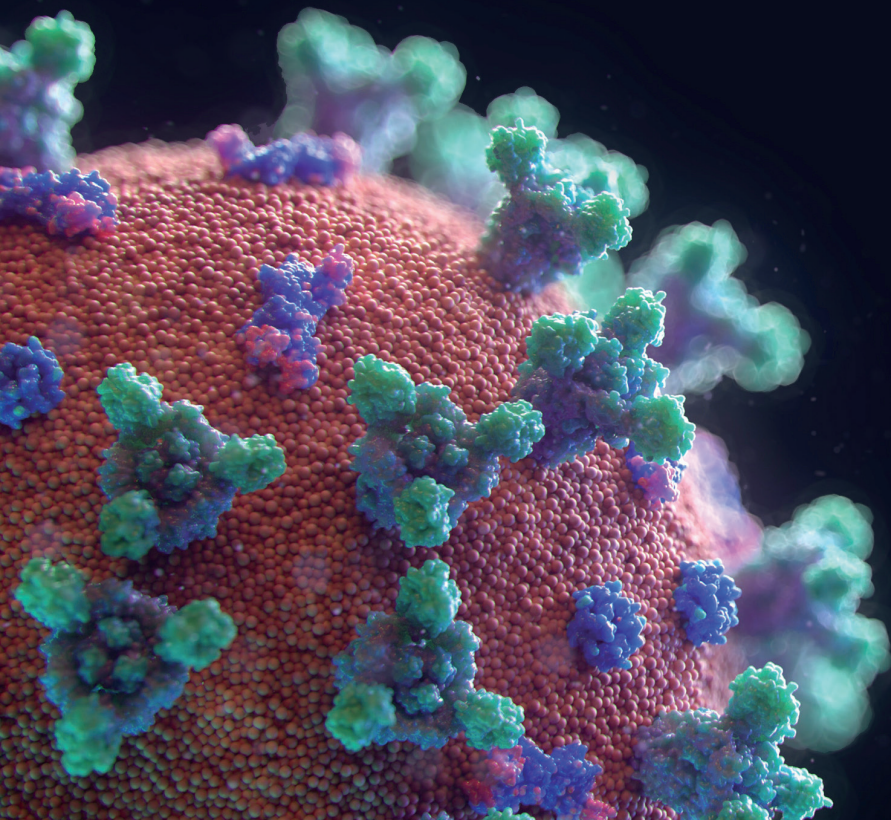


Coping with COVID-19: 12 Common Myths and 12 Lesser Known Facts about the Pandemic

Clearly Explained by an Epidemiologist

Working Draft

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*To all those who grieve and have suffered from this pandemic.
And to four incredible women: my lovely daughters Leila and Ariel,
my dear mother Tam, and my beloved Coloma.*

TABLE OF CONTENTS

SUMMARY	1
PREFACE	2
INTRODUCTION	5
MYTH 1: Covid-19 is really no worse than the annual flu.	8
MYTH 2: This pandemic is nearly as bad as the Spanish Flu a century ago.	8
MYTH 3: It is easy to become infected through casual contact.	9
MYTH 4: Contaminated surfaces are an important means of infection and require meticulous precautions.	10
MYTH 5: “Asymptomatic” persons are a major driver of the pandemic.	12
MYTH 6: Wearing masks is always necessary.	13
MYTH 7: “Social distancing” of at least six feet is always necessary.	14
MYTH 8: Children are at considerable risk of getting very ill or dying from Covid-19, and are “super-spreaders” who can easily infect other kids and adults.	15
MYTH 9: Simply being older or having asthma or HIV puts you at much higher risk of becoming seriously ill or dying from Covid-19.	18
MYTH 10: Increases in Covid-19 cases inevitably lead to corresponding increases in <i>deaths</i>	19
MYTH 11: Getting infected is (always) a very bad thing.	21
MYTH 12: In places like Sweden that did not fully lock down their economies and societies, there have been more deaths from Covid-19.	23

FACT 1: The majority of infections have occurred within <i>clusters</i> of family members, co-workers, prison inmates, inhabitants of Native American reservations, and other persons spending prolonged periods of time in close proximity.	25
FACT 2: The admonition that people with Covid-19 symptoms or who test positive should remain home unless becoming very ill appears to have been a major driver of the pandemic.	26
FACT 3: Outdoor transmission is up to twenty times less risky than transmission indoors.	26
FACT 4: <i>Voluntary</i> changes in behavior – widely adopted habits of routine hygiene, distancing, etc. – have been the main factor in slowing the pandemic.	27
FACT 5: Despite the fear that health delivery systems would be overwhelmed by Covid-19, this has rarely happened so far.	27
FACT 6: As horrific as this pandemic has been, to date it has killed just over half as many people as the “Hong Kong Flu” pandemic of 1968-69.	28
FACT 7: Many more people than usual have died this year from non-Covid-19 causes, such as heart attack, stroke, and appendicitis, because of being denied medical attention or from avoiding hospitals due to fear of contracting the virus.	29
FACT 8: The media has tended to portray the more extreme aspects of Covid-19, feeding fear and anxiety.	29
FACT 9: Some mitigation measures, particularly the use of ventilators, appear to have done more harm than good.	31
FACT 10: The financial collapse and lost income resulting from prolonged economic shutdowns have resulted in unprecedented consequences.	31
FACT 11: Even if a relatively effective vaccine is eventually developed it may not be a perfect solution.	32
FACT 12: There are reasons to be hopeful that we <i>can</i> return to (more) of a sense of “normality.”	32
CONCLUSION	37
ACKNOWLEDGMENTS	39
REFERENCES	40

SUMMARY

This booklet explains in understandable terms how scientists, as they struggle to understand Covid-19, have begun to identify the main ways the coronavirus is spread and the primary factors associated with severe illness and death. This emerging evidence can help us determine the best ways to reduce risk as well as anxiety and fear.

By examining 12 common myths and 12 lesser known facts about Covid-19, the author explores:

- How this *respiratory* coronavirus is mainly spread through close and prolonged contact, and why fleeting encounters are extremely unlikely to cause infection
- How most infections occur within *clusters* of people in indoor situations with poor air circulation: households, workplaces, nursing homes, prisons, mass transit, etc.
- The very low risk of infection while being outdoors and from surfaces
- Why a child is more likely to die from walking to school than from Covid-19, and the surprisingly low risk of children infecting others
- Why “facial distancing” is more helpful than “social distancing”
- The value and limitations of other prevention measures including masks, gloves, thermometer guns, hand sanitizers, vaccines, and “herd immunity” approaches
- Why having asthma does not increase the risk of severe illness or death from Covid-19 (and may even *lower* risk)
- Is it safe to work out again at the gym?
- What about “airborne” transmission: do we need to do anything differently?
- The not necessarily very high risk of old age, absent serious health conditions
- The need to focus on levels of Covid-19 *deaths* vs *cases*, even when surges inevitably occur
- The confusion surrounding “asymptomatic” and “pre-symptomatic” carriers
- The impact of shelter-in-place measures and other responses to the coronavirus, and
- What can be learned from past pandemics

PREFACE

I first met Dr. Daniel Halperin in 2004, while working in Zambia as a Health Advisor for the U.S. Agency for International Development (USAID). At the time, Daniel was USAID's Primary HIV Prevention Advisor globally. He had come to southern Africa to provide technical assistance for supporting some innovative efforts he had been developing in the region, which remains the world's hardest-hit by AIDS. I vividly recall attending various governmental and NGO meetings during his time in Zambia, embarrassed for him by some of the skeptical reactions, particularly from other North American and European experts in the country, to some of Daniel's then revolutionary-sounding notions about prevention. How could offering African men safe and affordable voluntary circumcision services make a dent in the raging HIV epidemic there? How would a keener understanding of complex networks of sexual culture possibly improve prevention efforts? A little later, there was an opportunity to bring Halperin to Nepal to offer HIV prevention guidance. From my perspective, I certainly saw Daniel as an iconoclast, but I saw real value in shaking things up. I lobbied hard but was unsuccessful. Others in the bureaucracy focused on what they saw as the political risks of bringing someone in with unconventional insights and an impulse to call out the Emperor wearing no clothes.

During the following several years, after clinical trials in Kenya, Uganda, and South Africa confirmed that circumcision substantially reduced HIV transmission, and various regional consultations and conferences (mainly organized by Halperin) concluded that more directly addressing sexual behavior was vital to combating AIDS, his previously controversial ideas were increasingly accepted by the UN, CDC, and other international organizations. Yet there was no basking in success for Daniel, and he continued to be a lightning rod for many sides of the political spectrum. For having believed in the value of the "Abstinence" and "Be faithful" elements of the widely-known "ABC" notion (though in Africa he mainly focused on the "B" or partner-reduction part), he often was attacked by some activists and others for being "anti-sex."

In the same year he first visited Zambia, a groundbreaking HIV prevention statement led by Halperin and published in the medical journal *The Lancet*, signed by 149 prominent scientists and global opinion leaders including Archbishop Desmond Tutu and the Ugandan President, nearly led to his dismissal by the Bush Administration because this "Common Ground" consensus document also included the "C" (for condoms) part of prevention.¹

Although justifiably proud of these and other significant contributions while at USAID, Daniel could no longer stomach the unrelenting political mine fields; in 2007 he accepted an offer to teach and conduct HIV research at the Harvard School of Public Health. Later, he held positions at the University of North Carolina School of Global Health (where he is currently Adjunct Full Professor), and the Ponce School of Medicine in Puerto Rico. Over this period, tiring of the politicization of the HIV/AIDS response, he shifted his focus to other pandemics facing the world, notably obesity. When, in early 2020, Covid-19 struck with a vengeance – given Daniel’s insatiable intellectual appetite to come to grips with what’s really happening with new and complex global public health challenges as well as his life-long desire to contribute at scale to improving well-being – he was caught up in the battle against this newest pandemic.

A couple of months back, as I was grappling with questions about Covid-19, I reached out to Daniel to ask how he understood the problem and learned that he’d been struggling to crystalize his own thinking in the form of a critical review and commentary on the – yet very incomplete – available evidence. This led to him submitting a paper to the journal *Global Health: Science and Practice*,² of which I am Editor-in-Chief, and having the article move through our peer-review process. His paper was subsequently published in our journal.³

After advance publication of the article in late May of 2020, several colleagues urged him to consider making the information available to the broader public. On July 1, he submitted this booklet for self-publication on Amazon’s Kindle platform, having promised his fiancée to finish it before their wedding the following day. He reported to me that the next night, just minutes after their ceremony concluded, he received an email from Amazon, announcing that for “violation of our Covid-19 policies,” they had refused to publish his important but iconoclastic booklet on their platform.

I am not in a position to speculate what the reasons for this decision may have been. But this response brought back to mind the resistance Dr. Halperin faced some 15-20 years ago, with the inconvenient truths suggested by his insights into major drivers and potential solutions for the HIV/AIDS epidemic. In his Covid-19 booklet he made what may seem to be counter-intuitive predictions that, for example, deaths in the southern US region would probably increase somewhat by mid-July, but a surge in mortality commensurate with the soaring cases was unlikely to happen. However, there are many other (perhaps appealing) myths, as well as many lesser-known but helpful facts that are explored in this booklet – supported by the best currently available evidence – that one can only wonder why it was rejected by Amazon.

Speaking as an editor (and a reader), I can assure you that Dr. Halperin’s work is easy to read, provocative, and actionable; it brings clarity to many of the areas we have all been struggling to understand about Covid-19. At the same time, speaking both as a citizen, husband, and father as well as an epidemiologist and global public health professional, I can inform you that he addresses fears we have all faced, and offers robust, evidence-grounded reassurance.

While I certainly do not know how this fairly concise but masterful work will be received more broadly, I remain a bit anxious that, like his experience many years ago – as he fought the good fight on HIV/AIDS around the world – Dr. Halperin may again experience misinformation and mischaracterization of his views. That said, those who decline to read this timely booklet do so at their

loss. After five months of pain, terror, and confusion, this document could not be more important nor more illuminating. I invite readers to peruse, digest, and process the information, analysis, and exceedingly useful and scientifically grounded insights he has to offer...while maintaining an open mind.

Stephen Hodgins, MD, MSc (Epidemiology & Biostatistics), DrPH, Associate Professor of Global Health, School of Public Health, University of Alberta, Canada

INTRODUCTION

IN EARLY JUNE OF 2020, WHILE FINALIZING A SCIENTIFIC ARTICLE ON Covid-19 for a global health journal,³ some colleagues urged me to prepare a more accessible version for a wider audience. Particularly because many people seem anxious about how to protect themselves from the coronavirus and what measures may actually be a waste of time, I eventually agreed with my friends' suggestion. This booklet is the result.

My background in public health research and programs for over four decades – half that time focused on the most recent major pandemic, HIV-AIDS^{1,4,5} – prepared me to some extent for this novel pathogen. Yet I too was caught off guard by the indeed novel ways the coronavirus managed to take off around the world. I also worried about my 91-year-old mother in a senior citizens' residence in San Francisco and my 88-year-old Spanish mother-in-law in Madrid, one of the world's hardest-hit cities. And as Covid-19, and the response to it, began encroaching on all our lives, I had déjà vu back to those earlier years of AIDS, with the devastating number of deaths as well as the pervasive atmosphere of confusion, fear, and often panic.

In June of 1981, when the first cases were reported of what would become known as AIDS,

I was living in the San Francisco Bay area. As the waves of death mounted, I eventually volunteered at a hospice in Oakland and later conducted HIV epidemiological and anthropological research at the University of California. In those early days, some political leaders were tragically slow to respond, and many, on all sides, engaged in ideological warfare, often ignoring the scientific evidence.^{1,4,6} As explored in *Tinderbox*, the book I co-authored

with Washington Post journalist Craig Timberg, even some health authorities made decisions, frequently under pressure to act quickly, that ultimately led to costly outcomes.^{4,5,7} Policies often became entrenched and difficult to walk back, even in light of new evidence. There was a tendency to defend previous decisions, and earlier openness to more innovative approaches

In past health crises, authorities have often defended previous policy decisions, even in light of new evidence.

could have saved many lives.^{4,5,6} Well-meaning but overly simplistic messages such as “Always use a condom with anyone, or die!” inadvertently created other complications.^{4,7,8} And in subsequent years, as funding began pouring in, a kind of “AIDS exceptionalism” took hold, with attention and resources for other important health problems often crowded out by the response to HIV/AIDS.^{4,7,9}

During the first years of AIDS, much remained unknown about the causes and main routes of infection.^{4,6,7,8} Many people understandably confused the lethality of the HIV virus (almost 100% fatal, until treatment was eventually developed) with likelihood of infection, which is very low in most circumstances. Rumors proliferated that anything from mosquitoes to contaminated condoms to shared toothbrushes were spreading the virus. After Magic Johnson tested positive in 1991, counseling centers were overrun by the “worried well.”^{4,7} At a Richmond, California center where I counseled at the time, when college students and others became petrified from having engaged in deep kissing or “unprotected” intimate touching, they flooded in to get tested, diverting attention from those truly at risk of infection.

Upon immersing myself in HIV research, and later while developing prevention programs for the federal government, I often felt like I was swimming upstream against the conventional wisdom. There were seemingly endless mine fields of political ramifications and push-back along the path toward what I was convinced were more evidence-based

approaches.^{4,5} But eventually I realized that, as public health scientists, we have a duty not to let the present political currents outweigh evidence that can inform efforts to improve people’s health and well-being.^{4,10} (Regarding one of the issues that many years ago caused

me much grief, the role of male circumcision for HIV prevention,^{4,5} while most experts were skeptical at best – and occasionally indulged in outright ridicule – one of the few who early on recognized the scientific evidence was Anthony Fauci.¹¹)

With the Covid-19 pandemic, there is still much that remains unclear, with seemingly conflicting information emerging almost daily. Many of us are confused and anxious. (One mindboggling indication of the level of worry is that as of May 24, 2020, the Johns Hopkins Coronavirus website was receiving some four *billion* hits a day.¹²) Such fear is certainly understandable, especially when spikes or occasionally large waves of new cases invariably erupt in one location or another. Fear can also help motivate behavior change.^{3,4,13} But *irrational* fear or panic often leads to impulsive decision-making and creates other problems,^{14,15,16} such as the alarming increase in people dying this year from heart attacks and other non-Covid-19 causes due to fear of entering the hospital.^{3,17-23} Moreover, it seems we have failed to learn other important lessons from the last major pandemic, including the danger of turning a health crisis into a platform for polarized ideological point-scoring. Some politicians, media outlets, and even health experts have sought to force us towards a false dichotomy, of having

Irrational fear and panic often lead to impulsive decision-making and other problems.

to choose between recklessly reopening the economy versus rigidly continuing strict lockdowns.^{3,10,24,25}

Reminiscent of past “condom wars,” masks – a helpful prevention tool when used appropriately – have become caught up in a bitter ideological battle, and judgmental attitudes such as “beach shaming” have re-emerged.^{26,27,28} But like any pathogen, this virus does not care about politics (or national borders²⁹); its only goal is how best to exploit whatever vulnerabilities we humans offer it. Mercifully, a key difference between the coronavirus and HIV is that, although both are RNA viruses, in the absence of treatment the coronavirus does not kill nearly everyone it infects. With Covid-19, if mainly younger people become infected, sharp increases in new infections can occur without a correspondingly huge jump in subsequent deaths, as appears to have happened in late June/early July 2020 in the southern regions of the U.S. While much can be learned from responses to previous pandemics, each is, of course, different. A useful HIV strategy, like prioritizing the prevention of any new **infections**, may not be optimal for combating Covid-19, where the main focus should be on preventing severe or long-term illness

We are still learning how to take useful precautions for avoiding risk, without falling into panic or despair.

and **deaths** among the most vulnerable populations, such as nursing home residents.^{30,31,32}

Recalling how well-meaning efforts to combat AIDS inadvertently led to exceptionalism and other negative consequences,⁹ the shelter-at-home and lockdown policies that have undoubtedly saved lives by helping curb this pandemic have also led to massive repercussions, including record unemployment^{24,33,34} and economic suffering^{35,36} as well as marked increases in domestic violence,^{37,38,39} child abuse,^{40,41,42} anxiety and depression,^{40,43,44,45} drug overdoses,⁴⁶ obesity,^{47,48} and divorces.⁴⁹ We are still learning how to take useful precautions for avoiding risk, without falling into panic or despair or counterproductive efforts that create more harm than good.

It is worth repeating that this truly is a *novel* virus. Hence there are many aspects (including some of the “myths” and “facts” explored below) about which scientists still know relatively little or are not very certain. That said, we are discovering and clarifying more facts every day. I therefore plan to update this living document at regular intervals and to address, when possible, questions or concerns posed by readers.

12 COMMON MYTHS

■ MYTH 1: Covid-19 is really no worse than the annual flu.

Although some politicians and even a few researchers initially thought this was the case, Covid-19 appears to be at least five times more lethal than the seasonal flu. Based on large antibody surveys that identify people who previously have been infected with the coronavirus, the actual fatality rate (which for various reasons is very difficult to estimate^{50,51,52}) seems to be roughly in the range of 0.2-1%, meaning that somewhere between 1 in 500 to about 1 in 100 persons who become infected will die.^{50,53} In June 2020 the CDC estimated a rate of 0.26%, yet the following month a World Health Organization (WHO) panel decided on an estimate of 0.64%.^{51,52} Of course, the chances of dying are much greater in older and sicker persons, and far lower in younger and healthier ones. University of Cambridge statistician Sir David Spiegelhalter has observed that in women in the U.K. aged 30-34, “around 1 in 70,000 died from Covid-19 over the 9 peak weeks of the epidemic. Since over 80% of these had pre-existing medical conditions, we estimate that healthy women in this age-group had less than a 1 in 350,000 risk of dying from Covid, around 1/4 of the normal risk of an accidental death over this period.”⁵⁴ Meanwhile, the actual fatality rate of influenza, which also mainly affects older and other vulnerable people, is probably less than 0.1%, although the annual flu kills many more infants and young children than Covid-19.⁵⁵

Covid-19 is at least five times more lethal than the seasonal flu, but the flu kills many more children.

■ MYTH 2: This pandemic is nearly as bad as the Spanish Flu a century ago.

Thankfully, this also is not true; that horrific pandemic slaughtered around 50 million people, when the world’s population was less than a fourth of what it is today. The fatality rate of the “Spanish Flu” was probably ten times higher than that of Covid-19, and it killed many healthy young people and children; the

The vast majority of deaths, at any age, are in persons with a serious underlying chronic condition such as diabetes or obesity.

average age of death is estimated to have been 28.^{56,57} In contrast, Covid-19 overwhelmingly affects the elderly, especially those with serious health conditions. The average (median) age of Covid-19-related deaths has been in the low- to mid-80s in European countries and about 80 in the U.S.⁵⁸ Between 96% (in the U.S.) and 99% (in Italy) of deaths, at any age, have occurred in persons with one of six preexisting chronic diseases including diabetes, heart disease, and chronic kidney disease,^{59,60,61} with those (especially men) who are obese^{62,63,64} or who smoke^{65,66} at twice or greater risk.

■ **MYTH 3: It is easy to become infected through casual contact.**

As with HIV, there has again been a tendency to confuse the new virus's potential *lethality* with its *contagiousness*. This is understandable, particularly when the pandemic seems to be spreading out of control. And infection from the coronavirus is indeed quite possible, normally much more so than with HIV, especially if your *face* maintains *close* and relatively *prolonged* exposure (several minutes or more) to the *face* of an infected person who is *symptomatic*.^{3,67,68,69} As with other *respiratory* pathogens, transmission is especially likely if contagious individuals cough, sneeze, shout, or sing loudly in your direction although, if you are in sufficiently close (less than about 3 feet) and *prolonged* contact, particularly indoors, the infectious droplets they emit during normal speaking and breathing can be sufficient to cause infection.

Similar to other infectious diseases, scientists believe there is a “dose response” with Covid-19, meaning the combination of *intensity* and *duration* of exposure predicts the likelihood of infection (and probably eventual clinical outcomes).^{67,68,70,71} This involves a threshold – or a *minimum amount of viral particles* – required to cause infection. The concept of dose response helps explain, for example, the extremely low risk from fleeting encounters, such as momentarily walking past someone, since this is very unlikely to entail a sufficiently intense or prolonged exposure to actually result in infection. Dose response may also help explain the large number of medical workers who have been severely affected by Covid-19, since they tend to be in close and relatively extended contact with symptomatic and often very sick individuals.^{68,70}

The infection risk from simply walking past someone or briefly exchanging hugs is extremely low, as such events are very unlikely to involve a sufficient **LEVEL** of viral exposure.

As with other serious health concerns, practicing evidence-based precautions is crucial. Yet it is also vital for one's mental health and quality of life not to suffer from becoming

anxious or fearful, disproportionately to the actual risk.^{3,14,15,16,27,67,71} Scientifically speaking there is little reason, for example, to refrain from giving hugs, as long as you avoid prolonged face-to-face proximity.

■ **MYTH 4: Contaminated surfaces are an important means of infection and require meticulous precautions.**

Laboratory experiments have found that the coronavirus can survive for extended periods on hard surfaces such as elevator buttons, doorknobs, and countertops. Yet based on the available evidence for viral transmission, as the CDC has concluded (and similarly to other respiratory infections), the *actual risk appears to be very low*.^{72,73,74} Considering the large number of customers served by industries such as transportation, rigorous sterilization procedures have been adopted by airlines, taxi services, and hotels. But in ordinary circumstances, including at home, the actual likelihood of infection does not warrant the obsessive attention to disinfection often being performed. Emanuel Goldman, a Professor of Microbiology, Biochemistry and Molecular Genetics at New Jersey Medical School, summarized the available data in a July 2020 paper in *The Lancet* medical journal.⁷² As Dr. Goldman explains: “The problem with those experiments was that the amount of virus they started with was much, much orders of magnitude larger than what you’re going to find in the real world.”⁷³ He notes that some studies measured the virus’s lifespan by placing as much as “a hundred thousand to 10 million virus particles on a small surface area,” vastly greater than the amount of virus particles present in a human sneeze. Dr. Goldman is concerned that “The supermarkets won’t take returns of anything that you buy now because of this...And it’s in ways little and large that it’s directed behaviour that’s not justified by the data.”⁷³

As the CDC has concluded, the risk of surface transmission appears to be very low.

The University of Minnesota renowned coronavirus expert Michael Osterholm corroborates: “The public right now is so confused about what is safe and what’s not safe. And one of the challenges has been this idea that surfaces play a major role in transmission. We’ve looked very carefully at the data, dating back for decades and research about these kinds of respiratory transmitted infections.

The prominent Coronavirus expert Michael Osterholm notes: “I think we’ve gone way overboard, we’ve made people feel very nervous about just opening a package...This is really all about air.”

And clearly, the surfaces play a very, very little role at all in transmission of this. I think we've gone way overboard relative to the disinfection and so forth, and we've made people feel very nervous about just opening a package...I mean, this is really all about air. Breathing someone else's air where the virus is present. It's much, much, much less about environmental contamination."⁷¹

Moreover, because the coronavirus can cause death it is not surprising that many people assume bleach or other strong cleaning products are necessary to kill it. As a result, toxic reactions and hospitalizations from misuse of such products have soared.^{16,75} In fact, normal use of soap and water or household detergent, as recommended by the CDC, are perfectly adequate to eliminate the coronavirus.^{74,76} Wearing *gloves* may actually increase risk, including because the virus tends to remain on latex.^{77,78}

Good hand washing practices are much more important.⁷⁶ The FDA has warned against using certain hand sanitizers containing the lethal ingredient methanol.⁷⁹ Indeed, the widespread use of these alcohol-based sanitizing products is unnecessary in many instances, where soap and water are readily available, and in some people they cause skin irritation and other issues.⁷⁶ Many (also overly used) antibacterial wipes are only effective, as the name implies, with bacteria and not with viruses.^{80,81}

Although thermometer guns may be useful in areas with high Covid-19 prevalence, their increasingly routine utilization in low-prevalence settings, where a high temperature much more likely results from any number of other reasons, is certainly questionable.⁸² One laboratory study created a stir by suggesting that fecal particles containing the coronavirus can enter the surrounding air, due to the flushing action, and potentially cause infection.^{83,84} However, as Osterholm and other experts have cautioned, we should avoid giving too much credence to preliminary, often non-peer-reviewed studies⁷¹ (some of which are finding the spotlight during a time of intensified public concern). However, *if* empirical research were to actually confirm that hypothetical possibility, perhaps governments should consider mandating lids be added to public toilets where needed.

Many scientists and the public are increasingly worried about the potential for aerosol-based infection, i.e., the virus's ability to linger in the air or possibly move across relatively large distances, especially in indoor settings with poor ventilation.⁸⁵ Although some data suggest this could be a factor in transmission to health workers, particularly while engaged in respiratory procedures such as intubation and administering medication by nebulizer, as the WHO reports there is so far insufficient evidence to confirm

Hospitalizations from misuse of toxic cleaning products have soared. Normal use of soap and water is completely sufficient to kill the coronavirus.

this transmission mode is prevalent in community settings.^{85,86} Similarly to the low risk of surface transmission, it may be that the amount of viral particles released into the air is normally inadequate to cause infection. Yet this area of concern urgently requires further study and analysis to inform practical conclusions and potential policy decisions. A July 2020 review of the evidence for aerosol transmission made a parallel to the earlier heightened fears regarding the risk from surface contamination, concluding that, “As the science comes in, recommendations can be fine-tuned based on what we learn. In the meantime, there is no reason to be any more alarmed or even, in most cases, to change what we’re doing to protect ourselves and others.”⁸⁷ However, the real possibility that aerosol transmission is a significant risk factor reinforces the ongoing importance of taking additional precautions in indoor settings with poor circulation and ventilation of air.^{3,67,71}

■ **MYTH 5: “Asymptomatic” persons are a major driver of the pandemic.**

Despite much speculation and some modeling exercises, empirical research to date suggest that persons who are “asymptomatic,” meaning those who will never develop symptoms, are probably rarely contagious.^{88,89,90} When a WHO scientist referred to these data on June 8, 2020, the global agency was hit by an avalanche of criticism not only because more research is needed, but because the confusion created by the remark might unnecessarily have called into question the value of wearing masks.⁹¹ Much of the attack on the WHO referenced a widely cited review article that curiously asserted (based on two or three Italian persons who “may” have been infected by asymptomatic individuals) that such carriers are important pandemic spreaders.⁹² Indicative of the ongoing confusion related to this disease’s complexity, the authors’ more evidence-based conclusion that perhaps 40-45% of all those *infected* by the coronavirus are asymptomatic was misunderstood by some commentators as meaning that nearly half of all *infections* are due to asymptomatic transmission.

The existing empirical data suggests those persons who are “asymptomatic,” meaning they will never develop symptoms, are probably rarely contagious.

Another important reason for the confusion surrounding the WHO controversy involves the distinction between asymptomatic carriers and those who are “pre-symptomatic,” meaning they have not yet but will develop symptoms within the next several days.^{88,89,90} While it is pretty clear that infection does occur from pre-symptomatic individuals, such pre-symptomatic yet contagious persons comprise relatively few carriers at any

given moment, considering the short time duration (usually less than 48 hours) in this phase. Furthermore, many appear to have low “viral loads,” which would help explain why: 1) they don’t yet have symptoms; 2) many may have a negative result from the standard PCR coronavirus test,⁹³ and 3) research to date suggests they are likely to be less contagious than actively symptomatic persons.^{88,89,90}

In a study of 243 Covid-19 cases in Singapore, 6% were identified as originating from pre-symptomatic carriers, and some instances of pre-symptomatic transmission have also been recorded in other countries.^{89,94,95} Although high viral loads have been detected in some pre-symptomatic carriers, the implications for the pandemic’s spread are unclear.^{70,96} While for some viruses, such as HIV, viral load is strongly associated with infectivity, the fact that pre-symptomatic coronavirus carriers are not actively coughing or sneezing may largely explain their lesser contagiousness in comparison with persons who are actively symptomatic carriers. More studies are needed, but existing research does at least suggest there is considerably higher likelihood of transmission from those late in the pre-symptomatic phase than from carriers who will never develop symptoms.^{88,89,90} In any case, so far it appears that the WHO’s assessment may be correct of asymptomatic and pre-symptomatic persons not being likely to constitute very important drivers of Covid-19’s spread,⁸⁸ although the potential role of pre-symptomatic transmission in the pandemic must not be ignored.

■ MYTH 6: Wearing masks is always necessary.

If worn by *infected* persons, a cloth-type mask provides *some* protection to *you* in circumstances where they are in close and *relatively prolonged proximity* to you, especially in enclosed indoor spaces. Similar to other public health measures, this can be taken to an extreme. As former CDC Director Thomas Frieden has observed, scientifically there is no reason to wear a mask if you are not near anyone else,⁹⁷ such as while driving or strolling alone.⁷¹ In fact, strict enforcement of mask-wearing, including in situations where it is not justifiable for prevention purposes, may exacerbate other health problems.^{98,99} Wearing them for prolonged periods, as many workers are now required to do even if they are not in close contact with anyone else, can be very uncomfortable, especially in hot weather. Extended mask-wearing has caused some elderly and other persons with breathing difficulties to faint, for example while waiting in the sun to enter stores that severely restrict the numbers of customers allowed inside.^{3,99} Furthermore, experts caution about the common problem

Scientifically, there is no reason to wear a mask if you are not near anyone else, such as while driving or strolling alone.

of incorrect placement, as well as the false sense of security potentially created by wearing masks, which are only partially protective, that may lead to neglect of other important precautions such as hygiene and distancing.^{100,101} It is better to be located a safe distance

away from infected persons who are not using masks than to be close by them, even if wearing masks.

It is better to be located a safe distance away from infected persons who are not using masks than to be close by them, even if wearing masks.

Perhaps reminiscent of some hurriedly-adopted and ultimately misguided past AIDS policies, Michael Osterholm (who endorses appropriate mask-wearing) criticized the lack of solid evidence for the effectiveness of cloth masks to support the CDC's abrupt May 2020 policy reversal: "Never before in my 45-year career have I seen such a far-reaching public recommendation issued by any governmental agency... This is an extremely worrisome precedent of implementing policies not based on science-based data or why they were issued without such data."¹⁰² However, while awaiting more conclusive evidence, in situations where sufficient distance cannot be maintained from other people's faces, including visits to doctors or barbers or while using mass transit and airplanes, studies have shown cloth-type masks do reduce the likelihood of transmitting the coronavirus.¹⁰³ They may also slightly reduce the risk of *becoming* infected, yet this evidence unfortunately is much weaker.¹⁰² (N-95 surgical masks are much more effective, but of course need to be prioritized for health care professionals and others at high risk, and those which include a release valve only reduce the wearer's risk of infection but do not protect others if the user is infected.¹⁰²) Although asymptomatic and pre-symptomatic carriers may only be responsible for a relatively minor proportion of total infections, pending further research and in populations where the coronavirus is circulating widely, a norm of appropriate wearing of cloth masks is a useful public health measure.^{71,97}

■ **MYTH 7: "Social distancing" of at least six feet is always necessary.**

As mentioned previously and as with other respiratory infections, close and prolonged proximity with someone who may be symptomatic, especially indoors, should be avoided whenever possible. In early 2020 the WHO and European and Asian health authorities recommended physical distancing based on identification of infectious droplets almost a meter (about three feet) away from coughing and sneezing individuals.¹⁰⁴ Meanwhile, in the U.S. one meter was initially translated into five feet and subsequently became "over

six feet.” Such an abundance-of-caution expansion of international standards does make sense in certain situations, and arguably a hard-and-fast rule to “always stay over 6 feet away from anyone” is simpler to mandate. However, scientifically it is unclear whether this is necessary, especially for *outdoor* commercial and recreational activities including construction, landscaping, playgrounds, and terrace dining (see Fact #3). It is clearly more practical to maintain a distance of about three feet instead of over six feet in certain situations, such as grocery shopping, where interactions are typically very brief, or while strolling outdoors with a companion.³ As a June 2020 review recommended, “A graded approach to physical distancing that reflects the individual setting, the indoor space and air condition, and other protective factors may be the best approach to reduce risk.”¹⁰⁵

A strict rule to always maintain 6 feet distance may not make sense in various situations, especially for outdoor activities such as construction, playgrounds, and terrace dining.

As others have commented, the term “social distancing” is problematic,^{71,106,107,108} since maintaining social connections is more important than ever, particularly as mental health problems related to isolation have soared.^{8,14,15,16,45,46} In fact, the concept of “physical” distancing is also not directly related to how the coronavirus is mainly spread: via *respiratory* droplets.^{3,67,68,71} What is actually most relevant is the distance between people’s **faces**, not the distance between their **bodies**. For example, if persons in a restaurant or office are seated back-to-back, a safe distance can be considerably closer than if they are positioned face-to-face. And if someone facing in your direction may be actively symptomatic, maintaining six feet of distance is certainly a good idea. Meanwhile, if a jogger or bicyclist zooms past you the risk of infection is extremely low, since the droplets scatter and evaporate quickly and because, as mentioned earlier, such fleeting interactions are very unlikely to lead to infection. In any case, a concept such as “facial distancing” could be more useful than “social” or “physical” distancing.

What’s important is the distance between people’s **faces**, not between their **bodies**. If people are seated back-to-back, a safe distance can be considerably closer than if they are face-to-face.

- **MYTH 8:** Children are at considerable risk of getting very ill or dying from Covid-19, and are “super-spreaders” who can easily infect other kids and adults.

Despite the widespread attention given to a disturbing “Kawasaki”-like childhood acute inflammatory syndrome linked to Covid-19, severe illness and death from this SARS-2

coronavirus, as with the first SARS epidemic in 2002-03,^{109,110} have actually been extremely rare in young persons.^{3,111,112,113} Among the several hundred children worldwide so far known to have contracted the inflammatory syndrome, nearly all have recovered within weeks, as happens with the usual Kawasaki disease, especially if detected and treated early.¹¹⁴ Of the over 450,000 deaths reported globally as of June 20, 2020, some two dozen were among persons under the age of 18, about half of them in the U.S.^{111,113,115} By comparison, for *each* known Covid-19 child death in the U.S., about 20 kids died last year from the flu, nearly 100 from drownings, and about 200 in car accidents.¹¹⁶ According to the aforementioned statistician Sir David Spiegelhalter, “If you’re aged 5-14 and you haven’t had it yet, your chance of death from Covid is 1 in 3,579,551. You are more likely to die walking to school.”¹¹⁷

For each child who has died of Covid-19 in the U.S., about 20 died last year from the flu, 100 from drownings, and 200 in car accidents.

An emerging body of biological and epidemiological evidence indicates that, unlike other respiratory pathogens such as the common cold, but similar to the earlier SARS-1 virus, children are both less likely to become infected with and less able to transmit the new SARS coronavirus.^{96,112,113,115,118,119,120} According to the CDC, as of May 2020 only 1.7% of all U.S. Covid-19 cases had been reported in persons aged 18 years or younger.¹²¹ Scientists have discovered that children are less easily infected because of lower production of the ACE-2 protein, the key (nasal) entry point for both SARS coronaviruses.^{110,115,122} Furthermore, it is believed that previous exposure to the common cold coronaviruses frequently acquired by children may provide some partial immunity to the new variant.^{96,119,123} Intriguingly, when blood samples collected before the fall of 2019 were analyzed (i.e., before humans were first exposed to Covid-19), about half those studied already appeared to have had some protective immunity to the new SARS virus, apparently due to past exposure to other coronaviruses.¹²³

Moreover, available evidence suggests that even when children do become infected, they are considerably less contagious than adults.^{96,112,113,115,118,119,120} A small but widely cited German study concluded that viral load levels in infected children are comparable to those in adults, but this preliminary finding has been criticized by Spiegelhalter and others.^{96,118,124,125} Even youth with high viral loads who lack symptoms such as coughing and sneezing will therefore expel fewer infectious droplets; a June 2020 *Nature* study found that 79% of infected persons ages 10-19 were asymptomatic.^{126,127} Remarkably, contact tracing studies conducted in China, Iceland, the

Contact tracing studies from many countries so far haven’t identified any cases of child-to-adult infection, out of thousands of cases analyzed.

U.K., the Netherlands, and elsewhere have so far not identified a single case of child-to-adult transmission out of many thousands of cases analyzed.^{96,112,115,119,120,128} A review of household infection studies from several Asian countries concluded that less than 10% of household clusters involved a child bringing the coronavirus into the home.¹²⁹

Of course, careful precautions for protecting students, teachers, and other school employees must be taken when reopening schools.^{112,130,131} Moreover, parents and others should be prepared for the occasional flareups of cases that will inevitably occur, knowing these will not necessarily – and in fact are unlikely to – lead to major epidemic eruptions. Those countries that never closed schools or reopened them by mid-May 2020, including Denmark,¹³² Norway, New Zealand, France, Germany, Netherlands, Taiwan, Finland, and Vietnam, have not experienced national increases in new Covid-19 cases or deaths.^{133,134,135} An April 2020 evaluation of data from five primary schools and ten high schools in Australia found that although nine staff members and nine students had been infected, no other staff or teachers and only two additional students may have subsequently become infected, even though those 18 infected persons had been in daily contact with 735 other students and 128 staff members.¹³⁶ A study conducted in a high-prevalence region of France, involving 540 schoolchildren ages 6-11 and 42 teachers, identified no instances of children infecting other children or adults.¹³⁷ German researchers who tested 1,500 high school students and 500 teachers in May/June 2000 found very few had been infected, concluding that schoolchildren could even be “acting as a break on infection” at the population level.¹³⁸ In the U.S., a preliminary analysis of some 40,000 children who remained in YMCA child care centers, including 10,000 in New York City, identified very few secondary infections (no more than one per site).^{139,140} In a separate study of 916 day care centers involving more than 20,000 children, only about 1% of staff and 0.16% of children had been infected.¹³⁹ (It is unknown whether those persons became infected at the centers or elsewhere.)

There have been enormous repercussions from keeping children at home, *particularly those from lower-income communities*, including undoubtedly long-lasting academic setbacks for many students,^{141,142} as well as dangerous increases in social isolation,⁴¹ anxiety and depression,^{43,44,45} hunger as well as obesity due to missed subsidized lunches and school-related physical exercise,^{47,118,143} and child abuse.^{40,41,43,144} Additionally, socioeconomic disparities are exacerbated, as some families have the technological tools, parental academic assistance, and other resources to enhance online learning, while less privileged children fall perilously behind.^{130,145,146} All of this makes it increasingly difficult, as

Keeping schools closed is exacerbating socio-economic disparities, as children from disadvantaged backgrounds fall perilously behind.

the American Academy of Pediatrics concluded in June 2020, to justify stopping some 55 million children in the U.S. and many hundreds of millions worldwide from returning to their classrooms.¹¹² Students with special needs such as autism, Downs syndrome, and ADHD are at particular risk, though months away from friends and the daily routine of classes has taken a toll on all children, as beleaguered parents everywhere can attest.^{130,141,147} Of course, parents will need to decide what's in the best interests of their own children and families, and teachers and other school employees likewise should have the right to assess risk and other factors.^{112,131}

■ **MYTH 9: Simply being older or having asthma or HIV puts you at much higher risk of becoming seriously ill or dying from Covid-19.**

While more evidence is being collected and analyzed, the raw statistics would suggest that an 85-year-old person not suffering from specific underlying medical conditions such as serious heart or kidney disease, diabetes, or obesity might be at lower risk of dying from Covid-19 than a 55-year-old who has at least one (and especially several) such conditions. The fact that older persons on average are at much greater risk of dying may largely be due to the elderly being much more likely to have such preexisting chronic illnesses. In addition, there might be biological reasons why persons older than about 65 are more likely to become *infected*, including possibly greater production of the aforementioned ACE-2 protein entry point.^{110,121} And there very likely are reasons, particularly immune system decline, why simply being elderly also increases the risk of dying from the disease. But considering that the vast majority of Covid-19 deaths, *at any age*, occur in persons with underlying serious medical problems,^{59,60,61} the increased risk of old age by itself might not be as dramatic as has been assumed.⁵⁸ More research and analysis could better determine the independently increased risk from being elderly, in the absence of such preexisting health conditions. Quality of life concerns are also vitally important, such as feeling comfortable briefly hugging one's grandchildren, which Swiss health authorities have encouraged since this is not inherently risky.¹⁴⁸

An 85-year-old person without underlying medical conditions such as diabetes or obesity may be at lower risk of dying from Covid-19 than a 55-year-old who has at least one such condition.

Because asthma is also a respiratory condition, intuitively it would seem to increase risk for complications from Covid-19. It is therefore not surprising that many people with the ailment, including many young persons, are frightened of becoming very ill or dying if

they get infected. Such anxiety has at times led to shortages of inhalers and other critical supplies. Yet investigators examining the association between asthma and serious Covid-19 outcomes or deaths found no such link,¹⁴⁹ and subsequent research has confirmed this finding.^{150,151,152} On June 25, 2020, the CDC modified its website to state that having moderate to severe asthma “might be” (rather than “is”^{3,152}) a risk factor for severe Covid-19 outcomes.¹⁵³

In fact, scientists are perplexed because some evidence suggests having asthma might even be somewhat *protective*.¹⁵¹ For example, data from New York indicate only 5% of Covid-19 deaths were among people with asthma, even though they comprise 8% of the population at large.¹⁵⁰ One hypothesis to be tested by investigators is whether standard allergy medications such as inhaled corticosteroids may partially prevent severe Covid-19 complications.¹⁵¹ Understandably, there is also concern about persons co-infected with both HIV and the coronavirus. An Italian study found they do not experience more severe outcomes from Covid-19 compared to HIV-negative persons.¹⁵⁴ However, a South African study found a relatively modest increased risk of death for persons co-infected with HIV and the coronavirus.¹⁵⁵

Some evidence suggests having asthma may even be somewhat *protective* against Covid-19.

■ **MYTH 10: Increases in Covid-19 cases inevitably lead to corresponding increases in *deaths*.**

Although the media, politicians, and even many experts habitually imply that rises in new *cases* are by definition a disaster – as opposed to spikes in severe illness and *deaths*, which of course *are* a tragedy – it is critical to remember that as testing expands, more cases will also inevitably be identified.¹⁵⁶ More importantly, a comparison of death rates between different countries rather dramatically shows how the number of reported cases does not inexorably equate with a similarly corresponding level of deaths. The numbers of deaths compared to reported cases, or case fatality rate, in such countries as South Korea (2.3% on June 22, 2020), Germany (4.5%), Norway (2.8%), Denmark (4.8%), and Japan (5.3%) has been much lower than in nations such as Italy (14%), France (16%), Belgium (16%), and the U.K.

The media, politicians, and many experts often suggest that rises in new cases are disastrous, whether or not similarly large spikes in severe illness or deaths also eventually occur.

(14%).¹⁵⁷ (Case fatality rates are nearly always far greater than *actual* fatality rates, which as previously mentioned are more precisely determined via large-scale, population-based antibody surveys.^{50,51,52,158}) Although partially due to more effective treatment in places such as Germany, the primary reason for the lower mortality in some countries is that (as of May 16, 2020) relatively more younger people had been infected compared to those countries with higher mortality rates, where many more cases had been reported among elderly persons.¹⁵⁹ (In addition, testing rates have been higher in countries including Germany and South Korea, where the total number of reported cases is therefore also greater, although in other places such as Japan testing has not been widespread).

One implication of this evidence is that we should not automatically assume that a higher number of Covid-19 cases equals correspondingly greater levels of serious illness and death. This is a rather different situation compared to other epidemics, such as HIV before treatment, when more infections did invariably translate over time into a commensurate increase in deaths. With Covid-19, if mainly younger and healthier people are infected then proportionally far less severe illness and death will result. One important conclusion is that we ought not to have focused so much on, for example, reprimanding college students for frolicking on beaches.²⁷ As Michael Osterholm notes, beaches are, “ironically, probably some of the safest places to go to if you’re not literally cheek and jowl with someone”.⁷¹ Rather than berating people for such low-risk activities, if we had instead targeted prevention efforts much more towards protecting long-term elderly care residents as well as meatpacking plant workers, prison inmates and guards, and other high-risk groups, many more lives could have been saved.

While blame games over the past are unhelpful, going forward it is imperative to prioritize prevention efforts strategically targeting the most vulnerable among us. This should include policy measures such as better remuneration and protection for nursing home employees. A significant part of the mortality in such institutions, especially among those that suffered an unusually large number of deaths, appears to have been from clinical “abandonment” of patients due to acute staffing shortages, exacerbated by fear of contracting the virus.^{31,160} A key take-home lesson is that for every 10,000 Covid-19 cases prevented among residents of elderly care homes, **vastly more** hospitalizations and deaths will be avoided than, for example, by preventing 10,000 new infections in college-age youth.

For every 10,000 Covid-19 cases prevented among nursing home residents, vastly more hospitalizations and deaths will be avoided than by preventing 10,000 infections in college-age youth.

■ **MYTH 11: Getting infected is (always) a very bad thing.**

Not necessarily. The large majority of people infected with this coronavirus, especially younger and healthier ones, will suffer relatively few symptoms and many will have none at all, the latter being those asymptomatic carriers who may comprise up to nearly half of all infected persons.⁹² Within two weeks following initial exposure, probably most infected persons will at least to a large extent have been “naturally vaccinated.” Experts including Anthony Fauci had generally believed that immunity probably extends for up to a year or so.^{161,162} Yet in July 2020 researchers in Spain and the U.K. reported that antibodies in many people appear to diminish quickly over a relatively short period (worryingly suggesting that potential vaccines would also only work for a short duration).¹⁶³ Other emerging data, including on the likely importance of different functions of the immune system such as “memory” T-cells, suggest however that immunity may in fact be longer-lasting, but the issue certainly remains far from resolved.^{162,163,164}

Assuming that relatively long-lasting immunity is indeed created, already-infected persons may be able to return to work or school with presumably much lower risk of (re)infection, perhaps including safely being near older and other vulnerable persons. However, there have been cases, which thankfully are statistically rare despite being highlighted by the media, of young and healthy people requiring hospitalization or even dying, so we cannot assume there is *no* risk from becoming infected. Furthermore, while the great majority of persons who survive will recover within a couple of weeks, quite a few will suffer an extremely unpleasant experience.¹⁶⁵ An unknown but apparently not insignificant number of people will however continue to have symptoms, often quite severe ones, for an extended period,^{166,167,168} a disturbing issue that researchers and clinicians are urgently investigating.^{165,167,169} (With other respiratory illnesses including influenza, a range of long-term severe complications is also not uncommon.¹⁷⁰) And of course, those infected with the coronavirus should first be quarantined to avoid infecting others.

Some people will continue to have symptoms, often quite severe ones, for an extended period.

One international standard that might be worth revisiting regards the period of time required for routinely quarantining persons for various reasons, including having arrived from another country. (The latter policy has been increasingly criticized by leading scientists.^{29,171}) It may be that the standard 14-day wait period constitutes an overabundance of caution, considering that: 1) the average length of time before developing Covid-19 symptoms is five to six days,¹⁷² 2) a May 2020 study found that 98% of symptomatic carriers developed symptoms by 11 days,^{172,173} and 3) as previously mentioned, studies to date suggest asymptomatic and pre-symptomatic carriers are

considerably less contagious.^{88,89,90} Perhaps a group of objective experts might end up concluding that, for example, a 10-day period is statistically/epidemiologically reasonable, if practical implications would merit changing the policy.

Meanwhile, some countries like Sweden had contemplated adopting a highly controversial strategy of attempting to reach “herd immunity,” i.e., essentially allowing younger and healthier people to remain at or gradually return to work and school, assuming that in the process many might become infected.^{24,174,175,176} The concept is based on the premise that if roughly 60%

of the population eventually becomes infected, and thereby naturally immunized – presuming that relatively long-lasting immunity is indeed conferred – the virus would then have much more difficulty in finding new hosts and would ultimately recede, even in the absence of a medical vaccine (which some researchers fear might take several more years to successfully develop¹⁷⁷). Antibody testing conducted in New York City found as many as 68% of people in some lower-income neighborhoods had previously been infected, compared to just under 15% in more affluent areas.¹⁷⁸ Even if a lesser amount, for example 35% of the population, becomes infected this may mean that considerably fewer people will be vulnerable to a future wave of infection. An international group of mathematicians has calculated that, under certain circumstances, astonishingly a threshold of as low as only 20% might be sufficient to create herd immunity.¹⁷⁹ If their unusual hypothesis proves to have any merit, it may help explain why by mid-July 2020 the earlier epicenters of infection – New York, Detroit, Madrid, Milan, Wuhan, etc. – had yet to see indications of a resurgence in cases.¹⁷⁹

Antibody testing in New York City found 68% of people in a lower-income neighborhood were previously infected, and only 13% in a more affluent area.

Large-scale antibody testing, which several other countries have also begun implementing, could enhance herd-immunity approaches, although the accuracy and reliability of these tests for clinical purposes has been problematic.^{50,71,158,180,181} Perhaps ironically, Sweden has decidedly failed to approach herd immunity: by mid-May 2020 only 7% of residents in the capital, Stockholm, tested positive for antibodies¹⁸² (half the percentage encountered in a rural part of Germany¹⁵⁸). This is undoubtedly because many Swedes already lived alone, telecommuted, and as has happened elsewhere, had voluntarily adopted distancing and other prevention habits.

Interest may eventually grow in alternatives to continually trying to stamp out all new infections, which in places including China and Germany has turned into a whack-a-mole challenge.¹⁸³ Although clearly imperfect, something along the lines of a herd

immunity approach might emerge as a more realistic, least-terrible, longer-term alternative, perhaps including in some lower-income regions with comparatively much younger populations.^{3,184,185,186} In such settings, even if widespread transmission occurs it would likely result in considerably fewer per-capita deaths than in places with many more elderly persons.^{187,188,189} In any case, it is crucial to determine how best to protect our most vulnerable people, particularly the elderly with preexisting serious conditions – clearly no easy task. Consideration of alternatives to lockdowns including herd immunity-based approaches may intensify if a major second wave occurs in late 2020 or early 2021, although as mentioned such controversial strategies could be far from ideal.

In poorer regions with much younger populations, even if widespread transmission occurs this would likely result in considerably fewer per-capita deaths than in places with many more elderly persons.

- **MYTH 12:** In places like Sweden that did not fully lock down their economies and societies, there have been more deaths from Covid-19.

The media as well as many experts have highlighted the higher official death rate in Sweden compared to other Scandinavian countries, which have reported – along with some other nations including Germany, South Korea, and Japan – unusually low mortality rates relative to elsewhere in Europe and the U.S.^{3,157,190,191} But as experts such as Thomas Frieden have urged, rather than relying on official tallies of Covid-19 death rates, which often are notoriously incomplete, in general it is preferable to determine the number of “excess” deaths, by comparing current mortality to levels from previous years.^{156,192,193,194} Cross-country comparisons between government statistics and numbers of excess death reveal that while official Covid-19 mortality tabulations in a handful of countries including Belgium and Sweden have captured nearly all excess deaths, many other countries have significantly missed the mark, under-reporting by as much as 88% of excess deaths.^{3,193,194} As of June 1, 2020, the number of per-capita excess deaths was lower in Sweden than in various other countries, including Italy, Spain, Belgium, the Netherlands, France, the U.K., and the U.S., all of which, unlike Sweden, did impose strict lockdowns.^{193,194}

Excess deaths this year have been lower in Sweden than in Italy, Spain, Belgium, the Netherlands, France, and the U.K, all of which, unlike Sweden, imposed strict lockdowns.

However, while daily Covid-19 deaths in Sweden had fallen from mid-April 2020 to fewer than a dozen per day by early July, this decline was not quite as steep as elsewhere in Europe.¹⁹⁵ The overriding problem in Sweden, as in many countries, has been the large numbers of deaths among people over 80, especially those in long-term care facilities,^{30,31,32,160,196,197} and not because of young people hanging out in bars or kids remaining in school.^{3,190,198,199} Furthermore, thanks to Sweden's generous immigration policies its non-European population is larger than in other Scandinavian countries, and has been disproportionately affected, reportedly due to a lack of culturally-tailored educational campaigns, a high prevalence of chronic health conditions, and crowded public housing.^{198,199,200} Immigrants account for an outsized share of deaths in Stockholm, notably among Somalis,^{199,200,201} many of whom may be more vulnerable than other Africans due to civil wars having kept them from receiving the childhood tuberculosis vaccine,²⁰² which may offer partial protection against Covid-19.^{203,204,205} Unlike elsewhere in Scandinavia, non-European residents constitute most of Stockholm's nursing home employees.^{199,200} Perhaps echoing difficult tradeoffs during the early AIDS years between wanting to avoid exacerbating homophobia and other persecution of marginalized groups while also needing to target prevention efforts for those at most risk, Swedish health authorities may, understandably, be struggling to balance the need to more directly serve the communities suffering most from Covid-19, against the possibility of inadvertently provoking a xenophobic backlash through increasing attention to the immigrants' plight.^{197,199,200}

Many Covid-19 prevention strategies have probably had little impact because they targeted potential risks accounting for only a small proportion of infections.

It is noteworthy that some other countries such as Japan, with a low per-capita Covid-19 death rate despite having the world's oldest population, also never locked down.²⁰⁶ And in the six midwestern and southern U.S. states that similarly did not fully shut down, as of early June 2020 observable increases in new cases had not occurred as compared to demographically similar rural states that implemented tight lockdowns.^{207,208} A key conclusion from the experience of those various states and countries is not that death rates in such places have necessarily been *lower* than elsewhere, but rather if outcomes generally have not been *worse* this suggests that fairly similar results may be achievable at a less drastic economic – and quality-of-life – cost. Of course, more urban regions will require different types and intensities of interventions than rural areas. As we ought to have learned from previous health crises such as AIDS, the tendency to apply a one-size-fits-all approach should be reconsidered.^{1,4,5,8} In any event, it is entirely conceivable that future medical historians will conclude that many current Covid-19 prevention strategies, including some that created substantial anxiety and hardship, probably had little impact because they targeted potential risks *accounting for only a small portion of total infections*.^{3,67,73,74}

12 LESSER KNOWN FACTS

- **FACT 1:** The majority of infections have occurred within *clusters* of family members, co-workers, prison inmates, inhabitants of Native American reservations, and other persons spending prolonged periods of time in close proximity.

“Clusters” of people living or working in *close* and *prolonged* proximity to one another,^{69,209} especially in indoor settings with poor circulation and ventilation of air,^{67,71,210,211,212} such as in certain factories, cruise ships, and churches,²¹³ have been particularly affected by Covid-19. As previously discussed, long-term elderly care facilities have been extremely hard-hit.^{30,31,160,196,197}

In Canada, for example, 81% of all reported Covid-19 deaths have been among elderly care residents, even though they only account for 1% of that country’s population.³² Meat and poultry plant workers are also especially vulnerable to infection because of working and living conditions common in the industry, including prolonged close contact among co-workers, typically cold indoor settings, eight- to 12-hour shifts, group housing, and shared transportation.^{214,215,216} A *JAMA* study found prisoners^{217,218} are over five times more likely to get infected and three times more likely to die of Covid-19.²¹⁹ Mass transit, especially when people were crowded very closely together, undoubtedly was also a significant mode of transmission.²¹¹ Perhaps not coincidentally, nearly all the places that experienced the largest Covid-19 outbreaks, including Wuhan, Milan, Madrid, London, and New York City, had heavily utilized mass transit systems (and often many smokers and worse air pollution, which may also be a factor²²⁰).

In Canada, 81% of all Covid-19 deaths have been among elderly care residents, even though they only account for 1% of the population.

- **FACT 2:** The admonition that people with Covid-19 symptoms or who test positive should remain home unless becoming very ill appears to have been a major driver of the pandemic.

Such public health pronouncements inadvertently but tragically led to a delay in seeking care, which diminished survival odds,¹⁷⁻²³ and also exposed household members to significant infection risk.^{209,210,211} Contact tracing studies have identified the single largest source of infections as the sharing of living quarters.^{209,210,211} Those Asian countries that quarantined infected persons *away* from home, in clinically provisioned camps or hotels, had much better success in controlling infections and, also importantly, in reducing death rates.²²¹ Iceland utilized a similarly successful approach, including use of a remote home quarantining method involving virtual medical supervision and counseling support.^{222,223} It would seem that in most European countries and the U.S., where such crucial prevention measures, as well as rigorous contact tracing, have largely not been adopted, we instead have been grasping at far less important considerations. These include fixating on avoiding behaviors and settings where the actual risk is very low, such as fleeting pedestrian encounters, surface-based transmission, or beach visits.^{3,27,71,73,74}

- **FACT 3:** Outdoor transmission is up to twenty times less risky than transmission indoors.

While perhaps the fact that outdoor transmission is less risky compared to being indoors is no longer particularly lesser-known, the huge difference in risk, which investigators have estimated to be 19 times lower, is worth noting.²¹² This gigantic difference is due to various factors, including dissipation of droplets in the air and the deactivating effects of ultraviolet radiation, in addition to heat and humidity.^{224,225,226} Those researchers were from Japan, where the government has strongly urged its citizens to hold meetings and other events outdoors.²⁰⁶ A contact tracing study in China found that 80% of infections involved household members and 34% involved mass transit (multiple possible transmission routes were assessed), whereas only a *single* infection event of the 7,324 cases investigated was linked to casual outdoor transmission.²¹¹ Exercising or relaxing in parks or at the beach, even if momentarily getting within a few feet of other people – or even participating in mass protest marches (especially if masks are commonly used) – are not high-risk situations for spreading the virus.^{3,27,71} In fact, now more than ever it is critically important for people of all ages to practice regular activity

Japanese investigators estimated that being outdoors carries 19 times lower risk of infection than being indoors.

for physical^{28,47,48,227} and mental health reasons.^{41,44,227,228} Even indoor public exercise may be safe to resume, at least in low-prevalence settings and if necessary precautions are taken. Preliminary findings from a large Norwegian trial found people who were randomized to work out at the gym did not have higher risk of acquiring the coronavirus compared to those randomized to remain home.²²⁹

- **FACT 4:** *Voluntary* changes in behavior – widely adopted habits of routine hygiene, distancing, etc. – have been the main factor in slowing the pandemic.

Although governmental measures such as shelter-in-place orders undoubtedly saved lives, especially in densely populated areas such as Wuhan, New York, and Madrid, voluntary adoption of simple *behavioral changes* like routine hygiene practices and physical distancing have had the greatest impact.^{3,207} Consistent with the experience of other public health challenges including HIV-AIDS, **coercive** measures such as issuing fines and arresting (or occasionally shooting) people for violating lockdown and curfew orders, as has occurred in a number of places, have been much less effective in curbing the pandemic.^{4,34,230,231,232} Many of the countries that had achieved the most successful responses, including South Korea, Hong Kong, Singapore, Japan, Taiwan, and Iceland, typically employed a more “surgical” or carefully targeted and evidence-based **public health** approach, focusing particularly on extensive testing, contact tracing, and quarantining.^{3,24,25,175,206,222,223} As a result, they were also able – unlike countries that relied on a more “blunt instrument” strategy of mandating total lockdowns – to keep open large parts of the economy and society, often including schools.

Many countries that achieved successful responses have employed a carefully targeted public health approach, and were able to keep open large parts of the economy and society.

- **FACT 5:** Despite the fear that health delivery systems would be overwhelmed by Covid-19, this has rarely happened so far.

Although medical personnel have occasionally been stretched to the limit in the hardest-hit areas, thankfully health systems have generally not been massively overwhelmed, except briefly in a few places such as northern Italy and Madrid, and have been able to respond adequately (and often heroically). In New York City, for example, many if not most of the 40,000 available ventilators apparently were not utilized, and makeshift temporary hospitals also went unused.²³² While flatten-the-curve emergency measures

are part of the reason this occurred – and while at the time it certainly seemed better to be prepared than sorry – moving forward we now know this is unlikely to happen, especially in more rural areas. Many rural hospitals are now facing the *opposite* problem: recently so few patients have been admitted, in part because of ongoing fear of contracting the coronavirus, that many hospitals will probably end up going out of business.²³³ A July 2020 analysis noted, “Thankfully, the scenario where hospitals across the country needed eight times their capacity did not happen. In the regions where the epidemic has already peaked, hospitals had sufficient capacity to care for all COVID-19 patients. On average, about one-third of hospital beds are available nationwide and most hospitals have plans for regional surges. Still, some cities or regions may have local surges that exceed hospital capacity, but this scenario should not be the norm.”²³⁴

However, as the pandemic increasingly expands into lower-income regions of the world including Africa and South Asia, the strain on already-fragile health systems will require ongoing attention and probably significant international assistance.^{36,184-89,235} Also, the situation in places like Houston and Arizona, where starting in late June 2020 many intensive care units (ICUs) began approaching near-capacity levels, certainly merits careful evaluation.^{236,237} Although the *proportion* of younger persons hospitalized with Covid-19 complications had increased, as would be expected since many more younger people were becoming infected, the absolute *numbers* of younger patients remained relatively low. Encouragingly, both the percentage of hospital patients requiring ICU care and the duration of hospital stays have been declining significantly.^{238,239}

- **FACT 6:** As horrific as this pandemic has been, to date it has killed just over half as many people as the “Hong Kong Flu” pandemic of 1968-69.

Especially if successful vaccines or effective treatment options are not developed within the next year or more, Covid-19 will eventually kill more than the approximately one million people who succumbed globally to that also-named “Forgotten Pandemic” (striking when the world’s population was half of today’s).²⁴⁰ The deaths from Covid-19 may even end up surpassing the estimated 1.5 million who died from the “Asian Flu” pandemic of 1958. While the devastation already inflicted by Covid-19 should not be minimized, thankfully it is very unlikely to kill anywhere near the over 40 million persons (2 million in the U.S.) who die each year from largely preventable chronic conditions including diabetes, hypertension,

Over 40 million persons die each year from largely preventable chronic conditions including diabetes, obesity, and smoking – the same predisposing conditions for dying from Covid-19.

obesity, and smoking.^{241,242,243} In fact, these are the very same underlying conditions that 1) *disproportionately affect poor and minority populations*, and 2) are associated with the great majority of Covid-19 deaths.^{59,60,61} Prioritizing effective prevention of such chronic conditions could therefore also help reduce future severe illness and deaths from Covid-19.^{3,62,63,65,243}

- **FACT 7:** Many more people than usual have died this year from non-Covid-19 causes, such as heart attack, stroke, and appendicitis, because of being denied medical attention or from avoiding hospitals due to fear of contracting the virus.

While probably most “excess” deaths (current mortality compared to death levels in previous years^{192,193,194}) observed in various countries have resulted from the previously mentioned under-counting of official Covid-19 deaths, a substantial number were also because of persons with other acute conditions who were turned away from hospitals, especially during the first months of the pandemic, due to an unrealized expectation of becoming overwhelmed by Covid-19 patients.^{21,23} An even greater number of unnecessary deaths, which according to a July 2020 *JAMA* study have accounted for *a third or more* of excess mortality this year,^{17,18} have occurred because of persons who, apparently from fear of acquiring the coronavirus, had avoided medical care for cardiac arrest, stroke, and other urgent conditions.^{17,19-23} Some pregnant women (who appear somewhat more vulnerable to Covid-19-related complications, though not of death^{244,245}) have also avoided giving birth in hospitals due to fear of contracting Covid-19.²⁴⁶

A third or more of all excess deaths this year have been among persons who avoided urgent medical care from fear of Covid-19.

- **FACT 8:** The media has tended to portray the more extreme aspects of Covid-19, feeding fear and anxiety.

Journalists deserve credit for quickly drawing attention to the magnitude of this crisis, especially earlier on, as well as for meticulously investigating many complex aspects of the problem (hence the large number of informative news reports cited in the references below). In retrospect, however, along with many of us attempting to make sense of a complicated challenge, the media could have done some things better. The pervasive

level of anxiety and fear surrounding this pandemic has been fed by stark mass media depictions of, for example, children dying from coronavirus-related causes or of young, healthy adults succumbing. Although this sort of dramatic coverage has not involved fabrication of evidence, it tends to misrepresent the actual nature of the disease, skewing the public's perception toward believing that many more young and healthy people are being impacted than is in fact the case.

Furthermore, and perhaps reminiscent of “AIDS exceptionalism,”⁹ the mass media typically does not contextualize the pain and loss caused by Covid-19. Without trivializing the pandemic's deadly impact, the public might be helped by placing the disease into a broader perspective. In Texas, for example, as coronavirus cases continued escalating during the first week of July 2020, reported Covid-19 deaths averaged 42 per day²⁴⁷ while average daily deaths from largely preventable heart disease were about triple that in the state.²⁴⁸ (However Covid-19 deaths did begin rising shortly thereafter.) Some media coverage has reinforced other misperceptions, such as tending to focus on issues like crowded beaches as the presumed source of new Covid-19 cases and deaths,^{27,71} rather than investigating much more important causes such as shortages of nursing home employees or the underlying reasons, including the obesity epidemic, for the high prevalence of preexisting chronic diseases.^{31,62,63,160,243}

On the other hand, and as the media has done during other health crises, it can also play a useful role in educating its viewers. For example, a physician expert interviewed by NBC News in May 2020 patiently explained why there is no scientific reason, if precautions are taken, for grandparents to avoid spending time again with their grandchildren. As she creatively suggested to viewers, from a health perspective simple but important gestures such as allowing children to hug one's waist or being comfortable kissing back of their heads is not risky. Even during periods of heightened concern caused by surges in new cases, it is vital not to allow ourselves to fall into unnecessary anxiety or fear. Responsible media coverage could help greatly in this regard.

A physician on TV patiently explained why there is no scientific reason for grandparents to avoid spending time again with their grandchildren.

- **FACT 9:** Some mitigation measures, particularly the use of ventilators, appear to have done more harm than good.

While apparently also not widely reported by the media, initial data suggested up to 85% of persons placed on ventilators for Covid-19 may have died, though more recent evidence indicates deaths have become substantially lower.^{249,250} Certainly, doctors are learning to use improved strategies, such as earlier provision of supplemental oxygen, and in countries like Germany have been encouraging people to seek treatment before symptoms become unbearable.^{238,239,251}

- **FACT 10:** The financial collapse and lost income resulting from prolonged economic shutdowns have resulted in unprecedented consequences.

While in hindsight the motives behind the more severe lockdown measures may be understandable, it is evident that they have also taken a huge economic and quality-of-life toll.^{24,33,35,36} These repercussions have been *far more painfully experienced in socioeconomically disadvantaged communities*,²⁵² including minority-owned businesses, for whom the long-term consequences appear dire.²⁵³ A May 2020 Kaiser Family Foundation analysis estimated that 27 million Americans had already lost their employer-based health insurance due to the economic downturn.^{254,255} The harm of remaining inside often-cramped living quarters for extended durations must also be considered, including documented upsurges in domestic violence,^{37,38,39} child abuse,^{40,41,42} obesity,^{47,48} social isolation,^{40,43} anxiety and depression,^{43,44,45} automobile accidents,^{256,257} and perhaps suicides.²⁵⁸ According to a June 2020 analysis, drug overdoses in the U.S. shot up 42% during the previous month, after finally having started to decline shortly before the pandemic hit.⁴⁶ Such stressors are experienced even more intensely among those suffering from obsessive-compulsive disorder,^{259,260} ADHD,²⁶¹ autism,¹⁴⁷ and other added challenges.

In poorer regions of the world such as Africa^{185,188} and South Asia,^{23,262} and despite the recently expanding epidemic in countries like South Africa, it is quite possible that the unintended repercussions from global lockdown measures could actually end up resulting in more harm than good.^{3,184,186,187,263} Indeed, in some places the harm done may eventually be of tragic proportions, including potentially vast increases in deaths due to hunger and malnutrition,^{33,34,264} malaria,²⁶⁵ tuberculosis,²⁶⁶ measles,²⁶⁷ AIDS,²⁶⁸ and other diseases,²⁶⁹ as vaccination,^{267,270,271} maternal and child health care,^{272,273} emergency food relief,

In parts of Africa and South Asia, the unintended repercussions from lockdown measures may even cause more harm than good.

HIV,²³⁵ and other basic services are suspended due to lockdowns or deprioritized while efforts refocus on Covid-19. Considering that young children are likely to be particularly impacted, this could represent an even greater magnitude of devastation if measured in terms of years-of-life lost rather than simply by counting excess deaths. Policy makers appear to be making enormously consequential decisions without fully considering some key demographic (and possibly significant climate^{224,225,226} and/or childhood vaccine-related factors^{203,204,205,274,275}) between lower-income tropical regions, characterized by more rural and much younger populations, and Europe and North America, with their more urban, considerably older and often more obese populations, that consequentially have much greater vulnerability to Covid-19 *mortality*.^{3,184-189}

■ **FACT 11:** Even if a relatively effective vaccine is eventually developed it may not be a perfect solution.

Based on experience with other respiratory pathogens and some emerging data on Covid-19, as mentioned earlier most experts believe that previous infection from the novel coronavirus probably offers some degree of immunity, although it remains unclear to what extent and especially for how long.^{162,163,164,276} However, if prior exposure does *not* provide relatively long-lasting immunity, then a vaccine is also very unlikely to work. Even if a successful vaccine is eventually developed, it may not be a perfect solution. While a relatively effective vaccine might be widely available by late 2020 at the very earliest, as previously mentioned it could certainly take much longer.¹⁷⁸ Vaccines may be far less than 100% effective, especially if the virus mutates significantly, and regular booster shots and/or constant reformulation may be required, such as with annual flu shots.^{161,164,165}

If prior infection with the coronavirus doesn't provide immunity, then a vaccine is also very unlikely to work.

■ **FACT 12:** There are reasons to be hopeful that we can return to (more) of a sense of "normality."

Intriguingly, there are suggestions that, at least in areas that were hard-hit, the coronavirus may be becoming less *lethal*²⁷⁷ (while evidently becoming more *contagious*²⁷⁸), a not uncommon pattern for viral parasites. Scientists in Italy, Spain, Israel, and the U.S. report discovering genetic mutations and other indications that the virus, through evolutionary self-selection, may be pursuing the kind of "don't burn the house" strategy that other pathogens regularly adopt

As new cases worldwide continued to climb throughout 2020, daily the number of Covid-19 deaths steadily declined from mid-April through late May.

in order not to kill too many of their hosts.²⁷⁷ Though it may be too early to know whether this is really taking place (which some other researchers dispute²⁷⁹), nonetheless it is curious that, while the number of daily new *cases* worldwide had continued to climb throughout the first half of 2020, from about mid-April through late May the daily number of reported Covid-19 *deaths* had steadily declined, and then remained relatively flat through early July.²⁸⁰ Although this discrepancy is partly due to poor official recording of deaths as well as to greatly expanded testing, it may also relate to the fact that many recent infections have taken place in lower-income regions. Despite the worrisome vulnerability in such settings of weaker health care systems, the age pyramid is typically much more weighted toward younger people, who are of course far less likely to die from Covid-19.^{184,185,187,189} There have been clear indications of this pattern occurring in India, for example.^{281,282,283} However, time will tell whether global deaths continue to hover at around 5,000 a day or whether they might, following a U-shaped curve, begin once again to rise substantially.

A widely circulated modeling study predicted in late April 2020 that U.S. deaths would reach 3,000 per day by the end of May 2020.²⁸⁴ Thankfully, daily Covid-19 deaths actually continued falling in the U.S. (as in Europe) from mid-April 2020, averaging less than 1,000 deaths per day between late May and late June, and then dropped even further through early July. However, in late May reported *cases* began rising at an alarming rate, particularly in several southern and southwestern states and in southern California, areas that had largely evaded the initial wave earlier in 2020. The recent reopening of bars, restaurants and other venues – more directly related to what can be termed “casual transmission” – is likely one reason for the surges in new cases. However, it is quite possible that *most* of the recent infections are consistent with the main pattern throughout the world so far. As previously discussed, extensive contact tracing studies conducted in Wuhan, China in February 2020 and subsequent research in several other countries have indicated that the large majority of coronavirus infections take place within *clusters* of family members, co-workers, church congregants and other persons spending prolonged periods of time in close proximity.^{3,67,71,209,210,211} As the U.S. economy began to reopen in many states, it seems likely that workers in a variety of industries, especially lower-earning manual laborers, began getting exposed in far greater numbers.

As the U.S. economy began reopening in many states, workers in various industries began getting exposed in far greater numbers.

The most important question regards the magnitude of increased *deaths* that will inevitably follow the ongoing steep rise in infections in the southern and western parts of the U.S. The fact that starting in late June 2020 many ICUs nearly reached capacity in cities such as Houston is troubling.^{236,237,239} Yet given that the recent wave of infections

has been disproportionately striking younger people compared to the elderly, the eventual increase in deaths will likely be much less pronounced than during the crisis that befell parts of the East Coast, Midwest, and Europe earlier in the year.^{239,285} As of July 10, 2020, over a month after cases began increasing sharply in states including Texas, Florida, and California, the predicted large jump in Covid-19 deaths had yet to materialize.^{286,287,288} Given the soaring numbers of cases in June, however, the amount of daily deaths could eventually double or even triple compared to the low point in early July of around 400 per day. Yet even in that unfortunate scenario, deaths are unlikely to rise anywhere nearly as sharply as have the tide of new cases. It may also be worth noting that if a sizeable portion of the population does end up becoming infected (perhaps due partly to the coronavirus having mutated over time to become more contagious²⁷⁸) while this may not approach herd immunity, as mentioned earlier substantially fewer people may therefore be at risk in a future wave(s). From a prevention perspective, a community where 35% of its members have previously been infected would probably be less vulnerable than one where only 5% may have immunity.^{178,179}

A community where 35% of people have previously been infected is probably considerably less vulnerable than one where only 5% might have immunity.

In addition, research is urgently needed regarding the prevalence, diagnosis, prognosis, and treatment options for longer-term severe Covid-19 complications,^{167,168,170} including post-traumatic stress disorder, which may be fairly common.^{289,290} Another crucial concern – in addition to the often-mishandled political leadership in the U.S., Brazil,^{291,292} the U.K., Iran, etc. – is the much higher Covid-19 death rate in African-American communities, due among other reasons to a greater prevalence of predisposing conditions such as diabetes, obesity, and hypertension.^{59,62,243} At the same time, the recent rise in new cases in states including Texas, Florida, Arizona, and California are disproportionately occurring not only in much younger persons but particularly among Latinos, including many undocumented immigrants with little if any access to health care.^{293,294,295} Members of these communities tend to share more crowded living quarters, to work in higher-risk occupations such as meatpacking plants, and otherwise are less able to practice distancing and other prevention measures. Additionally, Latino cultures tend to be, fairly similarly to southern Europe, more physically demonstrative.

As of mid-June 2020, 46% of cases in North Carolina were reported among Hispanics, who make up only 9% of the state's population.²⁹⁶ Interestingly, just 8% of recorded Covid-19 deaths occurred among this population (though likely due in part to under-reporting issues), compared to 33% of deaths taking place among African-Americans, who comprise 22% of the state's residents. In California, 57% of reported cases have been among Latinos, and the CDC estimated that by late June 2020 nationally 33% of all cases

had occurred in Latinos, about double their proportion of the U.S. population.^{293,297} In Arizona, where in early July 2020 per-capita cases soared the most of any state, according to the 2010 Census 30% of the population are Latinos, and data from June 2020 indicates the per-capita number of Covid-19 cases among Latinos is more than twice as high as other ethnic groups in the state.²⁹⁸ On July 7, 2020 the CDC reported on data from workers in 329 U.S. meat and poultry facilities across 23 states, finding that 56% of cases had occurred among Hispanic employees, who made up just 30% of the workers.^{215,216} Perhaps paralleling the Swedish situation mentioned earlier, some health authorities in southern and western U.S. states may feel torn between the need to focus, epidemiologically, where the problem is centered yet they may also be hesitant, especially given the politically explosive issue of immigration, to draw attention to the fact that Latino communities are being overwhelmingly affected.

Many had worried that the mass street rallies over the police murder of George Floyd carried out in many places including Minneapolis, Seattle, Washington, D.C., and New York City would result in spikes of new Covid-19 cases. Yet a month and a half later no notable increases in these regions had been observed, and routine testing of many thousands of protestors in those cities yielded seropositivity rates of about 1%, lower than in the surrounding communities.^{299,300,301} (Previously, it had been wrongly predicted that anti-lockdown protests in places like Michigan would similarly stoke the epidemic.) Future historians may view this as a pivotal moment when a key segment of the U.S. population not only took to the streets to protest racism and police brutality, but as a result also began to regain a meaningful sense of public “normality” for the first time since the Covid-19 crisis had begun. (However, the subsequent upsurge in new cases in some parts of the U.S. has, at least for now, dampened the mood, as starkly borne out in July 2020 polling data.³⁰²)

Along with the prospect that deaths appear to be declining somewhat over time (certainly in proportion to the number of cases), researchers and clinicians are hopeful because a slew of medications and procedures to reduce the risk of death and severe illness are being developed and tested, in addition to rapid and affordable home tests. Such drugs include combinations of antivirals, the anti-inflammatory steroid dexamethasone, as well as the possibility that current trials of century-old childhood vaccines against tuberculosis and polio may provide some protection against the new coronavirus.^{203,204,205} Although certainly much

A month and a half following the George Floyd mass street protests, associated increases in Covid-19 cases have not been observed.

If another big wave comes, we will be better prepared and hopefully smarter about focusing energy on the most useful precautions.

pain and death still lies ahead, these developments along with improved clinical practices, which are clearly another reason for the decline in deaths,^{238,239,249,250} offer some hope that perhaps the overall situation will be turning around before much longer. Despite the potential for a larger wave in late 2020, perhaps including in some places that were hit hard earlier this year, both the public and scientists know much more about this virus than we did just a few months ago. And if another big wave does eventually materialize, we will be better prepared and hopefully smarter about focusing our energies on using the most effective precautions.

CONCLUSION

This review of the existing (and yes, ever-changing) evidence has attempted to synthesize and present the best available data – and apparent myths – regarding the novel coronavirus and the global pandemic it has unleashed. All of us understandably are fearful or at least seriously concerned. (As I write these final words my teenage daughters, who just boarded a plane to visit me, are texting anxiously because the flight is full and someone’s sitting in the same row.) But I hope that a careful examination of the scientific evidence has provided some practical suggestions for lowering the risk of illness and death and has helped to alleviate anxiety and fear. I have been reassuring my normally adventurous elderly mother in California and my previously energetic mother-in-law in Madrid that they can, and indeed should, resume enjoying daily walks and (with care) socializing.

That said, it is of immediate concern that the peak in cases has not yet been reached in some areas, including parts of the southern and western U.S., Latin America,³⁰³ South Asia,^{23,262} and Africa.³⁰⁴ Although things remain painful and scary for many of us, and while understandably there is hesitation to let down our guard (and regardless of whatever ideological controversy may be broiling at the moment), it is imperative to remember that spikes and occasionally outright waves of cases are inevitable nearly everywhere. And as testing continues to increase, more cases will invariably be found. Indeed, we must continue expanding testing services to allow for early identification of cases, following those up with contact tracing, and ideally, despite seemingly immense logistical and cultural challenges, when possible quarantining new cases away from home. Yet the level of deaths must always be the most important indicator to monitor. We need to strategically prioritize how best to prevent severe (and longer-term) illness and **death**, instead of focusing overwhelmingly on attempting to eliminate new **cases**.

We must strategically prioritize how best to prevent severe illness and **death** rather than overwhelmingly focusing on attempting to eliminate new **cases**.

On a reflective note, while the previous respiratory pandemics of 1918-1919, 1958, and 1968-69 killed a horrifying number of people, in an evolutionary sense they also acted like enormous global “vaccines”: subsequent generations have to a large degree been naturally immunized from the three major influenza strains introduced by those global pandemics.³⁰⁵ It is quite plausible that the four known older strains of coronaviruses – which today cause many of the common colds that children and others acquire but are only rarely killed by – long ago made their entrance as similarly murderous pandemics.

Of course, we must continue doing everything possible to develop effective vaccines, medications, and other useful mitigation approaches. We must also attempt to prevent the next deadly – and potentially even more horrific – pandemic, such as through banning international traffic in exotic animals like pangolins, which may have served as an intermediary species to introduce a bat coronavirus into human beings.^{306,307} In addition, we might conceivably try viewing Covid-19 not only as an enemy to be somehow defeated but, from a longer-term and more ecological perspective, as a part of the natural world with which our species must, painfully but out of necessity, learn somehow to co-exist. If this coronavirus is indeed on an evolutionary trajectory toward advancing its survivability through becoming more contagious and less deadly over time,^{277,278} in the future it may essentially join its four cousins to become the newest widely circulating but uncommonly fatal coronavirus.

A May 2020 essay in *The Atlantic* advised it is time to figure out, as we have done with other health challenges such as AIDS, “how to have a (safer) life during a pandemic.”⁸ As an epidemiologist, teacher, son, and father myself, I agree it is time to move beyond excessive anxiety and fear. While carefully evaluating the best ways to practice precautions, we may also learn how to *live* better, grateful for what joy we can experience despite the challenging circumstances this novel virus has thrust upon us all.

It is time to learn, as we have done with other health challenges, how to have a (safer) *life* during this pandemic.

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