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Unmasked in the Plandemic: Misinformation during the novel coronavirus (SARS-CoV-2) pandemic

Gil Duran
gduran2@dons.usfca.edu

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Gil Duran

Master of Public Health Candidate

University of San Francisco

Capstone

Dr. Kelly McDermott

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Abstract

This paper explores the misinformation phenomena surrounding COVID-19 on social media platforms and its potential impact on the trajectory of the COVID-19 pandemic in the US. It defines the terms misinformation and disinformation and links these to recent political phenomena of *"fake news*" and political disinformation campaigns. It characterizes the sources of misinformation online and seeks to analyze the psycho-social and cognitive mechanisms of online misinformation spread such as source and message credibility through research on vaccine hesitancy and misinformation online during other global pandemics and resurging epidemics. Network analysis establishes that misinformation online spreads farther and faster than factual information on social media platforms. Relationships between misinformation and impact on health are explored utilizing research based in agent-based modeling techniques. It argues for the quantification and characterization of COVID-19 online misinformation in order to develop targeted interventions to vulnerable and at-risk groups using informed risk communication practices across all levels of government to mitigate disparities in COVID-19 case rates and transmission.

Keywords: SARS-CoV-19; COVID-19; Misinformation; Disinformation; Credibility; Network Analysis; Risk Communication; Crisis Communication; Health Communication

Introduction

On February 15, 2020, at the Munich Security Conference, Dr. Tedros Ghebreyesus, the WHO Director-General, outlined the threat of misinformation and called on the international community to counter the spread of misinformation, “We’re not just fighting an epidemic; we’re fighting an *infodemic*.” An *infodemic* is an overabundance of information that occurs during an epidemic and includes both accurate and inaccurate information (Tangcharoensathien et al, 2020). The deluge of information and misinformation during outbreaks is expected, but the difference now with social media is the amplification of this phenomenon which includes new challenges from sources of disinformation like trolls and bots. Public Health efforts to contain a pandemic depend on individuals understanding the associated risks in order to make informed decisions (Holroyd et al, 2020). The amount and characteristics of information available to the public about COVID-19, both reliable and unreliable, is constantly changing and evolving. Health-related misinformation has been associated with severe consequences with regards to people’s quality of life and risk of mortality (Vosoughi et al, 2018). Misinformation and disinformation spread over social media and can be a potential barrier to effective disease outbreak response (Broniatowski et al, 2018). Like viruses themselves, misinformation fills the void of knowledge in new disease outbreaks and can overtake slow process of science and building evidence. During an outbreak, time is of the essence not only to ensure people informed with appropriate information, but to ensure that people are informed with correct information in order to act appropriately and mitigate the spread of disease. In today’s media

environment, viral social media posts are also frequently reported on in the news media giving misinformation another potential route for dissemination.

Background

The WHO declared COVID-19 a global pandemic on March 11, 2020 and the US quickly followed suit declaring the virus a national emergency on March 13, 2020. Misinformation about the pandemic quickly spread online and was more popular than accurate information (Cuan-Baltazar et al, 2020). In a viral video retweeted, then deleted, by President Trump and his son Donald Trump Jr., a group of doctors led by Dr. Stella Immanuel held a press conference where they made the unsubstantiated claim that hydroxychloroquine is a “cure for COVID-19” despite multiple studies that have disputed claims that antimalarial and antiviral drugs such as hydroxychloroquine can help treat or even prevent the virus. According to the New York Times, this one example of misinformation was the #2 most-engaged post on Facebook on July 27, 2020 garnering 14 million views in 6 hours. A successful public health response to outbreaks depends on broad dissemination and wide-spread acceptance of accurate information (Parmet et al, 2020).

Inaccurate and deceptive information, or misinformation, erode trust in institutions and public health experts (Vosoughi et al, 2018). Traditional public health communication strategies and outbreak response are challenged by diffusion of conspiracy-like health-related information. The persuasive effect of misinformation on social media could have harmful consequences for the public if individuals disregard the social-distancing and protective health behaviors recommended by public health

authorities. In addition to individual-level health risks, non-compliance with public health recommendations creates negative consequences through the transmission of disease to others in the community. Individuals seek information in times of crisis, but with new evidence emerging almost daily the public needs information to inform their actions in order to prevent and reduce their risk for contracting and transmitting disease. Science reduces uncertainty, but slowly, and the information environment evolves rapidly. This paper seeks to explore the role misinformation has played in the COVID-19 pandemic, the characteristics of misinformation during the COVID-19 pandemic, how individuals interact with misinformation related to COVID-19, and the potential impact of misinformation on health behavior and outcomes.

Defining Misinformation and Disinformation

Misinformation has been defined as information that is contrary to the epistemic consensus of the scientific community regarding a phenomenon (Swire-Thompson et al, 2019). However, in general, science is continuously evolving and what is considered true and false is constantly changing as new evidence and methods are advanced, but this is especially true during new infectious disease outbreaks. Surveillance systems can identify early cases of novel disease outbreaks, but researchers need time to establish a case definition and establish risk profiles. Retrospective observational studies must be conducted in order to better understand the outbreak and studies can sometimes reach opposing conclusions or none at all. In this information vacuum, information that is inadvertently false and is shared with or without intent to cause harm tends to fill the vacuum and is called misinformation. Similar terms like “fake news” overlap with misinformation and have recently been popularized in the US and across

the globe as a result of the 2016 presidential election cycle. However, terms like “fake news” are harder to define and lack an agreed upon definition. Types of misinformation differ depending on intent and mode of spread. Disinformation is a coordinated or deliberate effort to knowingly circulate misinformation in order to cause harm, gain money, power, or reputation. It is, however, difficult to ascertain intent. For example, anti-vaccine propaganda may be spread both by those who have a genuine concern about vaccine safety and by those who are using disinformation as a tool to undermine trust in institutions or governments. Both the CDC and the World Health Organization now recommend cloth masks for the general public, but earlier in the pandemic, both organizations recommended just the opposite partly based on what was thought to be low disease prevalence earlier in the pandemic. However, news and social media were rife with stories purporting that the use of face masks were not effective against the transmission of COVID-19 despite clear evidence that masks can help prevent the spread of COVID-19 (Howard et al, 2020). Unless the intent is clear, the term misinformation is used in this paper as the umbrella term that includes all forms of false and misleading information.

Misinformation online

Misinformation is found in various types of media, including news media like Fox News, CNN, and online on social media platforms. Individuals learn about various illnesses, risks, and protective behaviors from a variety of sources, however, according to a Pew Research Report, 90% of all US adults used the internet in 2019 and 80% of internet users have looked online for information about any of 15 health topics such as a specific disease or treatment (Pew Report, 2020).

The pathways of misinformation online include direct to online sources such as the CDC or the New York Times where search engines are bypassed and online visitors go straight to the online domains to read information. Search-based engines are also a popular pathway, wherein approximately 5% of all internet searches were health-related in 2015 (Swire-Thompson et al, 2019). Individuals can find information online to support many different hypotheses. One study investigated online information seeking by asking laypeople in a hypothetical scenario involving a relative who was experiencing a particular set of symptoms and asked participants to hypothesize a diagnosis based on their searches. The researchers found that initially incorrect prior knowledge often led individuals to search of information on irrelevant websites and to seek out data that would confirm their initial incorrect hypotheses implying confirmation bias (Keselman, 2008).

An important and popular pathway of misinformation online include platforms with user-generated content that provide for an ecosystem with coproduction of content and consumption by users. A significant challenge with analyzing social media is the challenge to assessing source credibility seeing as how users are generating content and are not subject to forms of factual verification or accountability (Metzger, 2003). Some platforms are content-rating sites like Yelp, others provide for editing content like Wikipedia, and include social media platforms. Some platforms allow wide access to editing yet require users to follow a strict set of norms about what constitutes information worthy of inclusion like Wikipedia. Others, such as Twitter and WhatsApp, have less norms or rules about what information can be included or shared and are thus more permeable to misinformation. Facebook is the most popular of these

platforms with 2 billion users, followed closely by YouTube and WhatsApp. The social media landscape is also constantly evolving as seen by the advent and rise in popularity of TikTok. Table 1 outlines the different types of popular online platforms and their key features.

Table 1. Online Platforms and Key Features

Online Platform	Key Characteristics
Yelp	· Content-rating site · User generated content – coproduction and consumption
Wikipedia	· Online free encyclopedia with user-generated content · Requires users to follow a strict set of norms for including information like citing sources
Twitter	· User generated content – coproduction and consumption · Little rules or norms for content · Piloting new fact-checking mechanisms that flags tweets with contested or false information

WhatsApp	· Communications platform popular internationally · Content sharing enabled · Cited in international news media as rampant with misinformation
Facebook	· Most popular global social media platform · Little rules or norms for user-generated content · Company executives have resisted calls to tighten rules and norms against misinformation
Instagram and TikTok	· Mostly visual user-generated content · User-generated memes and videos frequently include content about the COVID-19 pandemic · Newer platforms popular with younger people

Misinformation on these platforms is widespread and contain narratives that are often dominated by personal, negative, and opinionated tones, which often induce fear, anxiety and mistrust in institutions. A study analyzed 800 vaccine-related Pinterest posts and found that 74% were anti-vaccine sentiment (Guidry et al, 2015). An early quantification of the misinformation and unverifiable content about the COVID-19 pandemic on Twitter analyzed about 673 tweets related to COVID-19, with around 24.8% of the tweets included misinformation (Kouzy et al, 2020). Figure 1 below includes examples of Tweets containing misinformation. Another study critically analyzed search results based on the search terms “Wuhan Coronavirus” during the

early stages of the pandemic in 2020 and used multiple information quality measures of health information. Critical analysis performed on the search terms included within the study used the Health on the Net Foundation Code of Conduct, the Journal of the American Medical Association benchmark, the DISCERN instrument, and the Google ranking as validation instruments for high quality health information online. It found that by February 6, 2020 no quality information in the search results was available on the internet about COVID-19 (Cuan-Baltazar et al, 2020). Online platforms and companies are uniquely positioned to address misinformation because they control the data on their platforms, but they do not allow researchers access to the data and block government efforts to regulate their industry while piloting in-house solutions to control the spread of misinformation.

Figure 1. Examples of tweets with misinformation.

The spread of misinformation

Misinformation spread at the individual level involves three components in its creation, production, distribution, and re-production - the agent, the message, and its interpretation. Many entities spread misinformation and disinformation online including, but not limited to, individuals, politicians, vested interests, news media, corporations and multinationals with economic interests attempting to shape the public debate, “bots” – accounts that automate content promotions, and “trolls” – individuals who misrepresent their identities with the intention of promoting discord (Broniatowski et al, 2018). When message agents are determined to be credible messengers, misinformation can have a lasting impact. This is the case in the traditional public health example of misinformation in the publication of fraudulent research linking the MMR vaccine to autism and bowel disease. While the study has been long discredited, the concerns raised by the study have been widely disseminated on social media and are highly influential among some groups (Taylor et al, 1999). New research suggests that the type of actor in the production and reproduction of misinformation online have significant impacts on online communication about vaccination. Where “content polluters” posted more anti-vaccine content, Russian trolls amplified both sides of the debate and sought to promote discord (Broniatowski et al, 2018).

At the system level, patterns of misinformation and its characteristics, particularly online, can be discerned and information cascades can be observed. Early literature on misinformation established the basic law of rumor in that the amount of rumor in circulation will vary with the importance of the subject to the individuals concerned times the ambiguity of the evidence pertaining to the topic (Allport et al, 1947). Rumor theory

is relevant to the online information ecosystem. In a study of news stories distributed on Twitter from 2006 to 2017, falsehood diffused significantly farther, faster, deeper, and more broadly than the truth in all categories of information. The truth rarely diffused to more than 1,000 people whereas the top 1% of false news cascades routinely diffused to between 1,000 and 100,000 people. It took the truth about six times as long as falsehood to reach 1,500 people and 20 times as long as falsehood to reach a cascade depth of 10. The greater likelihood of people to retweet falsity more than the truth is what drove the spread of false news in this study despite network and individual factors that favor the truth. Misinformation about the Zika virus diffused farther, faster, and deeper than true information about the virus and was associated to content messages that elicited more fear, disgust, and surprise (Vosoughi et al, 2018).

At the individual level, judgements are formed about the believability of the message and is informed by the source of the information, narrative and context; the reproduction of that misinformation can depend on the degree to which receivers suspect the information is credible or misleading (Brainard et al, 2018). Psychological and cultural dimensions of misinformation related to COVID-19 can increase or decrease perceived credibility of message and source and need to be analyzed to understand its import to individuals within their social and cultural contexts.

Credibility

The credibility of information related to COVID-19 encompasses message credibility, source credibility, and media credibility. Source credibility and persuasive content are factors when assessing the susceptibility of users to the messages

conveyed, as are misperception and confirmation bias where people's views on factual matters are strongly influenced by prior beliefs (Metzger et al, 2003). Some communities mistrust government and health professionals based on a long history of unethical research on and treatment of Black Americans has led many to question the credibility of government and public health institutions. Immigrant communities may be distrustful of public health departments and other agents of the state, particularly among immigrants without legal permission to reside in the US and face higher health risks. The perceived credibility of the message and its source can heighten the persuasive impact of the message, particularly for messages that reflect and reinforce group commitments that individuals identify with socially, culturally, and politically. Interpretation and acceptance of misinformation can vary based on a person's identity or personal beliefs and when framed in the form of "culturally antagonistic memes" that connect the message to divisive social and political issues, risk perception can be altered. An experiment found that exposing a large sample of ordinary members of the US general public to materials with culturally antagonistic memes excited opposing affective states among members of varied cultural groups. The memes linked Zika to global warming and unlawful immigration. Members of distinct cultural groups then displayed biased formation of beliefs about the dangers of the Zika virus (Kahan et al, 2017). More research is needed to understand how source credibility, message credibility, and media credibility interact with the socio-cultural context of individuals and the spread of that misinformation.

Network analysis

One study found that large-scale person-to-person diffusion of information is a fairly rare occurrence despite frequent reports in the news media. The study explored the structure of how content spread on Twitter and the likelihood it was to spread either by person-to-person diffusion (large-scale virality) or by being broadcast (where many people receive the information directly from the same source like social media influencers or news media). It found that the popularity of information was predicted primarily by the largest broadcast, and viral cascades were a relatively uncommon occurrence (Goel et al, 2016). The outcome of competition or whether misinformation gets shared or reproduced is often dependent on how much each message resonates with an individual's values. Social media increases these effects, both as a source of misinformation and as a catalyst for dissemination as viral memes are regularly reported on in news media and reach a wide audience (Sell et al, 2020).

Echo chambers on social media are often cited as having a polarizing effect on individuals as they have an information diet that reinforces their worldviews and where extremism is exacerbated. These chambers are environments in which a person encounters only beliefs or opinions that coincide with their own, so that existing views are reinforced and leading to more extremist views. A network analysis of the interconnectedness of anti-fluoride activists on Facebook who lobby against fluoride in drinking water found that the networks were highly interconnected and significantly moreso than the site overall (Seymore et al, 2015). Another study found that political fake news engagement was extremely concentrated on Twitter with approximately 1% of individuals that were exposed to 80% of the fake news sources, and just 0.1% of individuals shared 80% of the fake news sources. Apart from these "supersharers" of

misinformation, the individuals that were more likely to engage with fake news were conservative leaning, highly engaged with political news, and older adults (Grinberg et al, 2019). In fact, another study found that adults over the age of 65 were seven times more likely to share political fake news on Facebook than were those between 18 and 20 (Guess et al, 2019). Certain demographic groups may not understand the source of user-generated content on social media, and can have the impact of making older adults and other vulnerable groups especially susceptible to misinformation online.

Impact of misinformation on health

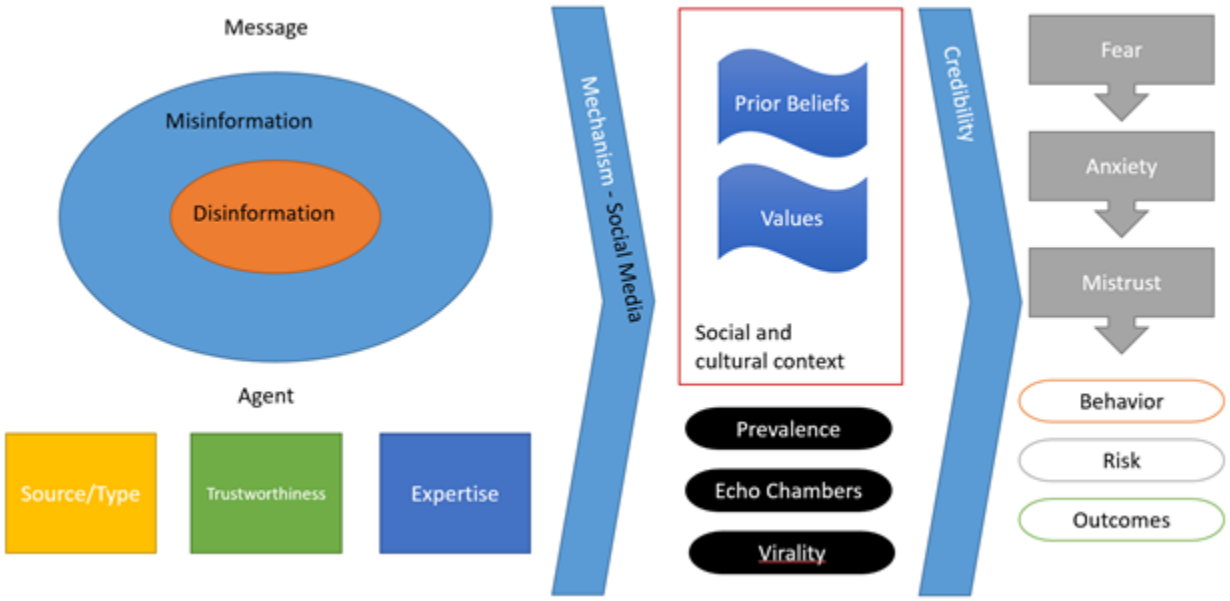
The impact of misinformation can vary depending on its prevalence, content, and persuasive capacity (Sell et al, 2020). Evidence from previous disease outbreaks concludes that misinformation is a serious threat to public health efforts to control a pandemic (Kalichman et al, 2009). Adults who endorsed conspiracy beliefs during the 2014 Ebola outbreak (e.g. a cure for Ebola exists but is being withheld) reported that they would be less likely to seek medical care if they thought they had Ebola. They also reported less support for quarantine policies than adults who did not endorse those beliefs (Earnshaw et al, 2019). In early 2019, the US experienced multiple declarations of public health emergencies due to measles outbreaks. In Europe, the WHO revoked the measles eradication status of four countries: Albania, Czechia, Greece, and the UK. Some reasons attributed to the revocation include global anti-vaxxer social movements, “too little, too late” responses from public health authorities, corrective information filled with high-quality scientific information but was filed with too much jargon, etc. (Poland et al, 2010). The anti-vaxxer movement is grounded in misinformation and conspiracy theories that are focused on rhetorical and personal arguments that induce negative

emotions like fear, anger, and sadness. More research is needed to quantify the impact on health and link the recent measles outbreaks to these movements.

Misinformation from seemingly credible sources, like governments, can have an impact on health. An example of this is when US President Trump touted chloroquine or hydroxychloroquine as a treatment for COVID-19 via tweet on March 19, 2020. In the two weeks after this mention, searches for how to purchase this unverified treatment for COVID-19 surged by more than 200,000 searchers over the average level prior to the COVID-19 crisis (Liu et al, 2020). Even after the news media reported on the fatal poisoning of a Phoenix man, searches for purchasing the drugs remained elevated at 200% and 1,167% higher than average for both drugs respectively (Liu et al, 2020). False remedies for illness, incorrect information on disease transmission, or allegations that disease is associated with a government conspiracy are all common examples of health misinformation during public health events or emergencies (Kouzy et al, 2020). In a working paper yet to be published by the University of Chicago, Bursztyn, et. al study the differential exposure to news media and how misinformation on two shows on the Fox News network affect behavior and downstream health outcomes (Bursztyn et al, 2020). Their preliminary findings suggest that the documented effects on health outcomes are driven by the differences in messaging in how the two shows on the same network covered the pandemic in February and early March. The researchers suggest that when the virality of posts on social media are reported on in the news media this potentially has an amplification effect and impact on health behavior and outcomes. However, while misinformation has been prevalent in other pandemics, more research

is needed to understand the prevalence of COVID-19 misinformation and its potential impacts on behavior and health.

Figure 2. Mechanics of misinformation



Recommendations

Misinformation related to infectious disease and vaccines have been shown to be highly prevalent online and in social media. In previous epidemics, misinformation has been shown to rely on its persuasive impact to propel its spread - informed by the credibility of the source, the message, and narratives that confirm prior beliefs and values. Misinformation agents can be bots, trolls, or individual “supersharers” that deal in narratives inducing fear, anxiety, and mistrust in institutions. Social media virality has also been reported on widely in the news media with the capability to broadcast

messages with potential severe consequences for health. However, the mechanics of how misinformation impacts behavior is not widely understood and the interpretation and persuasive impact of misinformation messages depend largely on prior beliefs, values, and the social and cultural contexts of individuals. Figure 1 below outlines a proposed model for understanding the mechanics of how misinformation related to COVID-19 might have an impact on behavior and outcomes.

Rather than engage in censorship to counter individual actors or bots and trolls, public health authorities should aim to build trust and credibility with vulnerable populations by leveraging the credibility of health care professionals to develop and deliver targeted risk-based communication interventions. The characterization of COVID-19 related misinformation is needed to develop evidence-based risk communication interventions during public health emergencies. Targeted interventions and risk-based messages must be a part of a resilient information system that supports an engaged and informed public and is designed to protect vulnerable and at-risk groups.

Risk Communication

The World Health Organization (2020) defines risk communication as the exchange of real-time information, advice, and opinions between experts and people facing threats to their health, economic or social well-being. Two broad risk models are commonly employed – one takes a realist approach where risk is seen to be objective and independent of social context, and the second is the social constructionist approach where risk is seen to be interrelated with the socio-cultural context. The literature has

increasingly recognized that society, communities, and patients view risk from a social constructionist approach (Abrams et al, 2020). The effectiveness of evidence-based risk communication interventions may vary according to each individual's personal beliefs, values, literacy, and socio-demographic characteristics. The effectiveness of risk communication during a pandemic is critical to ensure behavior change that reduces the risk of individual and community transmission. The WHO's strategy to counter the infodemic risk was to create a new information platform called the WHO Information Network for Epidemics (EPI-WIN). EPI-WIN staff of communications officers and consultants work with different professionals who provide them with advice, guidelines, and accurate information about epidemics. Staff search social media platforms for questions or rumors that spread who then rely on professionals to develop information to counter rumors. A similar approach could be adopted in the US with a focus on vulnerable populations and understanding the sociocultural context of misinformation messages.

Heightened risk perception during pandemics can have a profound impact on the trajectory of the pandemic due to the manner in which people perceive and respond to risk. Pandemics, including COVID-19, exhibit dread factors like high rates of infection, significant morbidity and mortality, lack of protective or therapeutic measures and rapid increases in cases or case fatality rates. The World Health Organizations noted that shortages of Personal Protective Equipment (PPE) at the early onset of the COVID-19 pandemic were leaving doctors and nurses dangerously ill-equipped to care for patients due to the limited access of supplies and that these shortages were largely as a result of panic buying, hoarding, and misuse driven by consumer fear and demand.

Misinformation in this environment of heightened risk perception and evolving information can increase fear and perception of risk potentially leading to shortages of PPE worldwide. The primary goals of risk communication include both alerting people and reassuring people – both are two different activities but required in order to be effective.

SARS-Cov-2 is highly contagious and lethal - the basic reproductive rate for the virus is estimated to be 2.5 compared to 0.9 for the MERS-CoV pandemic. As of August 2020, the CDC has yet to confirm a mortality rate for COVID-19 but early estimates project the mortality rate that is closer to 1% which is 10 times more lethal than the seasonal flu. Age and comorbidities are both risk factors for severe illness with COVID-19 infection. Latinos and Blacks are disproportionately contracting COVID-19 in the US and have disproportionately high case fatality rates when compared to whites (Adhikari et al, 2020; Wortham et al, 2020). Latinos and Blacks may also be more vulnerable to misinformation messages that employ narratives based on the historical abuses of government. More research is needed to understand the persuasive impact of these culturally antagonistic memes. As of August 2020, researchers and society continue to grapple with many unknowns and questions about the virus - its mutation rate, if a vaccine will be efficient, the case fatality rate, among other factors, not just its contagiousness and lethality. Uncertainty in illness has been associated with anxiety, depression and distress, and can result in panic and passivity (Abrams, 2020).

A key goal of risk communication is how to make people feel safe with uncertainty. Accurate and well-developed health communication can facilitate how societies handle uncertainty and fear, promote and accomplish adherence to necessary

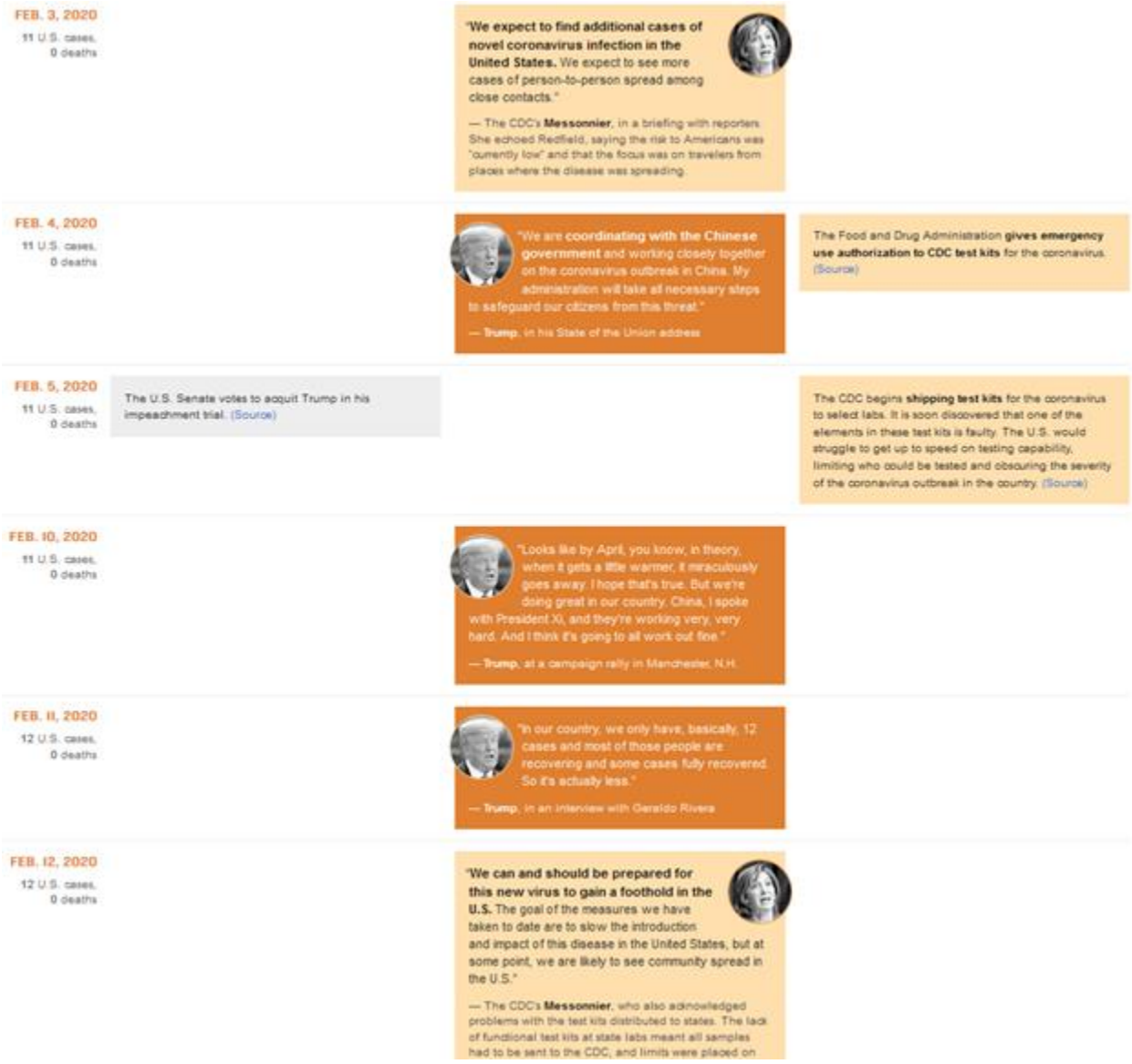
behavior change, and meet individuals' fear and foster hope during times of crisis (Abrams, 2020). Risk communication must cause just enough anxiety for individuals to take advice from authorities yet optimistic enough to feel that their actions make a difference.

The overarching imperative in risk communication is to communicate with transparency – authorities should declare what is known and what is unknown. Only facts should be shared and communicators should acknowledge the "temporality of facts" as a work in progress. In an evolving information environment such as an outbreak of novel disease, recommendations may change based on previously unknown evidence. Both the CDC and the World Health Organization now recommend cloth masks for the general public, but earlier in the pandemic, both organizations recommended just the opposite based on a variety of factors and the trajectory of the outbreak. However, more clarity and transparency should have been employed because these shifting guidelines may have caused confusion among the general public about the efficacy of masks in protecting against transmission.

The attitude and behavior of all leaders at all levels is important in order to flatter the curve. Flattening the cureve is a public health strategy to slow down the spread of the SARS-CoV-2 virus during the COVID-19 pandemic. The curve being flattened is the epidemic curve, a visual representation of the number of infected people requiring health care over time. In addition to shifting guidelines, the US President, Donald J. Trump, has mostly abdicated the responsibility for a coordinated national approach to each state. The only consistency in his communications is the inconsistency. NPR constructed a timeline of the trajectory of the pandemic, along with the president's

tweets that highlights that misinformation can come directly from the federal government and add to the confusion and anxiety among the public. Figure 2 below is a sample of the tweets from the NPR website. Many of the tweets speculate or over-reassure which can lead to people feeling more alarmed.

Figure 3. NPR Timeline of what the US President has said and done about the Coronavirus



Along with Trump's tweets, misinformation from other sources continue to circulate widely online and goes mostly unabated. A widely discredited video documentary called "Plandemic" circulated online and promoted the idea that wearing a protective mask can make people sick and that the novel coronavirus most likely emerged from a laboratory. The impact of this viral video is unknown, but social media is awash in videos of largely irate individuals ejected from public spaces and stores due to their unwillingness to comply with mask orders. Some of the subjects in the video cite the same misinformation narratives that can be found on social media platforms. Information should not be withheld because of fears of creating "panic." If officials withhold information and then are wrong, they will lose credibility and the trust of individuals. If officials are concerned, they should say so, and allow the public to feel concerned as well. Clear action steps should be provided like wash your hands regularly, cough in a tissue or elbow, practice social distancing, etc. Clear action steps that provide a sustainable approach by giving people options helps manage fear and works to counter quarantine fatigue or exhaustion associated with the new restrictive lifestyle that's been adopted to slow the spread of COVID-19. Figure 3 below are examples of effective risk communication messages. Effective, transparent, and clear risk communication that acknowledges emotions of fear and anxiety yet is consistent and specific enough to create hope can be one of the most effective tools in controlling or mitigating the pandemic.

Figure 4. Examples of effective risk communication messages

Educating the general public via universal messages based on principles of risk communication is key to reducing the spread of disease, but it is not enough. Culturally antagonistic memes are rampant on social media and are based on historical misdeeds of the US government and public health researchers. The well-known Tuskegee study of untreated syphilis was a clinical study conducted between 1932 and 1972 by the United States Public Health Service who enrolled 600 impoverished Black men. Researchers knowingly failed to treat participants appropriately and even withheld the diagnosis. Today, culturally antagonistic memes about COVID-19 contain persuasive narratives that include: COVID-19 was created in a laboratory; that it has been deployed as a bio-weapon against populations for the purposes of constructing and disseminating the use of cellular 5G networks with the aim to increase population level control; that it is used as an excuse by the government to employ forced vaccination against Blacks and Latinos; andamong many other theories that include messages of discord and often use or rely on historical markers or precedents like the Tuskegee Experiment.

Subsequent media reported groups of people across the US that were attempting to bring down cellular towers. While racial and ethnic non-white groups are being disproportionately affected by COVID-19 largely due to inequities in the social determinants of health, such as poverty and healthcare access, the rampant misinformation targeted towards these groups should not go unaddressed. Targeted interventions based in prevention have the potential to lift all boats, but targeted interventions need to be informed by the characterization and trends of COVID-19 related misinformation while simultaneously working to build media literacy that can teach the public how to protect themselves against misinformation.

The framework above combines psychological approaches to theorize the individual level cognitive response when receiving misinformation messages and network science of online social media platforms. Both are necessary to understand the individual level impact as well as the social mechanisms and patterns of the spread and prevalence of misinformation and its potential impact on outcomes. Confirmation bias plays an important role in cognitive response as well as the creation of online echo chambers. More information is needed to characterize the socio-psychological characteristics of those who believe and propagate misinformation, including bots and trolls who have malintent and promote narratives of discord, fear, and anxiety. In order to better understand the mechanics, COVID-19 misinformation must be classified.

Public health risk and crisis communications needs to develop communication strategies that are informed by patterns of narratives of misinformation in order to be effective. Unchecked, the accumulation of misinformation and conspiracy theories can promote social movements that attack the credibility of institutions and public health

authorities. Credibility is key to enacting behavior change and protection from risks in a pandemic. Efforts to promote behavior change require effective risk communication at the individual level and action at the community level to change the environment in ways that facilitate new behaviors. Risk communications should attempt to elicit and address common doubts and concerns people have about recommended advice (Khatri et al, 2020). Government agencies should develop interventions and strategies that include increasing their online presence on popular social media platforms in order to combat misinformation about COVID-19. Ultimately, tackling the challenges of misinformation and disinformation will require a cross-sectoral approach that works within the confines of the democratic system and the principles of free speech to imagine new and creative ways to address the rapidly evolving threat of misinformation during pandemics.

Implications

The internet has increasingly become polluted by both misinformation and especially disinformation. False and misleading information online and in social media platforms can influence people's opinions and behaviors with profound consequences for public health – like outbreaks of measles and individuals who refuse to adhere to public health recommendations like wearing masks during the COVID-19 pandemic. Public health authorities know how to slow the spread of the coronavirus – they should require face masks in public spaces, minimize time indoor spaces with multiple people, move as many activities as possible to the outdoors, wash your hands frequently, and stay home. The government should encourage all of these steps and organize widespread testing and competent contact tracing. However, misinformation is vast and

can challenge different aspects of mitigation and control efforts. It is the role of government, civil society, and private companies to work together to counter harmful misinformation and disinformation. The WHOs EPI-WIN has outline a roadmap for how this might work in the US. Another prevalent online theory that prompted an official response from the Washington Health Department in May espoused that people who talk to contact tracers will be sent to nonexistent “FEMA camps.” Contact tracing is an old public health tool that attempts to interrupt the spread of disease by reaching out to people who test positive and those they have been in close contact with to provide needed support for them to isolate. As states and the federal government attempt to ramp up contract tracing workers, petitions online are circulating to galvanize action against contact tracing in a direct challenge to the goals of this newly minted workforce. A lack of a coordinated response and approach to the pandemic at all levels of government will only encourage the spread of misinformation targeted directly at response efforts.

As COVID-19 vaccine trials in August of 2020 approach the later phases of vaccine development and begin human trials, anti-vaccine sentiment in the US will make it challenging to reach herd immunity against the virus even once vaccines are available to the general public. The same anti-vaccine sentiment and misinformation that lead to measles outbreaks in the US will play a large factor if health officials do not communicate what is known about the vaccine and what its safety profile is. Additionally, it was recently reported that researchers in the first phase 3 trial for a COVID-19 vaccine in the US are struggling to recruit Blacks and Latinos – the same

groups of people disproportionately impacted by COVID-19. Without participation in vaccine trials, researchers cannot ensure the same efficacy in these vulnerable groups.

Finally, in the same way that the US invests in global health surveillance systems to encounter and fight outbreaks before they spread, the US government should invest in new tools and strategies to counter the rapidly evolving misinformation and disinformation environment online. Misinformation and disinformation about the SARS-CoV-2 virus and COVID-19 are rampant online. Social media platforms with user generated content and little norms of accountability present significant challenges that include limited access to data in order for researchers to better understand the misinformation phenomena. At the individual level, sources of misinformation have varied credibility, trustworthiness, and expertise. Misinformation narratives and content are dominated by personal, negative and opinionated tones that often seek to sow discord and amplify both sides of a debate. Their persuasive impact is often informed by the values, beliefs, and identify of groups and their socio and cultural contexts. There is some evidence that misinformation with persuasive impact has the ability to change behavior, alter risk perception, and ultimately have an impact on health and the trajectory of the pandemic.

Public health should rely on best risk communication practices that both alert and reassure people, communicate clear information in transparent ways that help people manage their fear and open up a dialogue so that risk communicators receive important information from the public, including questions, rumors, and misinformation. Communication strategies should be developed that give people options and allow them to practice risk harm reduction versus taking an abstinence only approach.

While disinformation is more difficult to ascertain, it is increasingly a threat to public health efforts. The 2016 presidential election revealed the proliferation and role of disinformation actors like bots and trolls and new technology will allow misinformation to spread more rapidly, even as governments and social media platforms implement changes today to combat it. “Deep fakes” are video forgeries that will become more prevalent as machine learning algorithms are developed and artificial intelligence bots are built to falsify images and video. Governments should invest in research and development using these same new technologies to combat the potential disruption and impact these new technologies may have on the next pandemic. The WHO’s EPI-WIN information platform provides governments with a model and a framework for countering the growing infodemic. As misinformation and disinformation present growing threats to the trajectory of the pandemic, the US government should adopt a similar framework in order to increase its credibility and trustworthiness among the US public and ultimately save lives.

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Appendix A

MPH Foundational Competencies

Foundational Competency	Description of how used for Capstone
Evidence-based Approaches to Public Health	
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate	
4. Interpret results of data analysis for public health research, policy and practice	
Public Health & Health Care Systems	
5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings	*Analyzed system and network level factors about misinformation online and made recommendations based on the specific gaps after a comprehensive review of the literature.*
6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and societal levels	*Described the historical context as the source of the persuasive impact on risk and health behavior that are not understood as overtly racist. By identifying the etiology/history, the racist tendencies became increasingly clear.*
Planning & Management to Promote Health	
7. Assess population needs, assets and capacities that affect communities' health	
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs	*Critically analyzed and reviewed the literature on the spread of misinformation and the impact of socio-cultural context to health behavior and perceived risk in order to recommend new policies and program.*
9. Design a population-based policy, program, project or intervention	
10. Explain basic principles and tools of budget and resource management	
11. Select methods to evaluate public health programs	
Policy in Public Health	
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence	
13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes	

14. Advocate for political, social and economic policies and programs that will improve health in diverse populations	
15. Evaluate policies for their impact on public health and health equity	
Leadership	
16. Apply principles of leadership, governance and management, which include creating a vision, empowering others, fostering collaboration and guiding decision making	
17. Apply negotiation and mediation skills to address organizational or community challenges	
Communication	
18. Select communication strategies for different audiences and sectors	*Created a proposed visual framework for understanding how different components of misinformation spread can impact behavior and outcomes.*
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	Outlined, drafted and finalized Capstone paper including a literature review, recommendations and implications on a current public health problem. Created a slide deck based on the Capstone paper and delivered an oral presentation at Health Professions Day in front of an interprofessional audience.
20. Describe the importance of cultural competence in communicating public health content	*Identified gaps in existing risk communication and infodemic countering strategies that highlight the need to understand the content and narratives present in misinformation in order to counter their persuasive impact among Blacks, Latinos, and other vulnerable populations.*
Interprofessional Practice*	
21. Perform effectively on interprofessional teams	
Systems Thinking	
22. Apply systems thinking tools to a public health issue	

Health Policy Leadership Concentration Competencies

Competency	Description of how Capstone used
1. Apply economic concepts to understand the effect of changes in policies at the government, health systems, and public health sectors	
2. Synthesize economic concepts to assess equity and efficiency in making health policy recommendations in underserved communities	

3. Formulate efficient health policy change recommendations through the analysis of proposed health policy initiatives that could affect health outcomes of vulnerable populations	*Evaluated existing Risk and Crisis communication practices to determine gaps affecting the health of minority populations. Recommended a set of new initiatives and actions that the US government should take to counter the threat of misinformation on vulnerable communities.*
4. Develop recommendations to improve organizational strategies and capacity to implement health policy	
5. Analyze policy options to address environmental health needs at the local, state, and federal levels	