



COVID-19 Pandemic and the Fool's Errand of Pseudoscience-Based Decision-Making

Science is a very successful and reliable enterprise for understanding the natural world. Without science and the technology that stems from science, human population and life-expectancy would be a fraction of what it is now. Tombstones in cemeteries provide testimony of how prevalent childhood and early adult deaths were prior to advancements in science. Ironically, the success of science and technology blinds many people to the realities of life and death in the not-to-distant past. Those who faced the ravages of disease, common ailments, inhospitable weather, and other devastating realities of life would be shocked at the advances that we now take for granted. They would likely be equally perplexed at the significant and growing distrust of advances in science that have mitigated the suffering they had to endure.

Distrust of science and increasing adherence to pseudoscientific claims follow, in part, from how far science has progressed. Suspicions increase because of the advanced study often required to comprehend many scientific ideas and their justification. Few citizens or policymakers have the requisite background to understand and judge scientific claims. Even scientists are so specialized that they can only speak authoritatively in their own field of expertise. But citizens and policymakers can and must understand how to judge who are the authentic scientific experts, and then respect that expertise in personal and societal decision-making. Accurately identifying the community of authentic experts to trust in decision-making is crucial because the misuse and misrepresentation of science is a long-standing and growing threat to personal and societal well-being.

Distinguishing science from pseudoscience can be difficult for two reasons. First, while a strength of science is its ability to revisit and possibly revise ideas about the natural world, non-experts may wrongly see changing scientific knowledge as fleeting and unreliable¹. Second, pseudoscientific claims often sound scientific, invoke some aspects of authentic science, and wrongly promote doubt when scientific knowledge is modified. Pseudoscience takes two broad forms: (1) *Pseudoscience idea promotion* — encouraging ideas that are unsubstantiated or at odds with ideas that the community of experts maintain are best supported; and (2) *Science*

denial or inappropriate skepticism — rejecting or creating doubt about science in order to fabricate an illusion that a scientific controversy exists. Both forms result in uncertainty about and resistance to reliable scientific knowledge and consensus. This leads to doubting the community of authentic experts and a hesitancy to act appropriately to very real problems. Most disconcerting is the purposeful promotion of pseudoscience for personal, economic, and/or ideological reasons. The COVID-19 pandemic illustrates how pseudoscience promotes poor decision-making that places all of society at risk, and how the navigation of information and identification of trustworthy expertise are crucial for better decision-making.



Strategies of those spreading pseudoscience include: 1) appeals to the public via media rather than through expert peer-review; 2) “cherry picking” reports and data to support claims that are at odds with the full body of scientific evidence and the consensus view; and 3) challenging science using inconsistent arguments² (i.e., using unreasonable standards to challenge well-supported scientific claims while at the same time putting forward weak evidence for a pseudoscientific claim).

A clear example of deliberate pseudoscience promotion is the tobacco industry's doubt campaign during the twentieth century regarding smoking that has resulted in an estimated 100 million deaths. Early efforts employed persuasive advertising with images of doctors and researchers to encourage smokers to determine for themselves whether cigarettes cause throat irritation (Figure 1). This tactic inappropriately conveyed that personal experience and scientific research were equally reliable. By the mid-1950's, converging evidence from clinical observations, epidemiology, animal experts, and chemical analyses established a clear link between smoking and lung cancer. The tobacco industry, anticipating the economic threat to their industry, changed their pseudoscience approaches to cast doubt on the link between smoking and cancer. Rather than attack science

FIGURE 1
Cigarette advertisements appearing in 1947 and 1951



http://tobacco.stanford.edu/tobacco_web/images/tobacco_ads/pseudoscience/single_case/large/case_01.jpg
http://tobacco.stanford.edu/tobacco_web/images/tobacco_ads/pseudoscience/pseudoscience/large/pseudo_01.jpg

cancer was based on “animal studies” and “merely statistical.” The tobacco industry further exploited the public's lack of science expertise by promoting inappropriately skeptical questions that were already well understood by the scientific community, thus creating a false narrative of scientific controversy.

1. How do the smoking advertisements above use imagery and statements to infuse doubt and uncertainty among the public, while also endowing the consumer with a false sense that they have expertise like that of medical researchers and practitioners?

directly, the tobacco industry sought to convince the public of its own scientific credibility while simultaneously undermining the notion that scientific consensus existed about the ill effects of smoking³. For instance, they created a Council for Tobacco Research, spending \$300 million between 1954 and 1997 to manufacture doubt about the science on smoking and health invoked (Figure 2). This included releasing scientifically sounding reports and recruiting doctors and scientists (many of which lacked relevant expertise) to promote those reports^{4,5,6}. These pseudo-experts claimed that evidence linking smoking to

! **Pseudoscience efforts may also include misuses of well-established scientific claims to advance economic, ideological, and personal agendas. For instance, e-cigarette marketers wrongly convey that vaping is safe by emphasizing the well-established scientific conclusion regarding the adverse health consequences of smoking.**

FIGURE 2
Cigarette advertisements in 1954 and 1959. Kent's filter was made of crocidolite asbestos, which is considered the deadliest form of asbestos due to the small amounts that can cause mesothelioma.

The American Medical Association voluntarily conducted in their own laboratory a series of independent tests of filters and filter cigarettes. As reported in the Journal of the American Medical Association, these tests proved that of all the filter cigarettes tested, one type was the most effective for removing tars and nicotine. This type filter is used by Kent...and only Kent!



http://tobacco.stanford.edu/tobacco_web/images/tobacco_ads/filter_safety_myths/protects_your_health/large/protects_14.jpg
http://tobacco.stanford.edu/tobacco_web/images/tobacco_ads/pseudoscience/pseudoscience/large/pseudo_48.jpg

Many examples exist illustrating how pseudoscience has caused widespread doubt and detrimental public and personal decision-making, including the 1918 Spanish Flu and the COVID-19 pandemics. The 1918 Spanish Flu began during the end of World War I. Crowded camps and troop movements significantly contributed to the spread of the influenza strain⁸. The politics and cultural milieu during the war greatly exacerbated the effects of the 1918 Flu and fostered an environment conducive to pseudoscience promotion and questioning the severity of the pandemic. Censorship laws in Europe were increasingly utilized at that time to suppress news about the pandemic that might negatively impact national morale⁹.

A strong sense of patriotism among Americans and Europeans encouraged citizens to remain supportive and

consumed with the war effort to the point that expressing concerns about the flu was discouraged. On September 28, 1918 in Philadelphia, 200,000 citizens gathered for the Liberty Loan Parade held to promote government war bonds, creating a fertile ground for the Spanish Flu to spread¹⁰. Within three days every city hospital was filled, and approximately 12,000 people died of the flu in the ensuing month.

As the pandemic progressed, pseudoscientific thinking and remedies, including cigarettes (Figure 3) and snake oil elixirs gained traction¹¹. At the same time, more scientifically grounded preventative measures were enacted in major cities. San Francisco closed all schools, businesses, bars, and churches on October 18th and four days later passed an ordinance requiring masks consisting of at least four layers of fine mesh gauze or butter cloth be worn over the nose and mouth. A precipitous drop in influenza cases in San Francisco weeks after initiating the mask ordinance prompted several cities in America to also initiate such measures¹².

However, such stringent mask guidelines were not widely adopted, and people often constructed ineffective masks, thus inadequately preventing the spread of the flu and bolstering peoples' skepticism that masks work¹³. Mask use became a culturally and politically contentious issue despite being urged by the expert medical community.

Anti-maskers claimed such ordinances were government overreach, unconstitutional, and unjustified. Proponents of mask wearing advocated that doing so was a patriotic act that would support the war effort, and dubbed those that did not "mask slackers." The contention surrounding the effectiveness of masks permeated public discourse. For instance, a November 1918 publication in the Los Angeles Times reported of how city officials deciding on a mask ordinance solicited public feedback, which ranged from some opining that masks were merely harmful dust traps to others claiming their use would enable schools and churches to function¹⁴.

On November 13th only six new cases of the flu were reported in San Francisco. Sensing that the epi-

demic was over, social distancing measures were relaxed, businesses and churches were reopened, and on the 21st the mask ordinance was repealed. The mask ordinance repeal was met with such public jubilation that people literally ripped off their masks in the streets and celebrated. Unfortunately, thousands of new flu cases occurred over the following weeks and a reinstatement of the mask ordinance was deliberated on December 4th by the Board of Health and pivotal community members. The San Francisco mask ordinance reinstatement proposal was highly contentious, particularly given the upcoming holiday season, and met with resistance by those with political and economic interests. This resistance to mask

wearing grew throughout the winter of 1918 to spring of 1919 despite the San Francisco Board of Health and the American Public Health Association declaring the effectiveness of masks to mitigate nose and throat discharges that publicly spread the flu.

Doubt was cast on expert recommendations with claims that not enough was known about flu cause or prevention, and therefore mask use should not be enforced. Another sentiment published in the San Francisco Chronicle appeared to question the scientific community's well-substantiated discarding of miasmatic theory (that disease was caused by foul odors) in favor of germ theory (that microorganisms caused disease) as a means to cast doubt on the current medical recommendations:

The medical fraternity has impressed upon us for twenty years past that bad air is harmful to consumptives and that fresh air is the best preventive and cure. Now we are told to wear masks and breathe foul air.

FIGURE 3
Example of pseudoscientific advertising used during the 1918 Flu Pandemic



https://digging-history.com/wp-content/uploads/2020/03/The_Brooklyn_Daily_Eagle_Thu_Nov_14_1918_p21-Smo-ko-tobaccoless-cigarettes.jpg

FIGURE 4
Flyer promoting the Anti-Mask League rally occurring on January 25, 1919.



<https://static01.nytimes.com/images/2020/07/17/multimedia/00xp-virus-1918masks-anti/00xp-virus-1918masks-anti-jumbo.jpg>

Finally, on January 17th after 4,000 new cases and 327 deaths were reported the previous week, the mayor of San Francisco reinstated the mask ordinance. In response, a politically motivated newly formed organization, The Anti-Mask League held a 2,000-person rally condemning the mask ordinance and calling for the dismissal of the city health officer and recall of the mayor (Figure 4).



See the story “COVID-19 Pandemic and Decision-Making” that addresses why germ theory replaced miasma theory, and how germ theory has become well-established and is essential for understanding, treating, and preventing disease.

Many parallels exist between how people conceptualized and responded to the 1918 flu pandemic and the 2020 COVID-19 pandemic. Uncertainty and fear among the public, political-ideological divisions, and economic interests, combined with scientists and medical experts confronting a new and not well understood disease, provided opportunities for rampant pseudoscience to spread. A study¹⁵ published by the Reuters Institute for the Study of Journalism, reported that most COVID-19 misinformation entailed “...various forms of reconfiguration, where existing and often true information is spun, twisted, recontextualised, or reworked” and that “top-down misinformation from politicians, celebrities, and other prominent public figures” was forefront across social media. However, the majority of misinformation regarding COVID-19 has appeared on social media from ordinary people.

The pseudoscientific thinking and remedies prevalent during both the 1918 flu pandemic and 2020 COVID-19 pandemic are strikingly similar. Pseudoscientific COVID-19 cures and prophylactics peddled for economic gain include silver-containing wound gels and toothpastes promoted by radio show host, political extremist, and conspiracy theorist Alex Jones. The Food and Drug Administration (FDA) responded to Jones with a cease and desist for promoting the products without evidence¹⁶. Posting to 2.4 million followers on Twitter showing non-descript pills and a liquid injection, actor Keith Middlebrook claimed to have developed a preventative and cure for COVID-19 and sought investors¹⁷. Middlebrook, who was arrested by the FBI and charged with wire fraud, made claims using scientific terminology to make his assertions appear credible.

Pervasive pseudoscientific claims among the public wrongly assert that people should not be concerned about COVID-19 because it is no worse than the flu, has 98.54% survival rate, and is a concern primarily of the elderly and ill. Like many pseudoscience claims, they have vestiges of accurate science. For *some people* the flu may be more serious, but overall the novel coronavirus has resulted in significantly more deaths than even a major flu season¹⁸. COVID-19 has been attributed to approximately 30,000 American deaths per month while the 2019-2020 flu caused an estimated 4,000-10,000 American deaths per month^{19,20}. Second, fatality rates will vary greatly depending on contextual features such as who is infected, where they live, what medical resources are available and

whether they are in a heightened risk category due to underlying health conditions. The COVID-19 fatality rates (# deaths/# of confirmed cases) reported on August 8th, 2020 varied dramatically by country (e.g., 0.1% in Singapore, 3.3% in the United States and 15.1% in the United Kingdom). Moreover, while those over 65 demonstrate higher levels of mortality, one in five 18-34 year-olds infected with COVID-19 suffer for weeks from ongoing symptoms including cough, fatigue, and shortness of breath. In the United States, 18-44 year-olds accounted for 20% of hospitalizations and 12% of ICU admissions due to COVID-19²¹. Furthermore, cardiology research studies are reporting that a high percentage of study participants having recovered from mild to moderate COVID-19 cases are showing cardiac abnormalities; 76% had evidence of a biomarker signaling cardiac injury typically found after a heart attack, and 60% expressed inflammatory indications²². Further research will clarify the delayed health and mortality implications of COVID-19 infections among people of all ages.

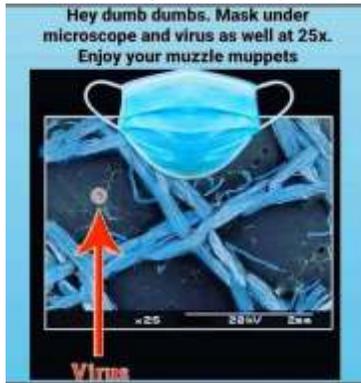
An earlier pervasive and carelessly optimistic notion that diminished how seriously people responded to COVID-19 was that the virus and resulting pandemic would fade with warmer weather. This idea made intuitive sense to many citizens, as the claim reflected prior experience with colds and flu that have seasonal variation. Like many pseudoscientific claims, just enough authentic science knowledge existed to make the false claim appear viable. While some research has reported that warmer temperatures and increased humidity may reduce the viability of SARS-CoV-2, epidemiological modeling research demonstrates that climate variations only become an important seasonal factor when a large proportion of people demonstrate immunity or resistance to the disease²³. Moreover, models that presumed appropriate social distancing measures are followed along with warmer temperatures did indicate the virus spread would be lower. Initial credible research and analysis projects that COVID-19 spread may vary seasonally if enough people demonstrate immunity, however further research is needed to develop certainty with how COVID-19 will seasonally fluctuate²⁴.

Among the most controversial issues in the United States during the COVID-19 pandemic is mask-wearing. Some leading political figures fanned this issue by refusing to wear masks²⁵. Similar protests also occurred internationally in countries such as Germany and the United Kingdom²⁶. Arguments against wearing masks are pseudoscientific, ideologically driven, and strikingly reminiscent of those during the 1918 flu pandemic. Some people argue that mask-wearing is an infringement on personal liberty and governmental overreach. Pseudoscientific claims include, but are not limited to, the belief that masks offer little or no protection from catching or transmitting the virus responsible for COVID-19. As with

many pseudoscience claims, anti-mask arguments reference valid scientific knowledge, but then manipulate it in a way to inaccurately support their pseudoscientific claims (Figure 5).

FIGURE 5

Meme retrieved from social media promoting pseudo-science about mask effectiveness. Note the meme wrongly indicates viral particles can be seen through a microscope at 25x magnification.

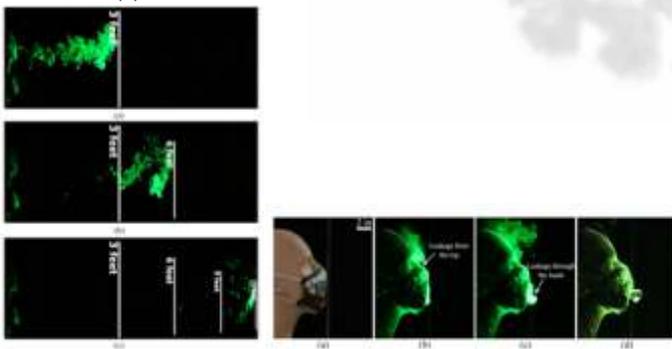


<https://www.facebook.com/TheCaliforniaPatriot/photos/a.106970434001526/320261816005719/>

For instance, claims that viruses are too small to be captured by common masks is correct. However, the SARS-CoV-2 virus responsible for COVID-19 disease requires droplets for effective transmission. Masks *are* effective at preventing a significant portion of droplets from escaping when one breathes, coughs, or sneezes; and they markedly reduce the distance that smaller escaping droplets travel, thus reducing the transmission rate (Figure 6²⁷)

FIGURE 6

Images published by Verma, Dhanak, and Frankenfield (2020) modeling the spread of droplets with and without masks. The first image shows how far an unimpeded cough can travel at (a) 2.3s, (b) 11s, and (c) 53s. The second images shows how far the same cough travels through a homemade two-layer cotton mask at (b) 0.2s, (c) 0.47s, and (d) 1.68s.



Another pseudoscientific claim is that masks will not adequately pass CO₂ and are thus harmful to the wearer. Note how this claim is at odds with the claim regarding the size of viruses compared to openings in the weaving of masks. Some evidence does indicate that tight fitting N95

masks may impact breathing if worn continuously for hours — particularly for those with respiratory illnesses — but the risk is virtually non-existent and exemptions to mask-wearing exist for young children and others who qualify²⁸.

Notice how these pseudoscientific claims play on peoples' common-sense notions about viruses, CO₂, and other science knowledge. To truly understand the claims being made would require a deeper understanding of science, including, but not limited to, knowing that the diameter of SARS-CoV-2 is between 0.06 to 0.14 micrometers (µm)²⁹, whereas a CO₂ molecule is merely 0.00033 µm. The size of droplets produced when people engage in various activities are typically between 1 µm to 500 µm in diameter with a mean diameter of 10 µm²⁷. The crucial take home messages here are that the clear consensus among the community of scientific and medical experts is that masks are effective at preventing a significant proportion of the larger virus-carrying droplets from escaping from exhaled air, and also somewhat effective (but less so) at preventing someone else's droplets from being inhaled. The more general take-home message is to understand how those promoting pseudoscientific claims use accurate science ideas in supporting incorrect conclusions and action.

Another tactic of those promoting pseudoscientific claims is to emphasize scientific uncertainty, particularly when scientific thinking changes. Early in the pandemic, uncertainties surrounding the methods of viral transmission and the potential shortage of protective equipment for frontline health care professionals led to recommendations which *at the time* were based on the best available evidence. For instance, at that time experts were unaware of how unique COVID-19 is regarding its high infectivity and the long duration to which asymptomatic people can spread the virus. Unfortunately, these initial uncertainties that are a normal part of emerging science, and decisions made to protect those on the front lines of medicine have been used as fodder for those seeking to spread pseudoscientific claims.

As scientists have developed a deeper understanding of how novel coronavirus spreads, the benefits of masks to prevent infection for both the wearer and others have become apparent and well supported^{30,31,32}. For instance, well-established research demonstrates that sneezing may produce as many as 40,000 droplets that can be expelled up to 100 m/s. A single cough or talking for five minutes each produce up to 3,000 droplets^{33,34}. A meta-analysis (i.e., a rigorous systematic review of many studies) by Bahl, et. al., (2020)³⁵ reports that droplets can travel more than six and up to 26 feet, and that aerosolized SARS-CoV-2 has remained viable for up to 3 hours and transmitted up to 13 feet. Other emerging research proposes that the six feet social distancing recommendations may be insufficient – particularly if

masks are not being worn^{36, 37, 38}. Through conducting a meta-analysis on the effectiveness of masks, Chu et al., (2020, p. 1980) demonstrated that while protection may differ based on mask type:

Across 29 unadjusted studies and ten adjusted studies the use of both N95 or similar respirators or face masks (e.g., disposable surgical masks or similar reusable 12–16-layer cotton masks) by those exposed to infected individuals was associated with a large reduction in risk of infection.

The overwhelming evidence regarding SARS-CoV-2 spread support precautionary measures recommended by the CDC to include wearing masks. Despite the consensus that has emerged among scientists and healthcare professionals, a significant portion of the public has become resistant to wearing masks for various ideological reasons that are often bolstered through pseudoscience.



Well established science has informed the enactment of rules and regulations that protect public and environmental health, which most people unquestioningly enjoy. For instance, the dumping of raw sewage from a private property is illegal because of the widespread detrimental impacts on human and environmental health. Other examples include protecting others from second-hand smoke in public spaces, requiring shirts and shoes in businesses, and other sanitation codes.

The unfortunate pseudoscientific politicization of mask-wearing is perhaps best summed up by many high-ranking public officials now promoting the wearing of masks. In mid-July, Senate Majority Leader, Mitch McConnell, stated, “I’m here to tell you, put it on... I’ve been saying over and over and over again, wear your mask... [The virus] has no idea what a Republican or Democrat is”³⁹.

What makes determining pseudoscientific claims most difficult for citizens and policymakers is when such ideas are put forward by what appear to be sufficiently credentialed individuals or groups. For example, in May 2020 a video called “Plandemic” was released on YouTube, widely shared across Facebook and other social media. The video is a clear example of pseudoscience and features Judy Mikovits, referred to as “one of the most accomplished scientists of her generation”⁴⁰. Mikovits does possess advanced science degrees, but much of her research and science opinions have been discredited by the scientific community. Her 2009 co-authored paper about mouse retrovirus contributing to chronic fatigue syndrome had to be retracted for being erroneous. That same year, she was fired from her position as research director at the Whittemore Peterson Institute located on the University of Nevada

campus. She has not published in the scientific literature since 2012 and has publicly made statements at odds with well-established scientific knowledge.

In the Plandemic video, Mikovits put forward absurd claims including that SARS-CoV-2 was being erroneously blamed for many deaths, flu vaccines increase the chances of getting COVID-19 by 36%, staying home and limiting exposure to microbes will weaken the immune system, and that wearing masks activates viruses. This pseudoscientific documentary played off citizens’ uncertainty and anxiety about the pandemic, and then used documentary-like filming to provide what wrongly appear as valid answers from what appears to be a trustworthy and credible expert. For instance, the video inappropriately invokes the hygiene hypothesis (that children must be exposed to germs to build the immune system to protect against allergic diseases) to persuade the viewer that sheltering in place is a poor health choice⁴⁰.

This is problematic on two fronts. First, while some emerging research indicates that recent infection by other coronaviruses may provide some protection, most humans have little to no pre-existing immunity to SARS-CoV-2. Second, emerging evidence and research on other coronaviruses (e.g., MERS) indicates immunity after recovering from COVID-19 may be short-lived^{41,42}. In a similar way, the claim that wearing a mask makes you sicker with reactivated coronavirus ignores the basic fundamentals regarding human immune responses, yet seems intuitive because it plays off of the fact that some viruses with higher viral concentrations and loads can play a role in infection and severity of sickness.

At times, even credible scientists put forward ideas that turn out to be false, but they continue to promote them. Linus Pauling, who received the 1954 Nobel Prize in Chemistry and the 1962 Nobel Prize for Peace, maintained that large doses of Vitamin C prevented colds and could cure cancer. Despite overwhelming evidence to the contrary, and the rejection of his claims, he continued his advocacy the remainder of his life. This illustrates that in assessing the merits of scientific claims, the consensus view of authentic experts in a field, not the view of one or a small number of experts, should guide decision-making.

2. At the conclusion of his Space Shuttle Challenger Accident report in 1986, Physics Nobel Prize winner Richard Feynman concluded "For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled." Mask design, construction, and protocols for wearing them are all technologies informed by science. In what ways does Feynman's quote relate to the contention surrounding masks during the 1918 Flu and COVID-19 pandemics?

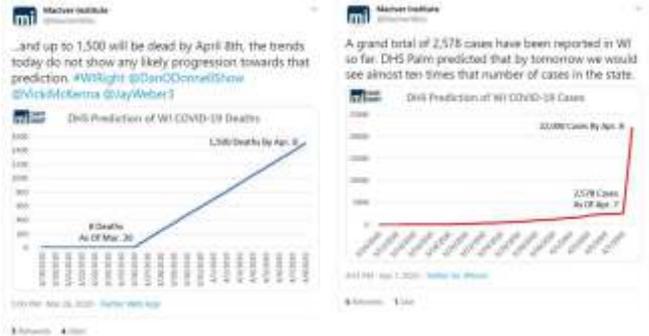
Scientific models have also been used by promoters of pseudoscience. While scientific models serve as powerful and valuable tools for informing policymakers and the public, they inherently entail varying degrees of uncertainty. This is illustrated in hurricane tracking and weather forecasts. While over the past decades we have witnessed increasing accuracy, they still have uncertainty. A variety of COVID-19 pandemic models made projections that, not surprisingly, reflected the emerging and uncertain nature of the pandemic. However, that uncertainty was wrongly used to dismiss the value of such models. Media reports and lay people often expect and speak about scientific models as if they should precisely represent reality and make accurate predictions; then are puzzled when the models are revised with new projections. However, incorporating incoming data, and revising model assumptions and parameters is standard scientific practice so that models reflect the best available evidence and knowledge.

These issues are further exacerbated when the COVID-19 models and modelers were misrepresented during the COVID-19 pandemic for economic and ideological agendas. For instance, early in the outbreak, conspiracy theorists claimed that the modelers were part of a deep-state plot seeking to use disease projections for political motives. Some politicians bolstered these notions by calling coronavirus warnings a “hoax” and questioning the projected COVID-19 cases and deaths. An early University of Washington Institute for Health Metrics and Evaluation (IHME) model predicted that if states enacted strict COVID-19 mitigating restrictions such as sheltering in place and social distancing, the first wave of infections would end by summer with a death toll ranging from 38,000 to 162,000. That same week, assertions were made that “Faulty models may be skewing COVID-19 data.” Later, on May 5th, a high-ranking public official wrongly stated the IHME’s updated projections of 134,000 potential COVID-19 deaths in the US did not include mitigating measures, when in fact they did. He later stated, “So you have all reports — look, models that have been very inaccurate. I’ve seen models that are very inaccurate... We did everything right. But now it’s time to go back to work.”⁴³ Misstating IHME model assumptions or misrepresenting data may be used to justify decisions at odds with the recommendations of health experts.

At times, promoters of pseudoscience misstated COVID-19 model assumptions, used projections out of context, or misrepresented the data⁴⁴. For instance, in late March a think tank in Wisconsin posted graphs on Twitter showing far fewer COVID-19 deaths than the high end of that projected by the Wisconsin Department of Health Services. In this ploy to promote reopening the state, the think tank did not report that the health services model projections were based on if the state took no action. But because the state had shut down and promoted social distancing, the deaths had been greatly diminished. A total of 22 graphs promoting skepticism of the DHS projections were posted between March 26th and April 8th on Twitter (Figure 7).

FIGURE 7

Examples of posts promoting skepticism of DHS projections.



<https://www.wisconsinwatch.org/2020/04/opponents-misuse-stats-to-attack-coronavirus-lockdown/>

On May 8th, The Wall Street Journal praised “The Georgia Model” for their COVID-19 response citing two weeks of declines in cases and deaths. However, it was later pointed out by Los Angeles Times columnist Matthew Fleischer that the Wall Street Journal’s praise was based on a graph where the appearance of a decline was realized through the state misrepresenting data by rearranging the case and death counts from different dates. Georgia Governor Brian Kemp’s office and the state Department of Health later issued an apology for the incident.

Early scientific models always contain more uncertainty, particularly when encountering the never-before-seen novel coronavirus. But the models and projects are not *mere* guesswork. Models should always make explicit their assumptions and overtly address uncertainty, which will typically diminish over time as more data are collected. For COVID-19, early models were based on the behavior of other diseases and included influences for many variables (e.g., mobility of population, practicing social distancing, death count, infection count, mandates, disease spread statistics, etc.)⁴⁵. As policy changed, and scientific understanding progressed about human behaviors and COVID-19 infection and mortality rates, the COVID-19 models changed to reflect the best available evidence. Revising ideas to reflect the best available evidence is a hallmark of the scientific endeavor.

3. The trust people have in science often depends on the issue. They are most likely to favor pseudoscientific claims when the authentic science appears at odds with their emotions or ideology. What are some positive and negative ways that our emotions and ideology impact how we reason about claims made by the scientific community?”

Despite the scientific community’s and health experts’ early recommendations to take COVID-19 mitigating measures, many policymakers and citizens chose not to

seriously implement those measures. COVID-19 rapidly spread throughout the month of July across Florida, Texas, Georgia, and Oklahoma where early mitigating measures were met with resistance, economies reopened early, and people were less likely to wear masks. These decisions were often accompanied with pseudoscientific thinking contrary to what the leading experts recommended based on the best available data, modeling techniques, and knowledge of previous pandemics. As of August 6th, the revised IHME projects that by December 1st the US could realize 300,000 COVID-19 related deaths. However, the model also projects that if 95% of Americans began wearing masks on August 6th, approximately 70,000 lives would likely be spared⁴⁶.

Questions that need to be asked are: Will those in the public demand unreasonable levels of scientific certainty before taking action that could save lives, such as simply wearing a mask in public? To what extent will pseudoscience be promoted by policy makers and the general public to cast doubt upon and discard the experts' recommendations that are truly in the best interest of human life and the economy? As is articulated in the parallel story, *COVID-19 and Decision-Making*, waiting for absolute certainty before taking actions is foolish. Similarly, historical and contemporary events demonstrate that making decisions based on pseudoscience is a fool's errand, for nature acts as it does despite our wishes.



So much pseudoscience has been promoted during the COVID-19 pandemic that not all cases can be thoroughly addressed in this story. Those include misconceptions that rapid herd immunity is the best response for mitigating COVID-19, consuming alcohol or detergents will eradicate the virus, and antibiotics and untested drug cocktails exist that will cure COVID-19 so preventative measures are unnecessary.

4. How is the reaction among many citizens today regarding the COVID-19 pandemic like that of the public during the 1918 flu pandemic?

5. Identify three pseudoscientific claims put forward during the COVID-19 pandemic and then describe how they interfered with decision-making that would have reduced COVID cases and deaths.

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