2022

Comparing Governmental Communication about COVID-19 Layered Protection Strategies in Taiwan, Kenya, and the United States: A Mixed-Method Analysis of National Health Agency Websites

Cynthia Mofunanya
University of Kentucky, cynthiamofunanya@gmail.com

STUDENT AGREEMENT:

I represent that my capstone and abstract are my original work. Proper attribution has been given to all outside sources. I understand that I am solely responsible for obtaining any needed copyright permissions. I have obtained needed written permission statement(s) from the owner(s) of each third-party copyrighted matter to be included in my work, allowing electronic distribution (if such use is not permitted by the fair use doctrine) which will be submitted to UKnowledge as Additional File.

I hereby grant to The University of Kentucky and its agents the irrevocable, non-exclusive, and royalty-free license to archive and make accessible my work in whole or in part in all forms of media, now or hereafter known. I agree that the document mentioned above may be made available immediately for worldwide access unless an embargo applies.

I retain all other ownership rights to the copyright of my work. I also retain the right to use in future works (such as articles or books) all or part of my work. I understand that I am free to register the copyright to my work.

REVIEW, APPROVAL AND ACCEPTANCE

The document mentioned above has been reviewed and accepted by the student's advisor, on behalf of the advisory committee, and by the Director of Graduate Studies (DGS), on behalf of the program; we verify that this is the final, approved version of the student's capstone including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Cynthia Mofunanya, Student

Dr. Anna J. Hoover, Committee Chair

Dr. Erin Haynes, Director of Graduate Studies

Comparing Governmental Communication about COVID-19 Layered Protection Strategies in Taiwan, Kenya, and the United States: A Mixed-Method Analysis of National Health Agency Websites

Dr. Cynthia Mofunanya

Master of Public Health, University of Kentucky

Abstract

COVID-19 is a novel coronavirus caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It can result in severe respiratory damage. Different countries have recommended different combinations of protections during the COVID-19 pandemic. Various combinations of mitigation strategies or "layered protections" against coronavirus have also been communicated differently across nations. This mixed-methods content analysis seeks to compare COVID-19 mitigation information on three national health agency websites for Taiwan, Kenya, and the United States. Availability and navigability of information was examined for each mitigation strategy. The Web Resource Rating tool was used to assess the quality of the information about health protections provided on each website. Findings included available information on all health protections in all three countries. However, navigation to and quality of information on some mitigation strategies varied across countries.

Keywords: COVID-19 communication, COVID-19 mitigation, health communication

Comparing Governmental Communication about COVID-19 Layered Protection Strategies in Taiwan, Kenya, and the United States: A Mixed-Method Analysis of National Health Agency Websites

COVID-19 is a novel coronavirus caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It can result in severe respiratory damage. SARS-CoV-2 was first reported in China at the end of 2019 and rapidly spread to the rest of the world over the subsequent months (Miller 2021). It is highly contagious and more fatal than other viruses, including viruses that cause influenza (Li 2021). In spite of its ability to kill more people, SARS-CoV-2 has had a lower death rate than the other notable epidemics (Li 2021), a result that may relate in part to how governments have communicated about multiple mitigation strategies, or "layered protections" against infection. These mitigation strategies include traditional hygiene-related infectious disease prevention strategies, as well as environmental mitigation strategies to slow airborne transmission of COVID-19. Different countries may have emphasized various combinations of protections in their official communications. An important platform for delivery of government information about COVID-19 mitigation is the world wide web. This analysis will evaluate how three different countries' government health agency websites have communicated about specific kinds of COVID-19 protections.

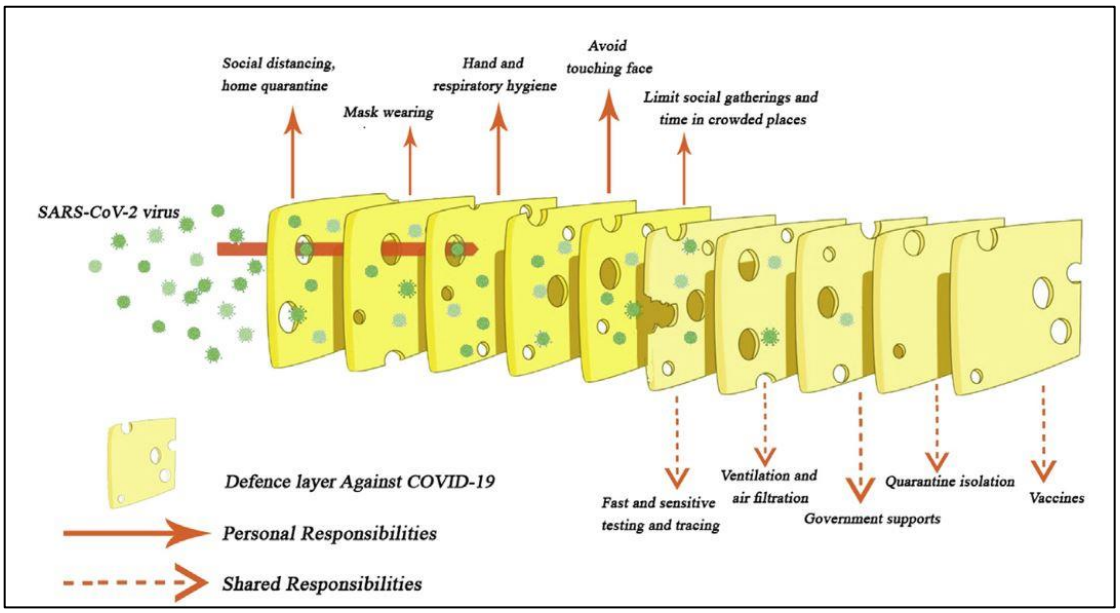
When news about COVID-19 initially broke, governments, scientists, public health officials, and healthcare workers across the world recommended different policies for mitigation and containment of the virus, and they deployed varying communication strategies to promote these policies (Chang 2020). For example, Mousazadeh (2021) described the Swiss Cheese Model of COVID-19 Defence (Figure 1), which relayed the idea that every individual form of protection is

imperfect, so multiple layers are needed to slow the spread of COVID-19. Protections recommended in the Swiss Cheese Model include vaccinations, COVID-19 testing, quarantine & isolation, social distancing, hand hygiene, masking, addressing ventilation and air filtration concerns, and enacting stay at home orders.

Different countries have recommended different combinations of protections at different times. Early in the Pandemic, for example, Taiwan developed the Taiwanese Communicable Disease Control Act, which allowed mandatory initiatives for lockdown at borders, contact tracing, and quarantine (Su 2021). Considering the severe economic consequences of countrywide lockdowns, other countries emphasized individual decision-making to implement recommended mitigations for containing the spread of COVID-19. The United States, for example, emphasized more voluntary health protective behaviours like handwashing, social distancing, quarantining, and mask wearing (Stroebe et al 2021). Kenya and other countries in sub-Saharan Africa responded to COVID-19 by trying to strike a balance to minimize morbidity and adverse economic impact through strategies that included adopting nationwide dusk-to-dawn curfews, decreasing social gatherings, and implementing mandatory handwashing before entry of any public premises or public transportation (Wangari et al 2021). These examples reflect the Swiss Cheese Model, with the different types of mitigation strategies, or “layered protections” being promoted to decrease the spread of COVID-19.

Figure 1

The Swiss Cheese Model of COVID19 Defence



Note. The Swiss Cheese Model of COVID19 Defence Identifies Personal and Shared Mitigation Strategies that Can Be Layered to Better Protect Against COVID-19 Infection (Mousazadeh et al., 2021).

Varied National Experiences During COVID-19 Pandemic

Varied national responses to the COVID-19 pandemic may have contributed to differences in controlling the spread of the virus (Mallah 2021). In China's Hubei province, the city of Wuhan - where SARS-CoV-2 had first emerged on December 1, 2019 - underwent a lockdown at its border on January 23, 2020 (Mallah 2021). Other Chinese provinces followed suit on February 11, 2020. According to Mallah (2021), "The lockdown on Wuhan was theorized to have delayed the spread to other areas in China by 2.91 days, decreased the number of cases by 33.3%, and reduced worldwide spread by 77%."

Other Asian countries responded quickly, using strategies that were refined after the 2003 SARS and 2009 H1N1 Influenza outbreaks. Taiwan had increased its

laboratory capacity to respond to COVID-19 by building a national program to include 27 laboratories in the country (Mallah 2021). To date, Taiwan has seen lower confirmed case counts and mortality rates than many nations. As of February 28, 2022, Taiwan's case counts were 2.59 confirmed cases per 100,000 persons, with a mortality rate of less than 0.01 per 100,000 persons (CDC 2022).

In comparison, sub-Saharan Africa began its emergency response on January 27, 2020, with mitigation and containment measures geared toward reducing case growth. While receiving funding and medical supplies from various nongovernmental organizations (NGOs), the African Union (AU) announced a COVID-19 fund to support accelerated COVID-19 testing (Mallah 2021). During the pandemic, the continent has seen proportionally lower cases and deaths than many parts of the world, with "Africa making up only 3% of the COVID-19 cases worldwide, and 3% of the deaths as of February 23, 2020, despite forming around 17% of the world population" (Mallah 2021). Among the countries comprising those continental outcomes is Kenya, which, as of February 28, 2022, has seen case counts of 0.3 confirmed cases per 100,000 persons, with a mortality rate of less than 0.01 per 100,000 persons (CDC 2022).

In contrast to other countries, the United States (U.S.) has experienced higher numbers of COVID-19 cases and deaths (Mallah 2021). As of February 2022, U.S. case counts were 100.4 per 100,000, with a mortality rate of 3.1 per 100,000 persons (CDC 2022). Total cumulative U.S. cases and deaths have been reported as 78,539,082 and 951,254, respectively (CDC 2022). While encountering its first case of COVID-19 on February 26, 2020, the U.S. faced delays rolling out widespread COVID-19 testing (Mallah 2021).

Minimizing Transmission by Layering Health Protections

According to the U.S. CDC (2021), the modes of SARS-CoV-2 transmission are inhalation, exposure to contaminated mucous membranes, and mucous membrane touched with hands that have had contact with the virus. An example of direct contact is shaking hands contaminated with the virus (Miller 2020). Indirect contact arises from touching contaminated objects, or fomites, followed by touching exposed mucus membranes such as the mouth, nostrils, or eyes (Miller 2020).

The U.S. CDC (2021) further explains, "the principal mode by which people are infected with SARS-CoV-2 is through exposure to respiratory droplets carrying the infectious virus." Individuals can release respiratory fluids in the air in the form of droplets through actions of quiet breathing, speaking, singing, exercising, coughing, and sneezing. The droplets carrying the virus are expelled into the air. The largest droplets (larger than 100 μm) can settle out of the air rapidly and fall to the ground or other surfaces. Large droplets also can travel directly from an infected person's nose or mouth to another person's eyes, nostrils, or mouth (Miller 2020). The smallest droplets (smaller than 100 μm) can remain in the air for minutes to hours (CDC 2021). The U.S. CDC also mentions that enclosed spaces with inadequate ventilation can lead to high concentrations of exhaled infectious aerosol particles for longer periods of time, increasing potential for inhalation, especially at distances less than 6 feet from an infectious source (CDC 2021). More recent studies have indicated that the production of aerosols < 5 μm can make people susceptible to inhalation at distances outside the recognized range of 6 feet (Dancer 2021). This more recent definition of infectious aerosols has been adopted by infection prevention bodies such as the World Health Organization (Dancer 2021). Currently, the infectious dose of SARS -CoV-2 is not known, and relative contributions of inhalation of the virus as opposed to deposition of virus on mucous membranes remains difficult to establish

(CDC 2021). The gaps in knowledge for the transmission of COVID-19 are stimulating further research, as well as challenges for communicating about potential health protections.

According to Prather (2021), discussions are needed about modes of virus transmission to ensure effective control strategies against COVID-19 and to provide guidance to the public, as physical distancing at least 6 feet apart may be inadequate for reducing aerosol transmission (Prather et al 2020). Although policies for both mask-wearing and hygiene have been adopted across the world to limit the transmission of the virus via droplets, Prather and colleagues (2020) argue that individuals are far more likely to inhale thousands of virus-laden aerosols than to be sprayed by or have contact with a droplet.

This type of transmission was demonstrated in Skagit Valley, Washington, U.S. On March 10th, 2020, a superspreading event occurred during a weekly choir rehearsal for the Skagit Valley Chorale. Fifty-three (53) of the 61 members of the Chorale confirmed or were strongly suspected to have contracted COVID-19 (Miller 2020). The route of transmission was believed to be through aerosol exposures since strict social distancing precautions were taken during rehearsal, including forward distances between rows of chairs of at least 4.5 feet (Miller 2020). Attendees of the rehearsal reported no physical contact with each other, and there was no direct evidence of transmission by droplet. As stated by Miller (2020), “The large number of infections arising from this event, compared to the low incidence in the country at the time, made it unlikely that infections were acquired at a different setting other than the choir.” It was hypothesized that transmission was likely generated by inhalation of respiratory aerosol from one index case through singing and “shared air” (Miller 2020). Thus, Prather et al. (2020) argue that attention should be shifted to protections

against airborne transmission, such as providing indoor ventilation and air filtration, moving activities outdoors, and using high-quality masks.

More recently, Greenhalgh (2021) has asserted that at least 59% of all global transmissions occurred from infectious aerosols from asymptomatic individuals, marking it as a key way SARS-CoV-2 has spread around the world. The lack of viable SARS-CoV-2 air samples due to limited effective sampling methods has led to inconclusive evidence to support a dominant route of transmission, respiratory or fomite (Greenhalgh 2021). Although air sampling has confirmed the presence of SARS-CoV-2 in hospitals, sampling has not always detected viable virus, even though surfaces and air vents provide reservoirs (Dancer 2020). It can be argued that mechanical ventilation systems, such as in healthcare environments, offer reasonable protection towards airborne virus, unlike community homes, restaurants, and public transport systems that do not have sophisticated ventilation systems. Lack of adequate ventilation and filtration, therefore, may lead to increases in exposures to SARS-CoV-2 from aerosols in indoor environments (Dancer 2020).

Peng and Jimenez (2021) have argued that carbon dioxide, or CO_2, can be used as a proxy to measure concentrations of SARS-CoV-2 indoors. According to the authors, "pathogen-containing aerosols and CO_2 are co-exhaled by those infected" with SARS-CoV-2 (Peng & Jimenez, 2021). Because measurements of virus-containing aerosols are difficult to obtain, and ambient level of CO_2 is almost stable, CO_2 levels may serve as an indication of infection risk from SARS-CoV-2 laden aerosols expelled by humans (Peng 2021). However, CO_2 levels corresponding to a specific concentration for COVID-19 infection risk is still largely unknown (Peng 2021). Aerosol science thus has opened the door for additional policies aimed to reducing infectious aerosols via measurements of air quality, providing guidance for

ventilation systems and air filtration, and wearing high-quality masks that can help reduce exposure risk.

CERC and Its importance in Public Health and Health Care Systems

Since one primary route of transmission of COVID-19 is still being debated, communication about COVID-19 prevention has focused on a variety of potential protections. The overall response to the COVID-19 pandemic has been an evolving process leading to new and creative strategies for mitigation and communication. In keeping with the precautionary principle (Kriebel et al, 2001), public health strategies can be recommended while evidence of effectiveness is still emerging to help prevent future harm to the public. When danger is perceived as imminent, cost-effective measures to prevent environmental exposures can be taken, even when threats of serious or irreversible damage lack full scientific certainty (Persson 2016).

While the primary driver of COVID-19 spread is debated scientifically, providing information for mitigating against all exposure routes is important. The timeliness of responses and adoption of specific preventive measures may be important to subsequent rates of COVID-19 infection (Yong 2022). Therefore, effective risk and crisis communication is a critical component in an infectious disease response. The U.S. CDC's Crisis and Emergency Risk Communication (CERC) initiative has been used to respond to a variety of public health emergencies (Yong 2020). CERC asserts that six principles should be followed during emergency response and recovery: 1. Be First (quickly sharing information about a disease outbreak); 2. Be Right (providing accurate information); 3. Be Credible (ensuring information is honest and evidence-based); 4. Express Empathy (acknowledging people's feelings); 5. Promote Action (informing the public about prevention strategies); and 6. Show Respect (listening and acknowledging cultural beliefs, fears,

or concerns) (CDC 2020). Public health communicators can use these principles to provide mitigation information that could help decrease the spread of COVID-19.

A recent study in an acute-based hospital in Singapore showed CERC principles to be a "valuable framework for understandable, actionable, accurate, concise, and timely updates to the response in the COVID-19 pandemic" (Yoon 2021). Nurses, allied health professionals, and administrative staff reported favourable areas of CERC principles such as being timely, being credible and providing accurate information, regarding the use of secure text messaging in the form of real-time updates that were seen as more useful than emails (Yoon 2021). At least 92% of survey respondents were clear about the hospital's response to COVID-19 while a smaller percentage (80%) were also able to understand their challenges and address their concerns. The study concluded that CERC principles can be an effective communication framework to produce better responses to COVID-19 both in the hospital setting and in public health communication strategies. Yoon (2021) asserts this study is the first to demonstrate that CERC principles applied early and appropriately may be as effective as vaccination and social distancing in preventing rapid outbreak of a contagious disease in South Korea (Yoon 2021). The study concludes that effective risk communication is critical to the global COVID-19 response (Yoon 2021).

While CERC provides a helpful framework for communicating COVID-19 mitigation strategies, different protection strategies may have been emphasized across nations during the global response. An important platform that national governments have used for delivering information about layering protections is through government health websites. This analysis will evaluate how different countries'

health websites have communicated about specific kinds of COVID-19 protections recommended.

Research Questions

This comparative website content analysis will examine information about various COVID-19 prevention and protection strategies in three countries: Kenya, Taiwan, and the U.S.. These three countries have experienced different case counts and mortality rates during the pandemic (CDC 2022). Comparing how protective strategies were communicated by each country may provide insights into how mitigation options are prioritized by each national health agency. Evidence obtained through this mixed-methods study may help identify gaps in governmentally provided information about specific mitigation strategies. This knowledge can inform future government communication efforts about layering protections to help decrease the transmission of COVID-19. Findings also may inform future research comparing the effectiveness of national health agency communication during a public health emergency. Findings also may contribute to best practices for promoting the adoption of layered protections strategies for COVID-19.

Specifically, this study seeks to address the following research questions: RQ 1. How do country-specific government websites for Taiwan, the U.S., and Kenya vary in availability of different types of information about different mitigation strategies? RQ 2. How do the websites vary in their navigability and process for users to obtain information about layered protection strategies against COVID-19? RQ 3. How do the websites vary in the quality of information they provide about layered protection strategies against COVID-19?

Methods

Study Design

This study is a cross-sectional, mixed-methods content analysis comparing online national health agency websites for Taiwan, Kenya, and the U.S. Health information about specific mitigation strategies was compared across the Taiwan CDC, the Ministry of Health for the Republic of Kenya, and U.S. CDC. Websites were compared between January 30 and February 28, 2022.

Participants

Participants were national health agency websites in three countries that have seen varying morbidity and mortality outcomes from the COVID-19 pandemic. According to NBC News, Taiwan has experienced fewer confirmed cases and fewer confirmed deaths (nbcnews.com). The U.S. has experienced the most confirmed COVID-19 cases and deaths (nbcnews.com). Kenya's experience lied between these two (nbcnews.com). The experiences of these three countries also have been compared elsewhere (Bremmer 2020).

The countries were selected based in part on their varying geographic locations to ensure representation from different regions globally. Taiwan was selected from Asia, Kenya from Africa, and the U.S. from the Americas. PubMed Central and Google Scholar were searched for COVID-19 response, mitigation, and communication literature in each country. Inclusion criteria for each country selected included: a national health agency website had to exist; an English language version of the website had to be available for review; and scholarly literature on national outcomes had to be available.

Data Collection

I searched each national health agency website to retrieve the most current information about specific COVID-19 mitigation strategies. Information was included

from articles/abstracts, press releases, videos, standard website pages, and other types of communication products.

Data Source and Measurement

In this content analysis, I examined three websites to compare the availability, navigability, and quality of website information on specific mitigation strategies for COVID-19. Below I describe how each construct was measured. Based on the Swiss Cheese Model, layered protection was defined as a combination of individual and community protections against SARS-CoV-2 intended to help decrease the spread of COVID-19. Since every form of individual protection has imperfections, information may be provided about multiple layers of protection to help slow the spread of COVID-19 (Mousazadeh 2021) (Figure 1).

Each national health agency website was analysed for information about the following COVID-19 mitigation strategies: 1. Ventilation; 2. Masking; 3. Travel and border control; 4. Isolation and quarantine; 5. Social distancing; and 6. vaccination.

Availability

The COVID-19 home page for each government website was retrieved through a basic google search. From this landing page, I searched for information about each mitigation strategy listed above, first to determine whether information was available. Appropriate links for mitigation strategies in the form of articles/abstracts, press releases, PDFs, pamphlets, infographics, etc. were searched and accessed through the main website page. The presence or absence of information about each form of health protection was noted by a dichotomous response of “Yes” or “No”. All responses were recorded.

Navigability

To determine navigability, or the ease with which users can find information about a given mitigation strategy, I counted the number of clicks required to access information about that protection. The total number of clicks for each website and mitigation strategy was aggregated in a table format.

Navigability was further assessed in relation to the types of informational products a national health agency website provided for each mitigation strategy. Specifically, I identified whether mitigation information was available in the form of press releases, journal articles or abstracts, video messages, PDFs and flyers, infographics, and/or standard web pages and visual aids. The total number of routes offered to obtain information about each layered protection strategy was aggregated in a table format.

Reliability and Quality

The Web Resource Rating tool (Dobbins et al., 2018), or WRR, was used to analyse the quality of mitigation information on national health agency websites. The tool provides metrics for assessing the following domains: Evidence Base, Transparency, and 3. Usability. The WRR quantification scheme for each domain follows.

1. Evidence Base:

The presence or absence of the following information was noted dichotomously with Yes (Y) or No (N): single published data from peer-reviewed sources, statistics, and textbooks; published randomized control trials at least in text or in a reference list; reference to at least a systematic review meta-analysis in text or a reference list; best practice guidelines in text or in a reference list; a site-wide policy which states the quality of the evidence; and the strength of the recommendation provided by either Grading of Recommendations, Assessment, Development and Evaluations

(GRADE) criteria, or the summary of a larger report using GRADE criteria to inform recommendations.

2. Transparency

Transparency of national health agency websites was analysed by the presence or absence of the following: peer-reviewed sources for each recommendation, such as in-text citations from credible peer reviewed sources; affiliation of authority was clearly labelled as taking responsibility of the website content; all advertising was clearly labelled; and the web resource was updated within the last three 3 years.

3. Usability

Lastly, to analyse the usability of the website information, the website was examined for: presence of a feedback mechanism such as a "contact us" link or a comment section; logical flow of information; and accessibility of the web resource information, such as text re-size options, screen reader for text content, and subtitles or transcription for non-text content.

Scores from each WRR section were added together: The total score for the Evidence Base section was provided in Step 1. The Transparency and Usability sections were totalled together in Step 2. A total score of Step 1 and Step 2 was calculated and noted in table format.

Results

Information was available for every mitigation strategy examined across national health agency websites for Taiwan, the U.S., and Kenya. No variance was found between countries in the basic availability of information about specific health protections. Each country had at the very least, some information about every form of protection included in the analysis.

Although information was available for all forms of health protections, the websites did have some variations in their navigability. Taiwan CDC required the

most clicks to access information about masking and isolation (Table 1a). The U.S. required the fewest clicks to access information about all layered health protections, with information readily available for each mitigation strategy after just one click. Kenya displayed some variation in navigability, requiring more clicks to access information about ventilation and travel (Table 1a).

Table 1a

Number of clicks required to access website information about each health protection strategy (January 30- February 28, 2022)

	Ventilation	Masking	Travel/border control	Isolation	Social distancing	Vaccination
Taiwan CDC	5	15	1	10	5	1
United States CDC	1	1	1	1	1	1
Kenya Ministry of Health	6	3	6	1	2	1

CDC, Centers for Disease Control and Prevention

The types of information products available for each health protection also varied across national health agency websites. All websites provided at least two or more types of information products for vaccination (Table 1b). The U.S. provided more types of resources for masking than any other website, while also providing more types of information products related to masking than any other mitigation strategy (Table 1b). Taiwan had fewer communication products for ventilation than other countries (Table 1b). At least one type of information product was provided for each health protection on each national health agency website.

Table 1b

Types of communication products made available for each health protection (January 30-February 28, 2022)

	Ventilation	Masking	Travel/Border Control	Isolation	Social Distancing	Vaccination
Taiwan CDC						
Press release						*
Journal articles/abstracts						
video messaging		*	*		*	*
PDFs flyers	*	*	*	*		*
Infographics					*	
general website/Visual aids						
Totals	**1**	**2**	**2**	**1**	**2**	**3**
Kenya Ministry of Health						
Press release						*
Journal articles/abstracts						
video messaging						*
PDFs flyers & Resources	*		*	*		
Infographics		*				
general website/Visual aids	*		*		*	*
Totals	2	1	2	1	1	3
United States CDC						
Press release			*			*
Journal articles/abstracts						
video messaging		*	*			
PDFs flyers/guidelines	*	*		*		
Infographics		*		*		
general website/Visual aids	*	*	*	*	*	*
Totals	2	4	3	3	1	2

The WRR tool was used to assess the quality of website information through evidence base, transparency, and usability. The websites showed no variation in the evidence or transparency across countries (Table 2). However, variations across countries were seen for usability. The national health agency websites for Taiwan and Kenya were more challenging to navigate for information about each layered protection, resulting in their lower scores than the U.S. for usability (Table 2). Thus, the U.S. scored slightly higher than Taiwan and Kenya in its combined score for demonstrating transparency and usability (Table 2).

Table 2

Web Resource Rating tool-assessed usability of COVID 19 information provided by each national health agency website

Tool Assessment: Assessing the Quality of online health Information COVID-19			
Evidence Base & Quality			
	Taiwan	Kenya	U.S.
1. is the web resource informed by published single studies?	Y	Y	Y
2. Is the web resource informed by published randomized controlled trials (RCTs)?	Y	Y	Y
3. Is the web resource informed by published systematic reviews/meta-analysis?	Y	Y	Y
4. Is the web resource informed by best practice guidelines?	Y	Y	Y
5. is the quality of the evidence reported?	Y	Y	Y
6. Is the strength of the recommendations provided?	N	N	N
Transparency			
7. Are peer-reviewed sources provided for each form of layered protection?	Y	Y	Y
8. Are the authors' or editors' name affiliated with the website content?	Y	Y	Y
9. Is the layered protection clearly labeled?	Y	Y	Y
10. Has the web resource been created or updated within the last 3 years?	Y	Y	Y
11. In there a feedback mechanism or "contact me " link?	Y	Y	Y
Usability			
12. Is there a logical flow of information offered to navigate each layered protection?	N	N	Y
13. Accessibility: Does the web resource offer options like subtitles to access the info?	Y	Y	Y
Web resource Tool Score calculation			
Step 1: Evidence-based criteria score:	5	5	5
Step 2: Transparency & Usability criteria	6	6	7
Total Score: Step 1 + step 2	11	11	12

Discussion

National health agency websites represent an important channel for sharing information to help decrease the spread of COVID-19. In this study, The Swiss Cheese Model best describes the concept of layering protections against COVID-19, recognizing that one individual form of health protection (such as masking, isolation, vaccination, etc.) can have imperfections and allow for the continued spread of COVID-19. The Swiss Cheese Model illustrates how combinations of protections can collectively decrease the spread of this virus (Figure 1). The precautionary principle

supports sharing potential harm-reduction information in the face of scientific uncertainty during a public health crisis. Because no dominant form of COVID-19 transmission has been identified, and gaps in evidence persist, precautionary measures such as layering protection strategies to decrease the spread of COVID-19 are reasonable and recommended (Fisher 2016).

Through this study, I found that information about masking, travel/border control, isolation, social distancing, vaccination, and ventilation is available across national health agency websites for Taiwan, Kenya, and the U.S. Each website examined provided information about each mitigation strategy during the period of January 30 to February 28, 2022. In keeping with U.S. CDC CERC principles, each website provided credible information and promoted actions aimed to decrease the spread of COVID-19. This mirrors the use of CERC principles in other contexts including the use of secure text messaging rather than emails to deliver timely updates on emerging new data for COVID-19 (Yoon, 2021). Credible data were also made available for Taiwan, Kenya, and the U.S. through website collaborations with World Health Organization, which provided published scientific literature on COVID-19 (Umviligihozo, 2020; Falciola, 2022). As evidence continues to emerge about dominant transmission routes, future studies may investigate the relative effectiveness of providing information about different combinations of mitigation strategies to decrease the spread of COVID-19.

Although information about each health protection was available across all three government websites, some information required more clicks to access (Table 1a). For example, masking and isolation information on the Taiwan CDC site took 15 and 10 clicks, respectively (Table 1a). On the other hand, the U.S. CDC provided access to information for all mitigation strategies included in this analysis with just

one click from the primary landing page. The U.S. CDC also provided the most information about masking through four types of communication products in the form of video messaging, guideline flyers (PDFs), infographics, and standard website pages and visual aids (Table 1b). Kenya's health agency website required more clicks to gather information on ventilation and travel when compared to the U.S. Vaccination information was easy to find across all three websites with only one click. Finally, information on isolation was featured in the fewest types of communication products across all three websites (Table 1b). Several factors may contribute to these discrepancies.

Information for masking and isolation in Taiwan was more challenging to find than vaccination information, potentially for several reasons. Asian countries focused more early mandatory lockdowns at borders (Mallah 2021), while other countries took more of a conservative response focused on decreasing social gatherings and promoting hand hygiene (Wangari et al 2021). Taiwan's response was built upon lessons learned after the 2003 SARS and 2009 H1N1 influenza outbreaks (Mallah 2021). Prevalence of masking during outbreaks in Asian countries tends to be higher, partly as a result of those lessons (Elachola, Ebrahim, & Gozzer, 2020). Thus, lower levels of masking information on the Taiwan CDC website may reflect assumptions about greater existing knowledge of the effectiveness of this strategy as it relates to the SARS response. The response of SARS 2003 involved the public and allowed the country to introduce measures such as "rapid dissemination, of information, early case detection and isolation, tracing and quarantining of SARS contacts, traveller screening, raising public awareness of risk and institution of stricter infection control in health care settings" (Ahmad 2009). Masking was among the measures "seen everywhere on the streets in Guangzhou" (Qui, 2018 p. 2). History thus may have

influenced Taiwan's response on managing disease outbreaks and the use of specific health protections like masking. Most of Taiwan CDC's recent focus on vaccination, however, may be an attempt to promote knowledge about this emerging COVID-19 protection. The U.S. has also placed a greater focus on vaccination, with the highest total number of vaccination doses per 100 people as of February 25th (Mallah 2021). Vaccination has become an important layer of protection to decrease the spread of COVID -19.

Quality of health protection information was noted to be similar in all areas except for Usability (Table 2). Appropriate evidence-based information was provided for all government websites across the three nations of Taiwan, Kenya, and the U.S., with the exception of the strength of the recommendations which was not provided in a GRADE format (Table 2). The transparency of the website information was present by all three websites as indicated by a "Y" response on the web resource tool (Table 2). The Usability was most similar in Taiwan and Kenya, with the U.S. scoring better than the two countries because there was a more direct flow by links to specific health protection information on the U.S. CDC website. Thus, the more direct flow to information through fewer links led to an assessment of more "logical flow", which resulted in a slightly higher U.S. score on the WRR for overall quality.

It is important to recognize several limitations of this research. This is a descriptive study that does not explore data about website user characteristics or adoption of mitigation strategies because these data were not publicly available during the study period. Since this was a cross sectional study and website information is constantly changing, findings do not reflect how national communication priorities have evolved outside the study time frame. Cultural variation may reflect what information is believed to be important or what knowledge is taken for granted as

known within a given country. Finally, only one coder rated the availability, navigability, and quality of website information across the websites. Thus, there was no intercoder reliability.

Although the Taiwan CDC and Kenya Ministry of Health websites scored slightly lower than the U.S. CDC on the WRR tool, both Taiwan and Kenya have seen better morbidity and mortality outcomes than the U.S. during the COVID-19 pandemic. It is important to recognize that the provision of national health agency website information is only one facet in a national pandemic response. Websites are just one of many channels for disseminating information to decrease transmission of COVID-19, and there may be important differences between users of national health agency websites and individuals who do not use such sources of information. For example, not everyone has access to computers or high-speed internet. Without user data, it is difficult to determine whether website visitors are representative of the general population. Further, previous research on governmental and popular health organization websites has indicated that online COVID-19 materials should be modified to reach recommended reading levels (Ojo 2020). Other user demographic factors such as age, health literacy, language spoken, and sociodemographic background also could play an important part in how information is received and used. For health messages to be followed effectively, they must be tailored to the health literacy of the audience, while also reducing panic and anxiety and serving as an effective source of health guidance (Castro-Sanchez 2016).

Although information about mitigation strategies is available on these national health agency websites, it is not known to what extent any of the mitigation strategies have been adopted as a result. Behaviour can be driven by political, social, or cultural influences. For example, perceived government empowerment can influence

individual behaviours (Chang 2020). Future research may wish to use prospective trials to track users who frequent national health agency websites. Baseline data on user perceptions and sociodemographic characteristics can be captured with initial surveys, with adoption and other behaviour changes tracked over a set of follow-up surveys. However, by identifying the availability, navigability, and quality of mitigation information across three national health agency websites, this study has taken an important first step toward identifying specific areas of interest and data-related limitations for future studies that may further examine pandemic communication channels and content.

References

Ahmad, Krumkamp, R., & Reintjes, R. (2009). Controlling SARS: a review on China's response compared with other SARS-affected countries. *Tropical Medicine & International Health*, *14*(1), 36–45. https://doi.org/10.1111/j.1365-3156.2008.02146.x

Bremmer, I. (2020, March 14). *The Best Global Responses to the COVID-19 Pandemic, 1 Year Later*. TIME The Best Global Responses to COVID-19 Pandemic, 1 Year Later | Time

Castro-Sánchez, E., Spanoudakis, E., & Holmes, A. H. (2015). Readability of Ebola Information on Websites of Public Health Agencies, United States, United Kingdom, Canada, Australia, and Europe. *Emerging Infectious Diseases*, *21*(7), 1217-1219. https://doi.org/10.3201/eid2107.141829

Centers for Disease Control and Prevention (2018, July). CERC: Introduction. CDC. CERC: Introduction (cdc.gov)

Centers for Disease Control and Prevention (2020, April 6). CERC Overview for COVID-19. CDC. Microsoft PowerPoint - COVID19_CERC_CLEARED (003) - Read-Only (cdc.gov)

Centers for Disease Control and Prevention (2022, February 28). *COVID Data Tracker.* CDC. CDC COVID Data Tracker

Chingching Chang (2022) Cross-Country Comparison of Effects of Early Government Communication on Personal Empowerment during the COVID-19 Pandemic in Taiwan and the United States, Health Communication, 37:4, 476-489, DOI: 10.1080/10410236.2020.1852698

Dancer, S. J., Tang, J. W., Marr, L. C., Miller, S., Morawska, L., & Jimenez, J. L. (2020). Putting a balance on the aerosolization debate around SARS-CoV-

2. *The Journal of hospital infection*, *105*(3), 569–570. https://doi.org/10.1016/j.jhin.2020.05.014

Dobbins, M., Watson, S., Read, K., Graham, K., Yousefi Nooraie, R., & Levinson, A. J. (2018). A Tool That Assesses the Evidence, Transparency, and Usability of Online Health Information: Development and Reliability Assessment. JMIR aging, 1(1), e3. https://doi.org/10.2196/aging.9216)

Elachola, H., Ebrahim, S. H., & Gozzer, E. (2020). COVID-19: Facemask use prevalence in international airports in Asia, Europe and the Americas, March 2020. *Travel medicine and infectious disease*, *35*, 101637.

Falciola, L., & Barbieri, M. (2022). Searching and Analyzing Patent-relevant COVID-19 Information. *World Patent Information*, *68*, 102094. https://doi.org/10.1016/j.wpi.2022.102094

Fischer, & Ghelardi, G. (2016). The Precautionary Principle, Evidence-Based Medicine, and Decision Theory in Public Health Evaluation. *Frontiers in Public Health*, *4*, 107–107. https://doi.org/10.3389/fpubh.2016.00107

Husnayain, A., Fuad, A., & Su, E. C. (2020). Applications of Google Search Trends for risk communication in infectious disease management: A case study of the COVID-19 outbreak in Taiwan. *International journal of infectious diseases: IJID: official publication of the International Society for Infectious Diseases*, *95*, 221–223. https://doi.org/10.1016/j.ijid.2020.03.021

Kim, D., & Kreps, G. L. (2020). An Analysis of Government Communication in the United States During the COVID-19 Pandemic: Recommendations for Effective Government Health Risk Communication. *World medical & health policy*, 10.1002/wmh3.363. Advance online publication. https://doi.org/10.1002/wmh3.363

Lin, C., Braund, W. E., Auerbach, J., Chou, J. H., Teng, J. H., Tu, P., & Mullen, J. (2020). Policy Decisions and Use of Information Technology to Fight COVID-19, Taiwan. *Emerging infectious diseases*, *26*(7), 1506–1512. https://doi.org/10.3201/eid2607.200574

Li, Y., Li, M., Rice, M., Zhang, H., Sha, D., Li, M., Su, Y., & Yang, C. (2021). The Impact of Policy Measures on Human Mobility, COVID-19 Cases, and Mortality in the US: A Spatiotemporal Perspective. *International journal of environmental research and public health*, *18*(3), 996. https://doi.org/10.3390/ijerph18030996

Li-Yin Liu, Wei-Ning Wu, David A. McEntire. (2021). Six Cs of pandemic emergency management: A case study of Taiwan's initial response to the COVID-19 pandemic. *International Journal of Disaster Risk Reduction,* vol,64. https://doi.org/10.1016/j.ijdrr.2021.102516.

Lo, Shih-Yu, Shu-Chu S. Li, and Tai-Yee Wu. 2021. "Exploring Psychological Factors for COVID-19 Vaccination Intention in Taiwan" *Vaccines* 9, no. 7: 764. https://doi.org/10.3390/vaccines9070764

MacDonald, I., & Hsu, J. L. (2021). Epidemiological observations on breaking COVID-19 transmission: from the experience of Taiwan. *Journal of epidemiology and community health*, *75*(8), 809–812. https://doi.org/10.1136/jech-2020-216240

Mallah, S. I., Ghorab, O. K., Al-Salmi, S., Abdellatif, O. S., Tharmaratnam, T., Iskandar, M. A., Sefen, J., Sidhu, P., Atallah, B., El-Lababidi, R., & Al-Qahtani, M. (2021). COVID-19: breaking down a global health crisis. *Annals of clinical microbiology and antimicrobials*, *20*(1), 35. https://doi.org/10.1186/s12941-021-00438-7

Miller, S. L., Nazaroff, W. W., Jimenez, J. L., Boerstra, A., Buonanno, G., Dancer, S. J., Kurnitski, J., Marr, L. C., Morawska, L., & Noakes, C. (2021). Transmission of SARS-CoV-2 by inhalation of respiratory aerosol in the Skagit Valley Chorale superspreading event. *Indoor air*, *31*(2), 314–323. https://doi.org/10.1111/ina.12751

NBC News (2022, February 28). *Map of how many cases have been across the country, by state*. nbcnews.com. Coronavirus in the U.S.: Map of how many cases have been confirmed across the country, by state (nbcnews.com)

NBC News (2022, February 28). *Confirmed Covid cases per country.* nbcnews.com Coronavirus map: Confirmed Covid cases, per country (nbcnews.com)

Ogunleye Olayinka O., Basu Debashis, Mueller Debjani, Sneddon Jacqueline, Seaton R. Andrew, Yinka-Ogunleye Adesola F., Wamboga Joshua, Miljković Nenad, Mwita Julius C., Rwegerera Godfrey Mutashambara, Massele Amos, Patrick Okwen, Niba Loveline Lum, Nsaikila Melaine, Rashed Wafaa M., Hussein Mohamed Ali, Hegazy Rehab, Amu Adefolarin A., Boahen-Boaten Baffour Boaten, et al. (2020). Response to the Novel Corona Virus (COVID-19) Pandemic Across Africa: Successes, Challenges, and Implications for the Future. *Frontiers in Pharmacology* vol, 11. https://www.frontiersin.org/article/10.3389/fphar.2020.01205 DOI=10.3389/fphar.2020.01205

Ow Yong, L.M., Xin, X., Wee, J.M.L. *et al.* (2020). Perception survey of crisis and emergency risk communication in an acute hospital in the management of COVID-19 pandemic in Singapore. *BMC Public Health* **20,** 1919. https://doi.org/10.1186/s12889-020-10047-2

Patricia Moyinoluwa Ojo, Tolulope Omowonuola Okeowo, Ann Mary Thampy, Zubair KabirmedRxiv (2020). Readability of selected governmental and popular health organization websites on Covid-19 public health information: A descriptive analysis 06.27.20141770; doi: https://doi.org/10.1101/2020.06.27.20141770

Peng, Z., & Jimenez, J. L. (2021). Exhaled CO_2 as a COVID-19 Infection Risk Proxy for Different Indoor Environments and Activities. *Environmental Science & Technology Letters*, acs. estlett.1c00183. https://doi.org/10.1021/acs.estlett.1c00183

Persson, E. (2016). What are the core ideas behind the Precautionary Principle? *The Science of the Total Environment*, *557-558*, 134–141. https://doi.org/10.1016/j.scitotenv.2016.03.034

Qiu, Chu, C., Mao, A., & Wu, J. (2018). The Impacts on Health, Society, and Economy of SARS and H7N9 Outbreaks in China: A Case Comparison Study. *Journal of Environmental and Public Health*, *2018*, 2710185–2710187. https://doi.org/10.1155/2018/2710185

Sørensen, K., Okan, O., Kondilis, B., & Levin-Zamir, D. (2021). Rebranding social distancing to physical distancing: calling for a change in the health promotion vocabulary to enhance clear communication during a pandemic. *Global health promotion*, *28*(1), 5–14. https://doi.org/10.1177/1757975920986126

Stroebe W, vanDellen MR, Abakoumkin G, et al. Politicization of COVID-19 health-protective behaviors in the United States: Longitudinal and cross-national evidence [published correction appears in PLoS One. 2022 Jan 21;17(1):

e0263100]. *PLoS One*. 2021;16(10): e0256740. Published 2021 Oct 20. doi:10.1371/journal.pone.0256740

Su Y. C. (2021). Legislative preparedness for the control of pandemics - using Taiwan as an example. *The Medico-legal journal*, *89*(1), 19–22. https://doi.org/10.1177/0025817220965381

Summers, J., Cheng, H. Y., Lin, H. H., Barnard, L. T., Kvalsvig, A., Wilson, N., & Baker, M. G. (2020). Potential lessons from the Taiwan and New Zealand health responses to the COVID-19 pandemic. *The Lancet regional health. Western Pacific*, *4*, 100044. https://doi.org/10.1016/j.lanwpc.2020.100044

Trisha Greenhalgh, Jose L Jimenez, Kimberly A Prather, Zeynep Tufekci, David Fisman, Robert Schooley. (2021). Ten scientific reasons in support of airborne transmission of SARS-CoV-2. *The Lancet, Volume 397 (*10285), 1603-1605. https://doi.org/10.1016/S0140-6736(21)00869-2.

Umviligihozo, G., Mupfumi, L., Sonela, N., Naicker, D., Obuku, E. A., Koofhethile, C., Mogashoa, T., Kapaata, A., Ombati, G., Michelo, C. M., Makobu, K., Todowede, O., & Balinda, S. N. (2020). Sub-Saharan Africa preparedness and response to the COVID-19 pandemic: A perspective of early career African scientists. *Wellcome open research*, *5*, 163. https://doi.org/10.12688/wellcomeopenres.16070.3

van Herten, J., & Bovenkerk, B. (2021). The Precautionary Principle in Zoonotic Disease Control. *Public health ethics, 14*(2), 180–190. https://doi.org/10.1093/phe/phab012

Vianna Franco, Molnár, O., Dorninger, C., Laciny, A., Treven, M., Weger, J., Albuquerque, E. da M. e, Cazzolla Gatti, R., Villanueva Hernandez, L.-A., Jakab, M., Marizzi, C., Menéndez, L. P., Poliseli, L., Rodríguez, H. B., &

Caniglia, G. (2022). Diversity regained: Precautionary approaches to COVID-19 as a phenomenon of the total environment. *The Science of the Total Environment*, *825*, 154029–154029. https://doi.org/10.1016/j.scitotenv.2022.154029

Wang, C. C., Prather, K. A., Sznitman, J., Jimenez, J. L., Lakdawala, S. S., Tufekci, Z., & Marr, L. C. (2021). Airborne transmission of respiratory viruses. *Science (New York, N.Y.)*, *373*(6558), eabd9149. https://doi.org/10.1126/science.abd9149

Wangari EN, Gichuki P, Abuor AA *et al*. Kenya's response to the COVID-19 pandemic: a balance between minimising morbidity and adverse economic impact [version 1; peer review: 1 approved, 3 approved with reservations]. Open Res Africa 2021, 4:3 (https://doi.org/10.12688/aasopenres.13156.1)

World Health Organization (2021, December 30). *Population by country- Worldometer.* Worldometer.info. Population by Country (2021) - Worldometer (worldometers.info)

Yoon H. Y. (2021). Is Crisis and Emergency Risk Communication as Effective as Vaccination for Preventing Virus Diffusion? Measuring the Impacts of Failure in CERC with MERS-CoV Outbreak in South Korea. *Risk analysis: an official publication of the Society for Risk Analysis*, 10.1111/risa.13842. Advance online publication. https://doi.org/10.1111/risa.13842Yen, M. Y., Yen, Y. F., Chen, S. Y., Lee, T. I., Huang, K. H., Chan, T. C., Tung, T. H., Hsu, L. Y., Chiu, T. Y., Hsueh, P. R., & King, C. C. (2021). Learning from the past: Taiwan's responses to COVID-19 versus SARS. *International journal of*

infectious diseases: IJID: official publication of the International Society for Infectious Diseases, *110*, 469–478. https://doi.org/10.1016/j.ijid.2021.06.002