and as we shall see, its implementation additionally rests on the moral principle of respect for autonomy (Beauchamp & Childress, 2019).

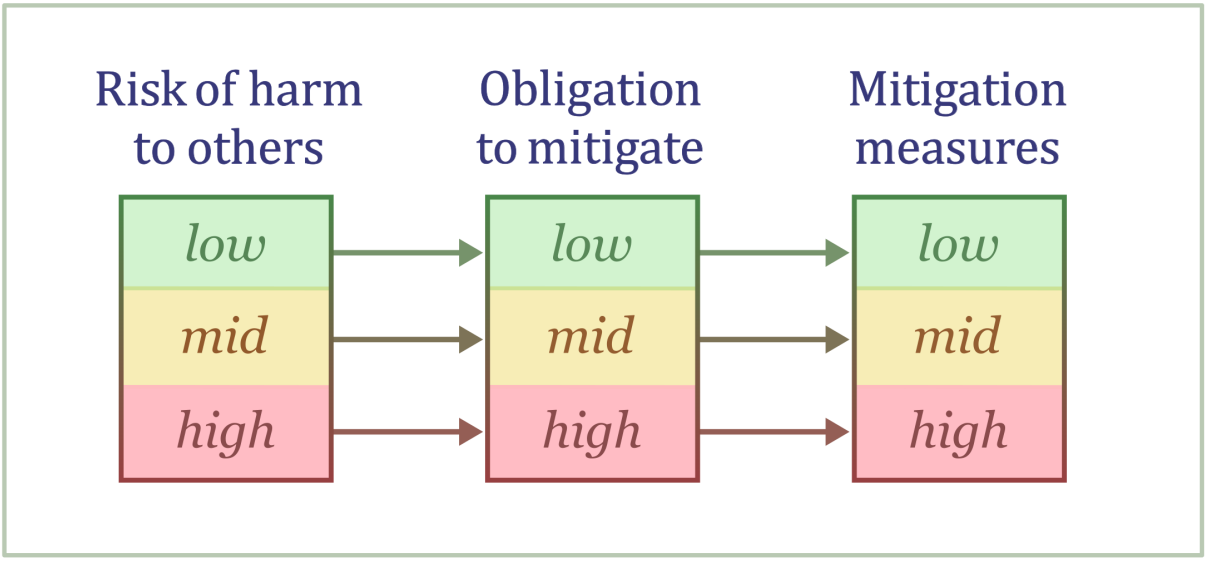

Figure 1: Increasing risk of harm to others (left) entails increasing ethical obligation to mitigate that increased risk (center), which in turn entails increasing the efficacy of the measures used to mitigate the increased obligation and risk (right). Across domains of risk, higher risks are mitigated with stronger measures revealing an intuitive commonsense ethical principle of risk-mitigation proportionality.

When Should We Practice Measures of Respiratory Hygiene?

Across risk domains we find a principle of proportionality between risk and duty such that as a risk of harm to others increases, a duty to mitigate that risk increases in proportion. For example, given an ethical duty of public officials to protect the public, low-, moderate- and high-risk prisoners are held in minimum, medium or maximum security prisons respectively. On an individual level, if you do not possess a firearm, you have no duty to prevent harm to others with a firearm. But if you acquire a firearm, both a risk of harm to others and an ethical duty for you to prevent that harm arise simultaneously. If you also have kids in your home, an even higher risk of harm arises and thus a stronger ethical duty arises to ensure the firearm is safely stored. As risk of harm to others increases an ethical duty to mitigate that risk increases in proportion.

Additionally, across risk domains, an increased ethical duty to mitigate increased risk requires increasing the efficacy of the mitigative measures applied thereto to prevent the possible harmful outcome(s). Therefore, high-risk prisoners are held in fortified prisons and if you have kids you should purchase a strong safe to store firearms. Higher-risk scenarios call for more effective mitigation measures. This proportional relation between levels of risk, ethical obligation and mitigation measures is depicted in Figure 1.[1]

Just as with other risks of harm, when the likelihood of being infectious with a respiratory illness increases, mitigative duties and measures should increase in proportion. And that is the case. Two measures of respiratory hygiene are ethical norms: (1) *cough etiquette* practiced at any time and (2) staying home when sick. Cough etiquette is a *source control* measure because it blocks germs at the source, the mouth, while staying home is a *quarantine* measure. Low-risk conditions are thus routinely

[1]Mathematically, the proportionality framework in Figure 1 is a composite function of two identity functions $f \circ g$ on the set of gradient values V = {*low*, *mid*, *high*}, such that for all $x \in V$, $(f \circ g)(x) = f(g(x)) = g(x) = x$.

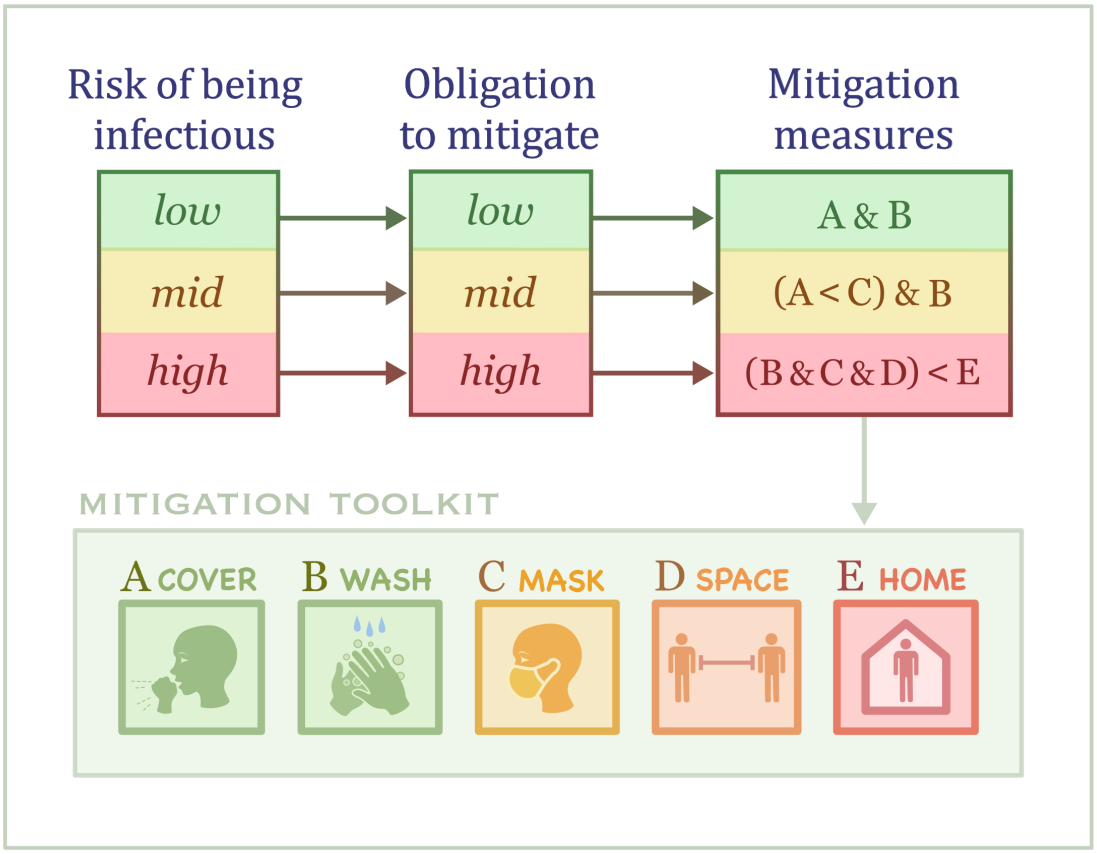

Figure 2: the abstract model in Figure 1 instantiated here into the domain of respiratory hygiene with a mitigation protocol in the right column that is linked to a toolkit of basic personal mitigation measures. REF protocols can be tweaked and more tools can be included. The given protocol seems reasonable with this toolkit. The meaning of the < operator is such that $x < y$ means: x and/or preferably y.

mitigated with a simple but low efficacy measure — covering coughs and sneezes with hand, arm or tissue — and the high-risk condition of being sick and thus probably infectious is mitigated with the costly but highly effective measure of self-quarantine.

We can therefore see that the same principle of proportionality found across domains of risk also undergirds respiratory hygiene. This is illustrated in Figure 2 wherein the abstract framework in Figure 1 is instantiated into the domain of respiratory hygiene with a mitigation protocol in the right-hand column linked to a toolkit that includes (A) cough etiquette, (B) hand washing, (C) masking, (D) social distancing and (E) staying home. Under the protocol, as risk of harm to others rises, increasingly efficacious measures and combinations of measures are deployed such that their composite efficacy magnifies their individual efficacy. Such layered mitigation implements the Swiss cheese model of hazard prevention (Perneger, 2005; Hey, 2020).

In Figure 3 the proportionality framework is extended to model more complex decisions with three two-variable decision matrices and a more gradient protocol. The given mitigation protocols in Figures 2 and 3 may be tweaked and can include other measures such as ventilation and vaccination. For brevity the toolkit here is reduced to immediate personal measures typically at one's disposal. In contrast, you may not be able to improve the ventilation in many indoor settings and there are not vaccines for all

infectious respiratory illnesses. Most broadly, REF encompasses any decision model wherein increasing risk of infecting others with a contagious respiratory illness incurs increasing ethical obligation to increase one's mitigative efforts against that risk. The protocols given in the models above I believe are reasonable instances thereof and a key transitional feature of them, masking, shall now be defended.

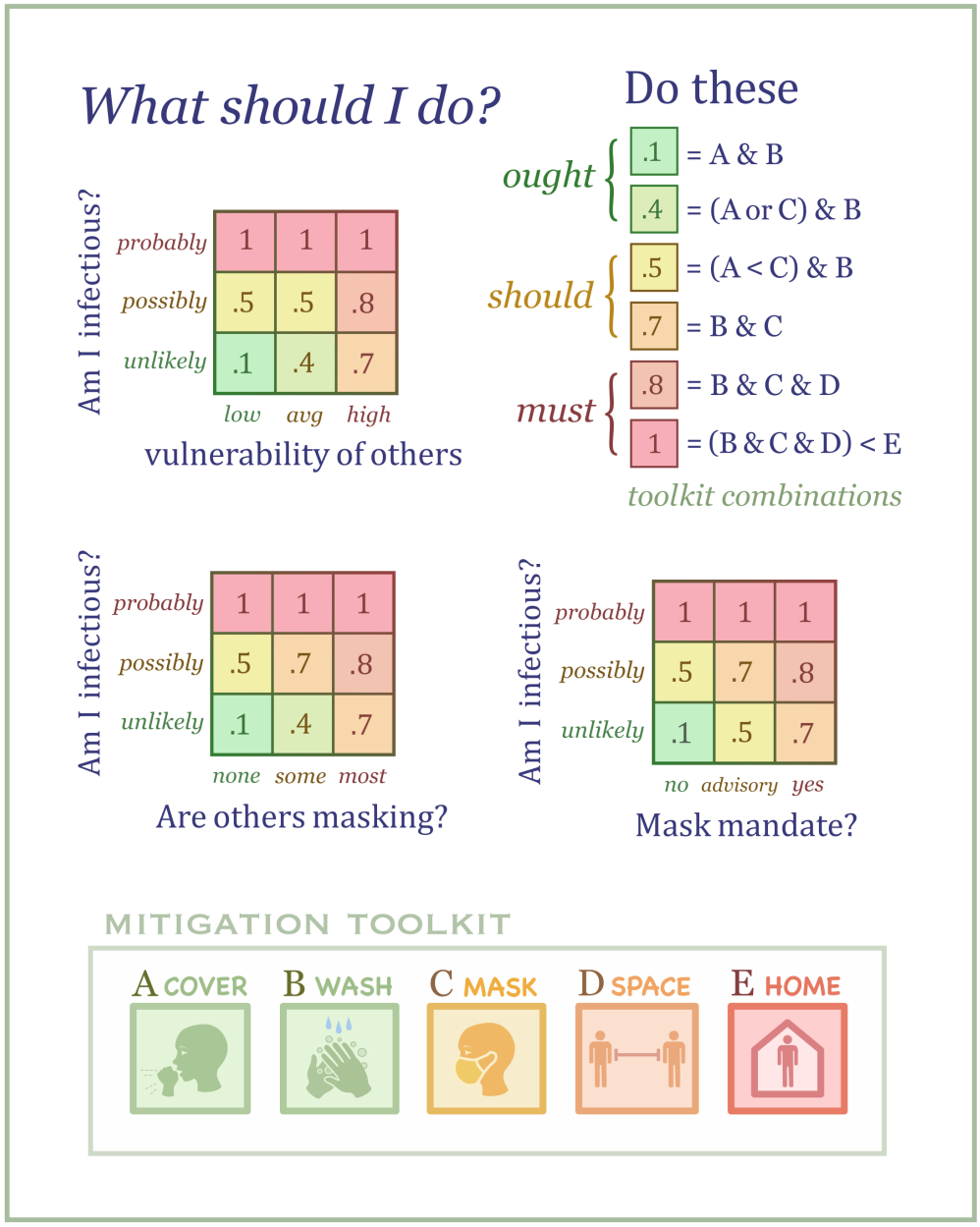

Figure 3 extends the decision model in Figure 2 to provide ethical answers for twenty-seven two-variable contexts. The first model considers the vulnerability of others. The second considers the preponderance of others masking as a gauge of *common consent* for or against unmitigated spread of respiratory effluent into a shared breathing space. The third considers whether mask mandates are in effect, which does not call for mandates but simply maps the interface of REF and mask mandates.

A Case for Masking When Infectious

Masking is one of several tools in the respiratory hygiene toolkit depicted above. Prior to the Covid-19 pandemic, masking while infectious to protect others—known *source control*—was not an ethical norm in western nations, and may still not be. However, even before the pandemic source-control masking was recommended in healthcare settings by agencies such as the United States Occupational Safety and Health Administration (2009), the United States Centers for Disease Control and Prevention (2009), and the World Health Organization (2007). While source-control masking is thereby a quasi-norm in the west, outside of healthcare settings is not a norm in most countries. Therefore, it is worth justifying its inclusion in the toolkit.

Table 1. Studies of face masks used by infectees for source control, not for self-protection

Study	Type	Measured	Results
Adenaiye et al, 2022	Lab	Emission of SARS-CoV-2 from respiratory effluent of infected people masked and unmasked.	48% and 77% reductions of virus from fine and course aerosols respectively when infectees wore a cloth or surgical mask compared to being unmasked.
Leung et al, 2020	Lab	Emissions of human coronavirus, influenza or rhinovirus from respiratory effluent of infected people masked and unmasked.	100% reduction of detectable human coronavirus, significant-to-modest reduction of influenza and modest reduction of rhinovirus from infectees wearing a surgical mask vs no mask.
Wood et al, 2018	Lab	Emission of *P. aeruginosa* from respiratory effluent of infected people coughing while covering with a mask or hand or not covering.	94% reduction of *P. aeruginosa* from coughing infectees wearing a surgical or N95 mask and 53% reduction by hand covering versus uncovered coughing.
MacIntyre et al, 2016	RCT	Risk of infection among household contacts of people with ILI* recruited within 24 hrs of symptoms and then assigned to mask or not.	Per-protocol analysis: 78% reduction in risk of clinical respiratory illness among household contacts of ILI cases who masked versus those that did not mask.
Canini et al, 2010	RCT	Risk of infection among household contacts of people with influenza recruited within 48 hrs of symptoms and then assigned to mask or not.	No difference. However, this study was terminated early, thus: "the lack of statistical power prevents us to draw a formal conclusion…face masks could nevertheless have a substantial effect."
Johnson et al, 2009	Lab	Emission of influenza virus from respiratory effluent of infected people masked and unmasked.	100% reduction of detectable influenza from respiratory effluent of infectees wearing surgical or N95 mask compared to being unasked.

To evaluate masking for *source control*, this table collects studies of masking by actively infectious people. Studies where uninfected people were masked, where the wearer was simulated by mechanical devices, or where endogenous flora were used as proxies for exogenous infectious germs are excluded. This evidence-base extraction most closely resembles the physical circumstances wherein an infectious person is making ethical decisions about how they can best protect other people from catching their infection. * ILI means influenza-like illness.

Masks are a tool of applied ethics insofar as they help a wearer reduce the risk of harm they pose to others. The primary way masks can provide that ethical utility is by source control, which is their ability to capture germ-laden respiratory effluent before it reaches others. Therefore, the scientific studies we should want to consult are those examining the ability of masks to capture infectious respiratory effluent from actively infectious people. Table 1 collects all such studies this author can locate. Studies with uninfected or mechanically simulated wearers are excluded in order to most precisely model the physical context at hand. These context-matched studies leave no doubt that if you have a contagious respiratory infection, even cloth masks can substantially reduce the quantity of germs you shed into your surroundings, thereby helping you fulfill your ethical duty to mitigate the risk of harm you pose to others when you are infectious.

Even where source-control masking is not a social norm outside healthcare settings, two other tools in the respiratory hygiene toolkit are, (1) covering coughs and sneezes and (2) staying home when sick. It has widely been a cultural norm to practice these two measures for the protection of others. There is, however, a large *efficacy gap* between them. While staying home can prevent *all* infectious respiratory effluent from reaching others, covering coughs with a hand only reduces germs from coughs by around 50% (Wood et al, 2018).[2] Moreover, given that talking can release similar amounts of respiratory effluent as coughing (Asadi et al 2019), and that germs can be aerosolized simply by breathing (Pöhlker et al, 2021; Stadnytskyi et al 2021; Coleman et al, 2022), covering intermittent coughs and sneezes is likely to have little impact on the total volume of respiratory effluent emitted by an infectious person. Therefore, as the likelihood that you are infectious increases, the ethical utility of cough etiquette decreases and yet the jump to staying home may be too large to be practical. The large efficacy gap between these two ethical norms calls for the need of a mid-range mitigation measure.

Masking is precisely such a mid-range measure that can bridge the yawning chasm between cough etiquette and self-quarantine because, unlike the former, it can provide *continuous* respiratory covering, and unlike quarantine, masking interferes little with daily activities. Furthermore, masking can provide superior suppression of germs from coughs than cough etiquette (Wood et al, 2018). By filling in where cough etiquette falls short, masking allows the respiratory hygiene toolkit to scale with a broader range of risk contexts. Let us now organize this argument for masking.

Argument 2 is an informal argument that derives an ethical obligation to mask from the superiority of masking to cough etiquette and our ethical duty to increase our mitigative efforts when the risk we pose to others increases. In this argument, being infectious refers to having a contagious respiratory illness spread by expired droplets and/or aerosols.

> 2.1. Given that (a) masking mitigates coughs more effectively than cough etiquette, and (b) those who are infectious may be continuously expiring infectious germs, and (c) cough etiquette *cannot* provide continuous suppression of respiratory effluent but masking *can*, it follows that: *if you are infectious, masking provides superior source control for the protection of others compared to cough etiquette*.
>
> 2.2. Given that (a) cough etiquette is ethically obligated even when it is unlikely that you are infectious, and (b) if the risk you pose to others increases, you are ethically obliged to increase your mitigative efforts against that elevated risk, and given 2.1, it follows that: *if the risk that you are*

[2]This result from Wood and colleagues (2018) may be the only study comparing a cough etiquette technique to masking for source control of infectious people. While sleeve, arm or elbow is preferred, the hand is the most common cough etiquette tool, being used to cover 64% of observed respiratory events compared to only 3% with a tissue or handkerchief and just 1% with an arm or elbow (Barry et al, 2011). The problem with hand covering is it leaves the hand covered with infectious respiratory effluent requiring prompt and thorough hand washing.

infectious increases, your ethical obligation to wear a mask increases too because masking provides more effective source control than cough etiquette.

Argument 2 makes clear that masking should be included in the respiratory hygiene toolkit as a means of source control for the protection of the uninfected from the infected. A mitigation measure that fills a large efficacy gap between two other mitigation measures that are ethical norms is naturally a candidate for also being an ethical norm. And given that masking during a respiratory infection is a virtually harmless low-cost measure, there's no reason why masking should not be an ethical norm as are cough etiquette and staying home when sick.

Masking not only fills said efficacy gap but *epistemic gaps* too. For example, you may have a few bodily signs that *might* be symptoms of an infection, but you are uncertain. And even if you get a negative test for one virus another might be the culprit. In that state of uncertainty, an epistemic gap, masking offers an easy way to increase your source-control mitigation given that your risk to others *might* be elevated. In another example, during an epidemic or pandemic the likelihood that you are asymptomatically infectious increases. Masking is a simple way to upscale your mitigation in that epistemic gap. Staying home every time you believe the risk that you are infectious *might* be elevated is untenable and yet cough etiquette is ineffective if you are in fact continuously expiring germs. Masking fills such epistemic gaps and is thus uniquely suited among respiratory hygiene tools to mitigate uncertain conditions of 'fuzzy risk' wherein you believe the risk of infection you pose to others *might* be elevated.

SUMMARY AND DISCUSSION

Motivated by ethical questions arising from the Covid-19 pandemic, the Respiratory Ethics Framework (REF) presented here addresses questions about why, how and when we should modify our practices of respiratory hygiene, as for example by donning a mask. REF is grounded in the moral principles of nonmaleficence, or non-harm, beneficence and respect for personal autonomy (Beauchamp & Childress, 2019). From the nonmaleficence principle REF derives a duty to engage in beneficent action for the benefit of others by acting to protect them from one's own respiratory infection. Because REF relies on a person's own assessment and mitigation of their risk to others rather than on top-down enforcement, it respects personal autonomy. From a proportionality framework depicted in Figure 1, wherein increasing risk of harm to others entails increasing ethical obligations to mitigate that risk with increasingly efficacious measures, REF's basic decision model is instantiated in Figure 2. REF is then extended into two-dimensional decision matrices in Figure 3 to guide ethical decision making in more complex contexts.

While the mitigation protocols in the decision models are consistent with norms, other protocols are possible and may be preferable in various contexts. Other mitigation measures such as ventilation, testing and vaccination may be included. The only feature of the given protocols that is not a norm in western nations is masking. So masking was defended based on its superior efficacy to the only other source control measure available, cough etiquette. Not only does masking provide superior source control of cough emissions, but most importantly, it provides *continuous* source control even while talking and breathing. The only way to upgrade the efficacy of your source control efforts is to replace inferior cough etiquette with superior masking. Because ethics requires increasing mitigative effort to counter increasing risk, masks are an ethically necessary tool in the respiratory hygiene toolkit.

The decision model in Figure 3 has 'unlikely' and 'probably' as lowest and highest values respectively for answers to the question, "Am I infectious?" because knowledge of one's infectiousness is always imperfect. Even test results for a virus cannot bring perfect knowledge about your infectiousness. At most a positive test means you are *probably* infectious while a negative result means

it is *unlikely* that you are infectious with the virus tested for, and you could be infectious with another virus. Your beliefs about your infectious status at any given moment are at best well-informed estimates that could nevertheless be wrong.

Several issues deserving further inquiry are not addressed herein. For example, an important question is the degree to which respiratory hygiene practiced for self-protection, rather than for source control when sick, is ethically obligated. Perhaps the best way you can avoid infecting others is to avoid getting infected yourself. Self-protection is therefore ethically relevant, not purely a matter of self-interest. However, the risk posed to others by someone who is probably infectious is imminent, ethically requiring immediate mitigative action on their part. In contrast, the risk posed to others by someone who believes they will probably get infected in a given context (the parallel maximal risk condition for self-protection) is less ethically urgent because there are several more steps in a chain of causation that need to take place, and which might not take place, before that person becomes infectious and thereby poses an imminent risk to others. Therefore, the strength of ethical obligation for source control seems to be greater than for self-protection. But how they compare and interact in ethical decision makings is an open question not answered here.

Another issue not addressed here are differences in potential harm posed by different respiratory pathogens and how those differences might affect our ethical decision making. The REF models herein apply equally to any contagious respiratory pathogen. Yet the risk of harm posed by a novel virus for which there is no vaccine—as we witnessed in 2020—is far greater than the risk posed by the common cold. However, it is an ethical norm that you should stay home when sick even with a cold. Given that a strong mitigative response—self-quarantine when sick—is an ethical norm even for low-risk germs, does the difference in question really matter? Or is it that you merely *should* stay home if you have a cold but you absolutely *must* stay home if you have Covid? That seems a plausible ethical stratification. However, people who feel sick and believe they are probably infectious are often unsure what type of germ they have, so they cannot stratify risk by germ type. The REF models herein comport with that common state of uncertainty by assuming nothing about what type of contagious respiratory germ you have. This fascinating line of inquiry is also left for future investigation. Hopefully REF as presented herein has laid useful groundwork for further inquiry into the unique ethics of airborne infectious disease.

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