**Master's Thesis**

# The Use of Social Media in Risk Communication during COVID-19:

*An Analysis of Stakeholders' Messages on Social Media*

Thesis Type: Review Article

**Denita Utami**

**Master of Public Health**

**Department of Sociomedical Sciences**

**Mailman School of Public Health, Columbia University**

**In partial fulfillment of MPH degree requirements**

**Expected Graduation: April 2021**

**Thesis Sponsor: Dr. Renata Schiavo**

**Signed: April 20, 2021**

Renata Schiavo

**Abstract/Executive Summary**

**Introduction:** As a global health crisis, COVID-19 has disproportionately affected various aspects of life. Unlike previous global pandemics, individuals nowadays are more interconnected with instantaneous access to a flow of information, including access to social media. Risk communication is one of the key pillars of outbreak communication, which requires an in-depth understanding of key groups and stakeholders to ensure effective risk communication responses to the COVID-19 pandemic. Social media can be useful for risk communication as it allows both experts and the public to quickly spread and gather information, however, it can also be detrimental as it generates widespread fear and misinformation.

**Objective:** This thesis aims to analyze the use of social media for risk communication during COVID-19. This includes how different types of organizations have been using social media, key trends of social media campaigns, lessons learned, and actionable suggestions to effectively utilize social media for risk communication.

**Methods:** A literature search was conducted starting in February 2020. The search was limited to articles published from January 1 to December 31, 2020 in PubMed, Scopus, Embase, and Web of Science to identify relevant articles to be included in the analysis. Only articles in English are included in the review.

**Results:** Based on the inclusion and exclusion criteria, 26 articles met the criteria of the review. The majority of the studies discuss the use of social media for risk communication of COVID-19 among government leaders and agencies, with a total of 16 studies retrieved. Most studies analyze the use of Twitter, followed by Facebook and local social media platforms. The frequency of posting and message trends highly correspond to the stages of the pandemic and related risk perception.

**Conclusion:** The pandemic has further elucidated the need for clear communication between stakeholders and the public in response to a public health emergency. This study has shown that government agencies are important stakeholders in risk communication on social media. News media companies and outlets, healthcare organizations, healthcare professionals, transportation services, celebrities, influencers, and youth groups are also among the most prominent stakeholders in COVID-19 risk communication on social media. Insufficiency, incongruency, and inconsistency across critical message types in communicating COVID-19 were prevalent in social media. This should further be improved to optimize potential public health communication strategies on social media.

## Introduction

### COVID-19 and the Role of Communication

As a global health crisis, COVID-19 has disproportionately affected various aspects of life across the globe. As the number of cases continues to skyrocket, information from multiple sources is constantly evolving. Unlike previous global pandemics, individuals nowadays are more interconnected than ever with instantaneous access to information. Information, accurate or otherwise, is rapidly flowing from one side of the world to the other via word of mouth, social media, news, and medical journals (Poonia & Rajasekaran, 2020). This has created a striking difference between the ongoing and previous pandemics with the coincidence of virology and virality, in which not only did the virus itself spread very rapidly but also did the information and misinformation about the pandemic (Depoux et al., 2020). As a result, effective outbreak communication, particularly at the early stage, never has been as fundamental to deal with public fear, while at the same time promoting risk awareness, empowering the public in taking protective actions, and gaining public confidence and trust (J. Q. Liao & Fielding, 2014) (Depoux et al., 2020). The pandemic has also elucidated several barriers to effective risk communication.

During a crisis that affects public health and livelihood in general, technical information must be compiled and presented with meticulous attention to comprehension by different audiences (Glik 2007). This requires identifying key stakeholders, understanding who these stakeholders are, identifying competing ideas on the topic, and strategically presenting the information with the stakeholders' perspectives in mind (Paulik, Keenan, & Durda, 2020). In addition, risk communication efforts during the pandemic present specific challenges such as the need to communicate at times of uncertain science with certain deadlines, the danger or threat of the pandemic such as deaths, health system collapse, and economic loss, and most importantly the need to leave no one behind, prevent further damage, while at the same time addressing people's emotional and psychological needs (Schiavo, 2009b, 2009c, 2010a).

COVID-19 is uniquely vulnerable to misinformation as this is the first pandemic in history that also has to deal with an infodemic. The term 'infodemic' refers to an overabundance of information that attempts to disseminate wrong information to undermine the public health response and advance alternative agendas of groups or individuals (Joint statement by WHO, UN, UNICEF, UNDP, UNESCO, UNAIDS, ITU, UN Global Pulse, and IFRC 2020). Considering the magnitude of the situation, the WHO released a joint statement with other UN agencies (UN, UNICEF, UNDP,

UNESCO, UNAIDS, ITU, and UN Global Pulse), and IFRC to urge the Member States to develop and implement action plans to manage the infodemic by promoting timely dissemination of accurate information. The information must be grounded on science and evidence, accessible to all communities, in particular high-risk groups, and preventing the spread of misinformation while respecting freedom of expression. In fact, Barua et al. (2020) state that the possible best approach to slow down the spread of COVID-19 is knowing the true and accurate information about its causes and how it spreads.

On the other hand, almost half of the world's population has no access to the internet (Broom, 2020). This circumstance has further exposed the digital divide and enforced existing inequality (van Deursen, 2020), therefore increasing the risk of marginalized communities, which are less likely to benefit of digital information and more vulnerable to the negative consequences of the crisis (Beaunoyer, Dupéré, & Guitton, 2020). As a result, there is a need to use social media strategically while also considering digital literacy and access to technology among marginalized communities around the world.

**Definition of risk communication**

Risk communication is one of the key pillars of outbreak communication. This term refers to the real-time exchange of information, advice, and opinions between health experts or officials or other leaders and people who face a threat (hazard) to their survival, health, or economic or social well-being. The objective of risk communication is to enable everyone at risk to make informed decisions to mitigate the effects of a disease outbreak and take protective and preventive action (World Health Organization, 2018). This approach is grounded in health and development communication, health promotion, and integrated marketing communication (IMC) to involve the participation of different key groups, communities, stakeholders, and segments of society. In order to be effective, risk communication should address key social determinants that act as barriers to protective behaviors through multisectoral, and integrated communication interventions. This can be achieved via multiple action areas and strategies, which include mass media and new media communication, community mobilization and citizen engagement, policy communication, and public advocacy (Schiavo, 2014). In terms of outbreak response, risk communication should reflect and address the complexity of epidemics, the management of decision risks, implementation risks, and risks related to existing environmental, health, political and social circumstances (Kreps, 2009; Schiavo, 2014; Schiavo, May Leung, & Brown, 2014).

In the past few years, interpersonal communication, along with community-based communication, social dialogue, and mobilization have played a major role in both risk and crisis communication among specific populations, communities and constituency groups. Past outbreaks such as the Ebola Virus Disease (EVD), anthrax, and Severe Acute Respiratory Syndrome (SARS) outbreak, have further demonstrated the centrality of communities in risk and crisis communication. The terms 'risk communication' and 'crisis communication' have been used interchangeably as the two fields merged in both theory and practice. One example is the Centers for Disease Control and Prevention's Crisis & Emergency Risk Communication (CERC). This concept is reinforced by lessons learned from past public health emergencies and research in the fields of public health, psychology, and emergency risk communication (Centers for Disease Control and Prevention (CDC), 2018). Engaging the community in the design, implementation, and evaluation of risk communication interventions can also strengthen community ownership, which can ensure sustainability in the response to epidemics (Leach, Scoones, & Stirling, 2010) (Schiavo, 2014) (Schiavo et al., 2014).

**Community-based risk communication**

In recent years, community-based risk communication has gained its prominence in epidemics and emerging disease settings. Recent public health emergencies such as the 2001 anthrax crisis in the United States, the SARS epidemic, the 2009 H1N1 influenza pandemic, and the Ebola Virus Disease (EVD) epidemic in the 2014-2016 and 2018-2020 have highlighted the importance of community mobilization and citizen engagement as key components of participatory communication processes. These components emphasize the importance of addressing cultural values, social norms, beliefs, attitudes, needs, preferences, and community-specific obstacles that may influence the adoption and sustainability of disease mitigation measures among different groups and populations (Zimmerman, DiClemente, Andrus, & Hosein, 2016). These approaches also facilitate additional community and public services during outbreaks and help secure the buy-in of key stakeholders and citizens on mitigation measure (Paek, Hilyard, Freimuth, Barge, & Mindlin, 2010; Schiavo et al., 2014).

Community-based risk communication refers to a participatory approach to communication, in which there is a two-way interaction with the community at every step of the risk mitigation process, including determining what issues should be addressed and why. Community participation is both a goal and a tool. This can be achieved through a bottom-up approach instead of the typical top-down approach. The bottom-up approach might encourage community and

stakeholder participation. This is related to the role of community members as both the expertise and problem solvers, as well as their role in the context of a larger social-ecological model, in which individuals, communities, institutions, and policies are interconnected to one another. Due to the role of community in the social-ecological model, initial two-way communication should include the evaluation of health statistics and data on knowledge, attitudes, behaviors, and intentions, as well as open-ended dialogue with community members and their leaders (Zimmerman et al., 2016).

**Stakeholders in risk communication during public health crises**

During crises, a variety of individuals, groups, and social actors are affected by risk, decisions, mitigation strategies, and/or processes. For the purpose of this thesis, these groups are referred to as “stakeholders.”. Stakeholders can both act as the source and/or merely convey information originated by different sources.. These stakeholders are dynamic and likely to change during the risk communication process. Some may be constant, others may come, go, and join in at different stages of the process (Jardine, 2008). When designed and implemented effectively, stakeholder engagement is an integral component of risk communication and can result in a better understanding of the existing risk and help build trust and credibility. When stakeholders are involved in the decision-making process, they feel that their interests matter and are taken seriously by the organization. Stakeholder engagement also creates mutual understanding and sharing of responsibility when things go wrong. As a result, it is important to engage with a variety of stakeholders and make sure their voices are heard by consulting them at different stages of risk communication (Ndlela, 2018).

In public health crises, there are usually multiple stakeholders. Public health crises affect different levels within the health system, such as the regional, national, and global health systems. These different levels and related viewpoints and interactions within the system demand we recognize the multiple roles of different stakeholders in public health crises. These include (Ndlela, 2018):

- Policymakers or decision-makers: those who establish frameworks for the delivery of health services. This includes local ministries of health, agencies, or any other jurisdictional entity with responsibility for disease prevention and care, within and across national boundaries.
- Influencers: health partnerships/coalitions, foundations, intragovernmental and nongovernmental organizations, civil society, media, professional associations (World Health Organization, n.d.)

- Service providers: those who operationalize preventive care and the delivery of healthcare services
- Industry providers: those who manufacture, provide, and purchase medical supplies and pharmaceuticals or other products that may be essential to the pandemic response.
- Patients
- General public/communities

Once the stakeholders have been identified, the next step should be the identification of competing ideas related to the topic and tailoring the information with the stakeholders' perspectives in mind. Stakeholder engagement should also be consistent and transparent to develop trust. Lack of trust can have negative consequences for public health as it can lead the public to obtain information from untrustworthy sources not rooted in science (Paulik et al., 2020)

The role of community stakeholders is crucial to ensure rapid implementation of outbreak mitigation measures. For instance, during the EVD outbreak in Sierra Leone, community-based stakeholder identification was conducted to ensure rapid implementation and buy-in of the EVD Community Care Centers (CCCs) for rapid isolation, diagnosis, protection, and care. UNICEF and the Ministry of Health and Sanitation (MOHS) worked in close collaboration with the District Health Management Teams (DHMT) and held meetings with community leaders to discuss the purpose of the CCC and to identify community members who could potentially serve as staffs. Following the establishment of the CCCs, the team conducted community dialogue and engagement sessions through various social mobilization approaches to ensure acceptance and support. In addition to community dialogue sessions, meetings with Paramount Chiefs and religious community leaders, and house-to-house visits were also implemented to secure community input on key messages and outreach strategies. This helped build confidence among local communities and helped mobilize and empower its members as trusted partners in the Ebola response.. This also eventually worked to improve dignity in patient care, decrease pain and suffering, and provide psychosocial support among participating communities (UNICEF, 2015).

**Risk communication media, channels, and venues**

Risk communication calls for timely and effective public communication strategies using appropriate channels and media to engage different populations (Ataguba & Ataguba, 2020). Information needs to be provided through contextually appropriate channels that reflect intended audiences' interests (World Health Organization, 2021). Communication channels should be able

to accomplish key goals of risk communication, which include reaching diverse audiences, establishing interactive and ongoing community engagement, facilitating disease protection and public empowerment, and increasing the transmission of urgent public health information (Burnett Heldman, Schindelar, & Weaver III, 2013; Ng & Lean, 2012). Channels can be categorized, for example (CDC, 2014; Tumpey, Daigle, & Nowak, 2018):

- Face to face: interpersonal communication between healthcare professionals and patients, Interactions between organization's staff member and state partner organization or organization's staff member and community members, dialogue between community leaders and community members
- Group delivery: small group communication, public meetings, community dialogue sessions, workshops, educational sessions, and others
- Public communication: public presentations, larger meetings, webinars, conference calls with partner organizations, videos for online clinical communities, or other forums.
- Organizational communication by response stakeholders and partners: organizational messages, web pages, and publications, digital press kits. This should include photos, videos, quotations from spokespersons, the latest data or information (e.g., graphics, charts, or maps), and information about how to obtain an interview.
- Mass media: radio, television, newspaper, direct mail, and online-based channels, such as websites, blogs, and others
- Social media: Twitter, Facebook, and YouTube.
- Community: employers, schools, malls, health groups, local government agencies, traditional forms of expression such as theater, poetry, and other art-based venues and media.
- Word of mouth.

It is important to conduct an initial assessment of the intended audience to identify preferred communication channels. Surveys or discussion with community leaders and members are suitable methods (Institute of Development Studies (IDS), n.d.; International Medical Corps (IMC) & International Rescue Committee (IRC), 2016). Of great importance, it should be considered that high levels of exposure to a particular communication channel do not necessarily correspond to high levels of trust in the information received through this channel (World Health Organization, 2021). Digital engagement should be complemented by safe and appropriately resourced in-person or otherwise interpersonal engagement to ensure equitable access to vulnerable groups and those who cannot access digital channels. For instance, during the Ebola outbreak, radio was

identified as a particularly effective means of accessing communities. Group delivery such as house-to-house visits and religious gatherings were also found to be effective (Toppenberg-Pejcic et al., 2019). SMS or text messaging was heavily used to track and combat rumors and to communicate with quarantined areas during the Ebola outbreak as seen in Sierra Leone. The government also utilized WhatsApp as one of its official response channels (Rubyan-Ling, 2015) and SMS for real-time monitoring (Francia, 2015).

During crisis and uncertainty, individuals tend to refrain from new or ad-hoc platforms set up by the authorities. Instead, they prefer familiar platforms that allow them to foster a sense of community and interact with their peers. As a result, social media has been widely used during risk communication due to its familiarity and responsiveness to users, which allow them to interact and leads to wider circulation of information (Potts, 2013). As risk communication calls for real-time exchange of information, the vast network of social media allows timely and real-time resources to spread quickly through user networks. Moreover, it allows interactive and user-generated content based on facts and values that can enhance (or be detrimental to depending on the quality and accuracy of information) risk awareness and strengthens preparedness by addressing public concerns and can foster compliance among users (Ding & Zhang, 2010).

**Types of risk communication messages**

Risk communication should be bidirectional, meaning that the intention is to be inherently collaborative and not merely an instructive message to communities and the general public. It is also important to consider that actual risk is composed of the disease-related hazard, and the public perception of hazard (Abrams & Greenhawt, 2020). Risk communication messages should be able to translate existing knowledge into actionable and behavioral change messages (World Health Organization, 2020) while taking into account the needs of vulnerable and affected populations (Bista, 2020).

Risk communication messages should be informed by four major factors that may add to their trustworthiness and credibility: empathy and caring, honesty and openness, dedication and commitment, and competence and expertise (Tumpey et al., 2018). Messages must also resonate with intended groups and affected populations, be easy to understand, and accessible (World Health Organization, 2021). Sample message types for risk communication during a public health crisis include:

- An expression of empathy: Acknowledgement of concerns and expression of understanding of how affected population or target audience are probably feeling. Messages should demonstrate how communicators are working to understand key concerns and perspectives.
- What is currently known and a related a call for action, including answering the questions of who, what, when, where, why, and how.
- What is currently known and what is not known, and how answers will be obtained.
- Explanations of what public health actions are being taken and why.
- A statement of commitment.
- When additional information will be provided.
- Where to find more information in the meantime.

In addition, a number of communication concepts (communication appeal) are commonly used in message development. Concepts are preliminary to messages and apply to actual messages as well as the content and graphic format of key materials, media, and activities. Some of the commonly used concepts in risk communication messages are (Schiavo, 2014):

- Fear appeal: Message concepts that developed to evoke fear and refer to an emotional response.
- Action step: Message concepts that explicitly highlight specific recommended actions.
- Rewards or benefits: Message concepts that emphasize on key advantages associated with recommended change.
- Perceived threat: Message concepts that aim to influence existing perception about group-specific risk levels for a specific health condition; attempts to elicit the kind of rationale response that is information-based.
- Perceived efficacy: Message concepts that target people's perceptions about their own ability to perform recommended actions and behavior, as well as the impact of such actions on the actual threat.
- Hope: Message concepts that suggest that the recommended behavior will enable people to achieve the kinds of milestones or changes they may hope for.

As the patterns of the epidemic change over time, it is important to constantly adapt messages and strategies for cultural and community relevance. Messages should convey evidence-based information on current understanding of the health issue, information needs, and what is most

likely to prevent and control infections. Previous public health crises have been often characterized by inconsistent, ambiguous, contradicting messages and the absence of clear, actionable, credible, and inclusive information from authorities, leaving room for misinformation and myths (Tumpey et al., 2018).

For example, during the early stages of the EVD epidemic in West Africa, messages that focused on Ebola causing death because of no cure being available frightened communities. In addition, survivors were faced with stigma because of misinformation surrounding the presence of the virus in body fluids for several months after recovery. These negative messages drove people away from organized services and toward untested remedies due to the fear of stigma. Another factor in this case study is the importance of balancing the simplicity of key messages with providing sufficient information. For example, lack of communication when people with suspected Ebola being transported in ambulances without adequate information to the community had fueled rumors that ambulances were a source of infection. As a result, having a clear, consistent, and harmonized message is important in risk communication (Gillespie et al., 2016).

**Lessons learned from past infectious disease outbreaks on offline and online media**

During previous outbreaks such as the Ebola Virus Disease (EVD) outbreak and the Zika virus outbreak, social media platforms such as Twitter and Instagram played a significant role in guiding the public (Gui et al., 2017). The use of image-based social media such as Twitter and Instagram, can be a useful tool to gauge public sentiment during a public health emergency, especially since most organizations are focused on education (Seltzer, Horst-Martz, Lu, & Merchant, 2017). Similarly, during the EVD outbreak, health organizations such as the Centers for Disease Control and Prevention (CDC), World Health Organization (WHO), and Médecins Sans Frontières (MSF, also known as Doctors without Borders) integrated the approach of strategic health risk communication on Twitter and Instagram. Government authorities also utilized social media for outbreak communication to promote public common responsibility for disease prevention and to express regards to the public for cooperation. Most of the organizations employed risk communication strategies such as solution-based and preparedness messaging, acknowledgment of public fears and concerns, and incorporation of visual imagery to produce the desired level of public engagement (Lwin, Lu, Sheldenkar, & Schulz, 2018) (Guidry, Jin, Orr, Messner, & Meganck, 2017).

While social media can offer opportunities for both experts and the general public to quickly spread information to a large number of individuals, social media can also generate widespread fear and misinformation. During the Ebola outbreak in West Africa, there were rumors circulating about false treatments (Oyeyemi, Gabarron, & Wynn, 2014); the Ebola epidemic being a hoax; and misinformation about the intentions and motives of healthcare workers caring for Ebola patients (Cheung, 2015). These circumstances hindered public health measures to communicate effective prevention and control methods. Research on Ebola-related misinformation found that rumors and misperceptions about the disease, or inaccurate information about experimental Ebola vaccines were common on social media during the outbreak, which led to fear, uncertainty, and confusion amongst the public (Sell, Hosangadi, & Trotochaud, 2020). These were associated with a decreased likelihood of adopting preventive behaviors, including acceptance of Ebola vaccines and seeking formal health care (Vinck, Pham, Bindu, Bedford, & Nilles, 2019).

The community has also played a significant role in risk communication during the EVD outbreak. For instance, WHO's social mobilization team utilized radio to reach communities with information on preventing the spread of Ebola in Sierra Leone. This strategy helped reach the community in a comprehensive way, not only physically but also mentally and emotionally. Some of the stakeholders included traditional leaders and other community members who were trusted, respected and who can influence and encourage behavior change. Since the inclusion of community engagement as part of surge operations, the number of Ebola cases has dropped significantly (World Health Organization, 2015)

The spread of misinformation has become an important global issue, especially on public health issues such as vaccines and infectious diseases (Vraga & Bode, 2020). Misinformation about vaccines has thrived on social media, which include conspiracy theories, general distrust, belief in alternatives, and concerns about safety that further elicit vaccine hesitancy (Burki, 2019). This subsequently contradicts evidence-based information and can lead to individual misperception or factual beliefs that are indeed false (Sell et al., 2020). Other than misinformation, there has been a proliferation of false information under the category of disinformation and medical mistrust, including what is often called "conspiracy beliefs". Disinformation refers to strategically and deliberately spread false information, while misinformation refers to false information, not necessarily with the intent to mislead. There is also mistrust, which refers to more than the lack of trust or suspicion of ill intent due to the history of discrimination and wrong=doing many communities unfortunately experienced. These are multi-faceted phenomena, with

heterogeneous underlying motivating factors that further create public confusion (Jaiswal, LoSchiavo, & Perlman, 2020).

**Specific aims**

This thesis focuses on risk communication during COVID-19 in social media. As the pandemic continues to spread, effective responses to the COVID-19 pandemic require proper understanding and effective implementation of risk communication. Previous studies suggested that the importance of effective risk communication during a pandemic cannot be overstated, however, lessons in risk communication are usually retrospective and drawn from previous pandemics and therefore cannot be adapted to the current circumstances considering the magnitude of the pandemic. The popularity and ubiquity of social media have also changed the trajectory of information, in which the public is no longer the passive consumer of the message. This has created a very different dynamic compared to prior pandemics such as the Swine flu (H1N1),

Through this literature review, I will analyze how public health can utilize social media for risk communication during COVID-19. The specific aims of this review article, include:

i. Analyze how different types of organizations (e.g. government leaders, government health agencies, and non-governmental organizations) utilize social media for risk communication during COVID-19.
ii. Analyze the social media campaign trends during the COVID-19 pandemic.
iii. Explore lessons learned from the trends on social media during COVID-19.
iv. Provide actionable suggestions for organizations to effectively utilize social media for risk communication.

**Methods**

This review article attempts to answer the following questions:

- Research Question 1: How different types of organizations (e.g. government leaders, government health agencies, and non-governmental organizations) utilize social media for risk communication during COVID-19?
- Research Question 2: Did social media campaigns trends evolve during the COVID-19 pandemic? If yes, how?
- Research Question 3: What are the lessons learned from key trends on social media during COVID-19?

- Research Question 4: How can social media be utilized effectively for risk communication in the public health response during COVID-19?

**Search Strategy**

Literature databases such as PubMed, Scopus, Embase, and Web of Science are used to identify relevant articles to be included in the analysis. The keywords included in the search will consist of relevant terms such as:

- Primary keywords: COVID-19, Coronavirus, pandemic, risk communication, crisis communication, misinformation, infodemic, social media, government, scientist, nongovernmental, nonprofit and public health.
- Secondary keywords: healthcare, medicine, prevention, treatment, PPE, personal protective equipment, mask, vaccine, and chloroquine, public health.

To broaden and narrow the search, Boolean operators such as 'OR' and 'AND' were used to combine search terms. Example of the search strategies using Boolean operators are:

- ((("covid 19"[All Fields]) AND ("risk communication"[All Fields])) OR ("crisis communication"[All Fields])) AND ("social media"[All Fields])
- (("covid 19"[All Fields]) AND ("misinformation"[All Fields])) AND (social media)
- (("covid 19"[All Fields]) AND ("infodemic"[All Fields])) AND (social media)

**Inclusion Criteria**

As COVID-19 pandemic is a global health issue, there is no limitation on the location of the articles, however, only articles in English are included in the review. Inclusion criteria for both quantitative and qualitative articles from the grey literature and peer-reviewed literature consist of articles that addressed risk communication in the public health response, focuses on public health messages from key public health stakeholders (decision-makers: Ministries of Health, government agencies, other government departments at the national level and public health influencers: health partnerships, foundations, intragovernmental and nongovernmental organizations. These represent key stakeholders but is not an all-comprehensive list), and focused on the messages communicated on social networks and media sharing networks during the COVID-19 pandemic. "Social networks" are defined as web-based platforms that allow users to create an account, establish a profile, and interact with other members such as Facebook (including Facebook Messenger), Twitter, and Sina Weibo. On the other hand, "media sharing networks" are social media that provides users the ability to upload photos, videos, or slide presentations and share in a public forum such as Instagram, Tiktok, and YouTube. Since the

pandemic is still ongoing, the search was limited to articles published from January 1 to December 31, 2020. This review only includes peer-reviewed articles in the analysis, while the grey literature has been used to substantiate the analysis in the discussion section.

**Exclusion Criteria**

For this review, the exclusion criteria included articles written in languages other than English, articles that do not use social media as a tool for risk communication, articles presented as review articles, articles that discussed other social media platforms other than social networks and media sharing networks, studies whose full texts could not be found, and articles written before and after the time limit (January 1 to December 31, 2020).

**Data Analysis**

The articles retrieved from the search were categorized and analyzed based on the type of stakeholders (World Health Organization, n.d.), social media purposes (U.S. Department of Homeland Security, 2013), and communication concepts (Schiavo, 2014). Furthermore, the findings were reported based on the categories reflected in the specific aims and research questions, which include the types of organizations and how they utilize social media for risk communication, social media campaign trends, and suggestions for future direction. Social media campaign trends were analyzed thematically by identifying common themes, which include the target population, content, types of social media platform, and stakeholders. The analysis is presented in the form of a table (Appendix 1 and 2).

***Table 1: Definition of key terms for data analysis***

| | |
|---|---|
| **Stakeholders** | • Public health decision-makers: Ministries of Health, government agencies, other government departments at the national level.<br>• Public health influencers: experts, academic institutions, research institutions, health partnerships, foundations, intragovernmental, nonprofit organizations, and non-governmental organizations, |

| | |
|---|---|
| | including leaders of the organizations mentioned above. |
| **Social media purposes** | • Social networks: web-based platforms that allow users to create an account, establish a profile, and interact with other members. Examples: Facebook and Twitter.<br>• Media sharing networks: social media that provides users the ability to upload photos, videos, or slide presentations and share in a public forum. Examples: Instagram and YouTube. |
| **Communication/message concepts** | • Fear appeal: Message concepts that developed to evoke fear and refer to an emotional response.<br>• Action step: Message concepts that explicitly highlight specific recommended actions.<br>• Rewards or benefits: Message concepts that emphasize on key advantages associated with recommended change.<br>• Perceived threat: Message concepts that aim to influence existing perception about group-specific risk levels for a specific health condition; attempts to elicit the kind of rationale response that is information-based.<br>• Perceived efficacy: Message concepts that target people's perceptions about their own ability to perform recommended actions and behavior, |

| | |
|---|---|
| | as well as the impact of such actions on the actual threat.<br>• Hope: Message concepts that suggest that the recommended behavior will enable people to achieve the kinds of milestones or changes they may hope for. |

## Results

The initial search using the identified keywords was conducted in February 2020 and returned 206 articles through PubMed, Scopus, Embase, and Web of Science. The search results were imported to Covidence to streamline the review process through abstract screening and full-text review. Over 41 articles were marked as duplicates, with 165 studies screened for the title and abstract review. Of the latter, 70 studies were marked as irrelevant, and 95 articles were fully included for full-text assessment. Based on the inclusion and exclusion criteria, 69 articles were excluded, and 26 studies met the inclusion criteria. One article was obtained through backward referencing, as it is a prior study of one of the included articles. The articles are presented in Appendix 1 and Appendix 2. The articles were further analyzed based on the following themes: (1) social media platform; (2): stakeholders; (3) key messages/topic; and (4) lessons learned/suggestions. These will be further discussed into the use of social media for risk communication among stakeholders, social media campaign trends throughout the different phases of the pandemic, and lessons learned for the effective use of social media for risk communication during COVID-19.

### Social media use among different types of organizations and stakeholders

#### Government agencies

**United States-based government agencies**

Based on the findings, the majority of the studies analyzed the use of social media for risk communication of COVID-19 among government leaders and agencies, with a total of 16 studies retrieved. In the study by Raamkumar (2020), public health agencies in Singapore (Ministry of Health, MoH), the United States (Centre for Disease Control and Prevention, CDC), and England (Public Health England, PHE), conducted their outreach efforts on Facebook to gauge public

interest. It was found that each agency focused on different themes. For example, the CDC and PHE posts were largely related to preventive measures, while the MoH focused more on the situation update. Additionally, the MoH published 16 posts to clarify false information, while CDC and PHE did not issue any posts.

Zeemering (2021) instead analyzed government agencies at the city level in Atlanta, San Francisco, and Washington DC. All three agencies use primarily Twitter. Washington DC has 54 active city Twitter accounts, San Francisco, has 75 active city Twitter accounts, and Atlanta has 26. From the beginning of the pandemic, Atlanta has used Twitter as a part of its rapid response and daily communications to provide real-time information to residents and business owners. One example of their social media use was the widespread diffusion of information about city office closures at the start of the pandemic. The city also utilized Twitter to mention other agencies and departments and share content to reflect the city's coordination across agencies, which was guided by their social media policy document. This can be seen in their social network graph that includes 133 nodes, or distinct user accounts mentioned in the observed tweets, and connecting these nodes are 434 total edges, or distinct mentions connecting two nodes. The account for Mayor Keisha Lance Bottoms (@keishabottoms) and the main @cityofatlanta account also exhibit high out-degree centrality, mentioning city agencies and aggregating content.

Similarly, San Francisco, the home of Twitter, has also actively utilized Twitter for both internal coordination of messages and external outreach. Based on the centrality analysis, in-degree centrality (the number of other accounts that have arrows pointing towards the designated Twitter account) illuminates internal coordination across city agencies, while out-degree centrality (the number of arrows directed away from the designated Twitter account) provides evidence of city agency outreach to other agencies within city government, as well as general public engagement. The social network graph has 728 nodes, or distinct Twitter accounts, with 905 edges, or lines connecting nodes through mentions and retweets. The city government's primary Twitter account (@sfgov) and Mayor London Breed (@londonbreed) are among the most active accounts conveying information about the pandemic to the public.

In Washington DC, the social network graph of Twitter mentions includes 516 nodes and 1153 edges representing mentions or retweets. Measures of out-degree centrality show a set of agencies engaged with local businesses and diverse groups within the community, such as by sharing public resources offered by other city agencies and information resources for business

seeking assistance. Similar to both Atlanta and San Francisco, Mayor Bowser (@mayorbowser) leads the list of in-degree centrality, which indicates a high level of coordination among Washington DC agencies using the mayor as a central spokesperson for COVID-19 response.

Wang (2021) analyzed how government agencies, which include federal and state-level agencies in the United States, communicated across different networks through text mining (the process of transforming unstructured text into a structured format to gain insights and information) and dynamic network analysis (a combination of network analysis, link analysis, social simulation and multi-agent systems within network science and network theory) using Twitter data. The CDC's Twitter account has the highest degree, meaning that it has the highest level of connections with other agencies, followed by the HHS, FEMA, and WHO. For state agencies, the WA DOH and NY DOH have higher degrees than others. The study also showed that in general, the communication flow followed a hierarchy from federal health agencies (e.g. the CDC, U.S. Food and Drug Administration, U.S. Department of Health & Human Services) with various message types, such as external resources/knowledge, operations, opinion, and commentary, and resources provision first, followed by state health agencies (e.g. Florida Department of Health) and then federal stakeholders (e.g. Federal Emergency Management Agency United States Department of Transportation). For example, on average, federal health agencies started disseminating messages on resources or knowledge in late January, while early February for state health agencies and mid-March for federal stakeholders.

The study by Sutton (2020) also highlighted United States-based public health agencies' social media strategies. The study identified 7 distinct periods of communication that emerged from the data from February 1 to March 31, 2020. Each period, described as ''epoch'', is characterized by a distinct pattern of communication emphasis, as shown by distinctive hashtag use. This further concluded that government public health agencies have different emphasis on their communicating information, individual and collection action, sustaining motivation, and setting social norms based on the periods of communication in the first 60 days of the pandemic.

**Government agencies – global settings**

In general, governments communicate to the public through the most popular social media channel in their area. For instance, a microblogging site Weibo (also known as Sina Weibo), is one of the biggest social media platforms in China and used by the governments to communicate about COVID-19. Liao (2020) analyzed the Weibo data which showed that the most active

government agencies are the Municipal Health Commission (MHC) in several cities of China, including Wuhan, Zhuhai, Shanghai, and Beijing, and one city-level hospital in Sichuan Province, China. Government agency posts were more likely to share information about policies, guidelines, official actions, and instrumental support. In the study by Zeng (2020), China's Center for Disease Control and Prevention (CDC) experienced an increase in new tweets and followers with 60,000 new tweets and 1.4 million new followers on the 134 CDC accounts compared with the pre-epidemic statistics,. Of the tweets, 90% were about public health emergencies related to COVID-19. The CDC communicated through Sina Weibo, a microblogging website, with four major themes, which include the daily epidemic updates, CDC's work, public education about the epidemic, and the typical deeds and dedication of the anti-epidemic pioneers, especially the CDC.

In Vietnam and the Philippines, the government, such as the Ministry of Health and Local Government Units (LGUs), utilized Facebook to communicate COVID-19-related information. In both countries, Facebook is considered as the primary channel for receiving or seeking information (La, 2020). In the Philippines, the LGUs mainly utilized Facebook to provide regular updates or reports on local crisis response and management, promote self-protective behaviors, encourage civic engagement, provide regular updates on local crisis situation, and address misinformation, fake news and other issues about the crisis (Flores & Asuncion, 2020).

Studies by Drylie-Carey (2020), Prayoga (2020), and Rufai & Bunce (2020) focused on individual government leaders on Twitter. Drylie-Carey focused on European leaders in four of the most affected European countries, the United Kingdom, France, Spain, and Italy, in addition to Tedros Adhanom as a representative of the World Health Organization (WHO) and Ursula Von der Leyen President of the European Union (EU). This study showed that the leaders are aware of the importance of the use of the visual image to build leadership and use it as a main source of communication. For instance, they put the full-length version of their press conference video, infographic resources, and hashtag in their content.

In light of the large-scale social restriction in Jakarta, Indonesia, Purnomo (2020) analyzed four Twitter accounts of Jakarta public transportation services, consisting of LRT (Light Rail Transit), MRT (Mass Rapid Transit), BRT (Bus Rapid Transit, also known as TransJakarta), and Commuter Line (commuter line system). Based on the content analysis, it was shown that the tweets' content mostly focused on COVID-19, transportation information, risk information, and community information during the pandemic. The study categorized the use of Twitter of Jakarta's public

transportation department into five categories: information related to some schedule changes, situation report such as conditions of corridors and terminals, risk communication, mental assistance, and service information.

**Non-governmental organizations and other agencies/institutions**

**News Media Companies and Outlets**

Media companies and outlets also utilized social media to cover public health crises. Yu (2020) analyzed and compared the news updates of two main Spanish newspapers, El País and El Mundo during the pandemic on Twitter. The different types of media translated to the characteristics of their respective themes on social media. With a combination of topic modeling (a type of statistical model for discovering the abstract "topics" in a collection of documents) and network analysis method (the process of investigating social structures through the use of networks and graph theory), the center-left media focused for the most part on family life and living issues ("Livelihood"), while the center-right media focused the most on the Spanish capital news ("Madrid").

Besides Twitter, the news media and entertainment industry utilized YouTube to focus on prevention behaviors to mitigate community transmission. In the first study by Basch (2020), news media had the highest upload (85%) among the 100 most commonly viewed YouTube videos in January 2020 and March 2020. The message of stay indoors from the garnered the highest views with 81.3% among all videos produced by news media. However, in the second study (Basch, 2020), by March 20, 2020, the majority (57%) of the most widely viewed videos in this study were uploaded by entertainment television, garnering almost 55% of the total cumulative views and there was a large decline in the number of videos uploaded by news sources (from 85% to 19%). Similarly, the most commonly viewed videos from the entertainment industry conveyed the message of stay indoors. Li (2020) also found that network news and entertainment news were the main sources of included videos on YouTube. However, it was found that videos from internet news and entertainment news were significantly more likely to have non-factual information compared with professional and government videos. D'Souza (2020) also analyzed the 113 most-widely viewed videos about COVID-19. However, they had a different finding in which news agencies were more likely to post useful videos than misleading videos. The content ranges from prevalence or incidence, information on outcomes, or prognosis.

In China, People's Daily as one of the main Chinese state-owned media platforms has shifted the paradigm of media coverage by placing more emphasis on communication with the public via social media. Using Sina Weibo as the largest social media network, Ngai (2020) highlighted that disease prevention posts delivered in a narrative style were able to achieve a high number of shares. Content and style also contributed to a high engagement among social media users. The use of a narrative style in disease prevention posts had a significant positive effect on generating comments and likes by the Chinese public, while links to external sources fostered sharing.

**Healthcare organizations and healthcare professionals**

The popularity and reach of social media make it an ideal platform for healthcare organizations to launch their social media campaigns. Graffigna (2020) designed a social media campaign aimed at improving citizens' health engagement toward behavioral change for preventing the spread of COVID-19 was promoted in Italy in the early months of the pandemic. The first implementation was conducted on Facebook with the hashtag #I-am-engaged (in Italian: #Io-sono-engaged) along with Facebook posts, live videos, and video testimonies. The campaign was launched on March 10, 2020 and overall, the preliminary data showed that the campaign was able to reach 33.390 on Facebook. Out of this, only 10% of the audience showed an active engagement with the campaign, by expressing likes (n=697), by writing comments (n=102), or sharing its contents (n=253). These results had shown that Facebook generally appears a more suitable platform for engaging with the audience and as a means to convey public health information in a dynamic manner.

Healthcare professionals experienced an increase in the number of followers on social media due to COVID-19. This increase is evident across three social media platforms, Instagram, Twitter, and YouTube as analyzed by Pérez-Escoda (2020). In addition, healthcare professionals utilized social media to foster international collaboration and rapid information dissemination among their community during a global pandemic. In the study by Kudchadkar (2020), the pediatric critical care community promoted the joint usage of #PedsICU and #COVID19 throughout the international pediatric critical care community in tweets relevant to the coronavirus disease 2019 pandemic. Healthcare providers were the largest stakeholder group tweeting all #PedsICU content (72%), and non–physician healthcare providers contributed the highest engagement in COVID-19 tweets (46%). The use of hashtag has expanded the reach to six continents, with most tweets from North America and Australia. The most popular tweets shared on Twitter were open-

access resources, including links for updated literature, narrative reviews, and educational videos relevant to coronavirus disease 2019 clinical care.

Wahbeh (2020) analyzed English tweets collected from 119 medical professionals on Twitter between December 1, 2019 and April 1, 2020. Tweets were classified in eight topics, namely actions and recommendations, fighting misinformation, information and knowledge, the health care system, symptoms and illness, immunity, testing, and infection and transmission. The majority of the tweets focused on needed actions and recommendations (2827/10,096, 28%) to control the pandemic, followed by fighting misinformation (2019/10,096, 20%). Other tweets discussed general knowledge and information (911/10,096, 9%) about the virus as well as concerns about the health care systems and workers (909/10,096, 9%). The remaining tweets discussed information about symptoms associated with COVID-19 (810/10,096, 8%), immunity (707/10,096, 7%), testing (605/10,096, 6%), and virus infection and transmission (503/10,096, 5%).

**Celebrities, influencers, and youth group**

Among the 114,145 tweets posted by the 337 accounts since January 1, 2020, Kamiński, (2021) analyzed 17,331 tweets related to COVID-19. Among those tweets, most of them originated from multiple stakeholders such as academic institutions, official state institutions, and health agencies. The tweets of celebrities and politicians related to COVID-19 outperform those coming from health and scientific institutions. Celebrities had the largest average number of followers followed by health agencies. The largest number of “likes” was received by tweets of celebrities (median nominal, relative likes; 14,918, 0.036 percent), politicians (259, 0.174 percent), and health agencies (231, 0.007 percent). Most re-tweeted messages were also posted by celebrities (2,366, 0.005 percent), health agencies (130, 0.004 percent), and politicians (55, 0.041 percent). Retweets and likes peaked in March 2020, and the overall sentiment of the tweets was growing gradually. In terms of the message tone, celebrities and politicians posted positive messages, whereas the scientific and health authorities often employed a negative vocabulary. The posts with positive sentiment gained more likes and relative likes than nonpositive.

Similarly, Sadasri (2020) analyzed the social media messages posted by celebrities appointed by the BNPB (*Badan Nasional Penanggulangan Bencana* or National Disaster Management Authority) in Indonesia. Considering the strong influence of internet users in Indonesia, the government collaborated with celebrity influencers to gauge public engagement on COVID-19

through social media. The results showed that their content on self-efficacy focused more on the personal protection message compared to symptom information. In total, 48 (67.6 percent) of the content highlighted the prevention and health protocol related to the COVID-19. In addition, the youth group in Brunei actively supported the social distancing initiatives in Brunei Darussalam through the use of social media platforms such as Instagram, Twitter, and Tik Tok. The study by Mohamad (2020) found that there were five apparent narratives based on qualitative content analysis (QCA) on young people's Instagram and Twitter contents, which include the narrative of fear, the narrative of responsibility, the narrative of annoyance, the narrative of fun, and the narrative of resistance.

**Social media campaign trends during the COVID-19 pandemic**

**Timeline and critical period of COVID-19 on social media**

The majority of the study followed the pandemic timeline (Table 2) to set their inflection points, such as 1) marking the dates when the countries reported their first COVID-19 cases and 2) declared the outbreak as a national-level pandemic as well as 3) the date when the WHO declared COVID-19 as Public Health Emergency of International Concern (PHEIC) on January 30, 2020. Raamkumar (2020) found that February was the most active month for both MOH and PHE. While both MOH and PHE had their most active month in February, CDC published the highest number of COVID-19 posts in March, following the timeline when the WHO declared a global pandemic on March 11, 2020. They had the highest number of posts on a single day on March 8, 2020 with 5 posts.

**Table 2: Timeline of COVID-19 in Vietnam, Spain, and the Netherlands**

| Study | Country | Timeline | Significant events |
|---|---|---|---|
| La (2020) | Vietnam | Period 1: before the first case was confirmed (January 23, 2020),<br>Period 2: after the first confirmed case of COVID-19 infection on January 23 to February 26, 2020.<br>Period 3: February 27 to March 5, 2020, with no new patients detected and the country entered | Fake news on social media mostly emerged during period 1 and period 4.<br>Responses to combat such mis/dis-information were made in both periods 2 and 4, formalized in a government decree in which anyone |

| | | | |
|---|---|---|---|
| | | a pause in the timeline of the outbreak<br>Period 4: March 6, 2020 until now, marked by the second outbreak with the confirmation of the 17th patient. | spreading fake news could be fined between (US$430-860), around 3–6 months' worth of basic salary in Vietnam. |
| Yu (2020) | Spain | Pre-crisis period, lockdown period, and recovery period. | El País focused the most on public health professionals and real-time alarming ("Pandemic Update") information during the first two periods.<br>El Mundo coverage on Twitter focused on the state of alarm and confinement ("Lockdown") related information.<br>During the recovery period, the proportion of general political news ("Politics") update is largely increased in El País, being the third most prominent news frame in this stage, while there were no such changes for El Mundo during the recovery period. |
| van Dijck & Alinead (2020) | Netherlands | Crisis response stage and the smart exit strategy stage | The crisis response stage was characterized by the emergency response mode of the immediate lockdown, Smart exit strategy stage shifted attention from the medical emergency response |

| | | | |
|---|---|---|---|
| | | | to the broader concern about the further implication from the lockdown. |

**Communication trends within organizations**

**United States-based agencies**

Wang (2021) showed that different organizations started communicating pandemic-related information at different time points. Communication frequency increased significantly over late February to middle March when the WHO along with government agencies in the United States, which include federal and state-level agencies, averagely posted four to five tweets on weekdays and two to three tweets on weekends to communicate about COVID-19.

**Global agencies**

Based on the analysis of the Facebook accounts owned by the MoH, the CDC, and PHE in Singapore, United States, and England, Raamkumar (2020) found that the communication flow started from federal health agencies with external resources/knowledge, operations, opinion, and commentary, and resources provision first, followed by state health agencies and then federal stakeholders. For example, on average, federal health agencies started disseminating messages on resources/knowledge since late January, while early February for state health agencies and mid-March for federal stakeholders. State health agencies also contributed more discussions to situational awareness, strategies, and guidance, and management of rumors in the early stage compared to other actors

In China, based on Weibo data, Liao (2020) highlighted that as the pandemic evolved, sharing situation updates, policies, guidelines, and official actions became less common in personal posts. Government posts remained stable or increased significantly in sharing the aforementioned content. At the same time, personal posts shifted their messages to exhibit more empathy to affected people and population. As the epidemic evolved and message trends have shifted to empathetic content, this eventually corresponded to a slight increase in sharing instrumental support, praising, and empathizing in government posts.

In terms of government communication, the study by van Dijck & Alinead (2020) in the Netherlands showed that the first stage of the crisis response stage was characterized by high volatility and uncertainty, when scientific knowledge-making and evidence-informed policymaking almost overlapped with public sense-making as they both were under intense time-pressure. Throughout late February and early March, the government employed a careful and subtle response approach to the communication strategy. During this stage, the government highlighted rational explanation and relied on trusted health experts. Following that, in the smart exit stage, the government officials were gradually aware of the need to involve nonmedical experts, professionals, and nonexperts from civil society to shape future exit strategies. However, this stage was also filled with messages from nonexperts that challenged the information strategies developed by scientists and policymakers.

**Sample global themes of social media campaigns**

Raamkumar (2020) categorized trends into six themes: preventive measures, situation update, disease information, public reassurance, falsehood correction, and others (appreciation, research, testing and diagnosis, and miscellaneous). While the themes from the MOH are more diverse with no theme exceeding 30% of the total posts, the CDC and PHE posts were mainly related to preventive measures. The top two themes for the MOH were situation update and preventive measures. In terms of misinformation, the MOH issued 16 posts while the CDC and PHE did not issue any post to clarify or correct any false information.

In Spain, the study by Yu (2020) analyzed the news frames of two main Spanish newspapers, El País and El Mundo, on Twitter. For El País, Overall, “Livelihood,” “Public Health Professional,” “Pandemic Update” and “Politics” were the principal news frames of El País. The news frames shifted as the pandemic progressed. During the pre-crisis stage, “Livelihood” is the most prominent news frame and the frame network showed that this frame had a strong connection with “Politics,” “Economy” and “Public Health Professional”. In the next two periods, it started to have a more significant relation with “Madrid.” During the second period, the “State of Alarm” and “Covid Information” frames rose to prominence, while the “Politics” frame was less reported. During the recovery period, the pandemic related news frames (“Pandemic Update,” “State of Alarm,” “Public Health Professional” and “Covid Information”) were becoming less prominent.

For El Mundo, “Madrid,” “State of Alarm” and “Lockdown” were the three most frequent news frames during the pre-crisis period. As the outbreak became more severe, “Covid Information”

news frame started to become more frequent. During the recovery period, these four news frames ("Madrid," "State of Alarm", "Lockdown", and "Covid Information") appeared more frequently in the newspaper. Throughout all periods, "Madrid" was the most prominent news frame of El Mundo, although the proportion of this topic was highly changed from the second period to the third. This frame has the strongest connection strength with "Lockdown" and "State of Alarm" during the first two periods, and during the last two periods the connection between "Madrid" and "Covid Information" became stronger.

In China, Xu (2020) classified Weibo social media content into three parent classification areas: news and knowledge, public sentiment, and public reaction. The posts were further categorized into news and knowledge related to the causative agent of the disease, epidemiological characteristics of the outbreak, official or personal recommended protective measures, and information on the government's actions taken to address the COVID-19 outbreak. Public sentiment comprised of 69.72% of all the posts, with general category of anxiety about COVID-19 as the most popular user sentiment. This included expression of uncertainty; being scared, worried, and nervous; and cautious sentiment. Negative sentiment was also detected in the expressions of anger, while there was also some general positive sentiment including those who expressed calm and optimistic attitudes. Public reaction was the least common message with 4863 (47.87%) posts that self-reported user reaction to COVID-19–related information. Reactions included self-reporting protective behavioral factors including wearing masks; washing hands more frequently; and canceling all unnecessary travel, gatherings, and events. In addition, public reaction also included behaviors that could increase health risk, including self-treatment with unproven therapy and nutritional products, maintaining preoutbreak lifestyle and habits, and self-evacuation from Wuhan.

**Message trends**

Wang (2021) also analyzed the message trends among federal and state-level United States agencies. In the beginning, crisis risk communication on strategies, guidelines and order that encourage the public's preventative behaviors were considered insufficient. The messages were primarily dominated by situational information, which introduces the present pandemic situations, and external resources/knowledge which directs users to other media. These messages were followed by strategies and guidelines, order, and opinion and commentary as the second major messages. There were inconsistent attitudes towards wearing masks, which were observed from the various guidance on whether the general public should wear masks and the type of masks

that evolved over time. Similarly, there were incongruent assessment of the risk of COVID-19 among different agencies. In the beginning, agencies reported low-risk levels of coronavirus to U.S. citizens. As more cases were reported among young adults and general population, the messages started to shift to the general population by sharing the hospitalization data and community spread cases.

Liao (2020) also analyzed individual and government post content on Weibo. Government agency posts were more likely to share information about policies, guidelines, and official actions ($\chi 2_1$ =14.5, P<.001), and instrumental support ($\chi^2_1$=32.5, P<.001), while personal account posts were more likely to share information on public responses to the epidemic ($\chi^2_1$=19.1, P<.001). Personal account posts were more likely to be classified as emotional exchange ($\chi^2_1$ =30.5, P<.001) including showing empathy to affected people, attributing blame to people or organizations for malpractice during the epidemic and expressing worry about the epidemic. On the other hand, the government posts more likely praised people or organizations such as healthcare workers ($\chi^2_1$ =8.7, P=.003).

**Visual information and hashtags**

Visual information such as images and videos were ubiquitous in political leaders' crisis communication during the COVID-19 pandemic. Drylie-Carey (2020) analyzed how political leaders of the most affected European countries utilized visual information to highlight the strategies of recommendations by health authorities during the first 40 days of the pandemic on Twitter. The analysis showed that Ursula von der Leyen (with 25% of tweets from these sources), Emmanuel Macron (with 19% from specific sources), and Boris Johnson (with 15%) were among those with the highest usage of personal video or selfie or re-tweets of content from social networks. The use of the specific materials indicated the areas of engagement which are relevant in the discussion related to the enhancement of leadership and authenticity.

In terms of types of images, the leaders also utilized infographic resources with Boris Johnson having the highest percentage of infographic posted (29.4%). Among the analyzed tweets from Boris Johnson's account, the use of hashtag was prevalent with 70.5% among the analyzed tweets. The use of hashtag was also dominant in Ursula Von Leyen, Pedro Sanchez, and Giuseppe Conti with 92.2%, 83.9%, and 78.1%, respectively. For videos, Emmanuel Macron had the highest percentage of videos less than 180 seconds, and he was also among those with the shortest means of video time posted (2 minutes 50 seconds), along with Ursula von der Leyen (2

minutes 36 seconds). In contrast, Tedros Adhanom had the longest means of video time posted with 80 minutes and 50 seconds, followed by Pedro Sanchez with 49 minutes and 49 seconds.

The use of hashtag was helpful for rapid dissemination of information among the international pediatric critical care community. The community encouraged the joint usage of #PedsICU and #COVID19 in tweets relevant to the coronavirus disease 2019 pandemic and pediatric critical care. There was a large increase in usage of the #PedsICU hashtag during the annual Society of Critical Care Medicine Congress, with 5,202 tweets were shared including #PedsICU and involved 1,245 unique users. Concurrent use of a COVID-19 hashtag with #PedsICU gradually increased from late February to early March 2020. For the next two weeks (week of March 7–13 to the week of March 14–20), the use of COVID-19 hashtags in tweets with #PedsICU tripled from 1,345 to 4,238 as did the number of unique users. After this initial peak, COVID-19 hashtags have continued to dominate the #PedsICU conversation on Twitter with 69% of both tweets and impressions.

**Public engagement**

In terms of public engagement, Raamkumar (2020) showed that there was a considerable increase in the public engagement metrics in the peri-COVID-19 time period. In general, the MOH had a 7-fold increase in comments per post, with a higher average number of people commenting in 2020 (peri-COVID-19, mean=2.2) compared to 2019 (pre-COVID-19, mean comments per post 15.6). The CDC saw a 9-fold increase in the mean reactions per post from 2019 (mean=230.7) to 2020 (mean= 2128.2) and nearly 10-fold increase in mean shares per post from 2019 (mean=240.9) to 2020 (mean=2373.8) For PHE, the highest increase was shown in the shares per post, with nearly a 5-fold increase from 2019 (mean=102.6) to 2020 (mean=478.9).

Public engagement also corresponded to the types of media shared. The study by Prayoga (2020) analyzed 150 tweets from Indonesian President Jokowi (@jokowi) related to COVID-19 from January 1, 2020, to April 30, 2020. There were 80 tweets with images (53%) and 25 tweets with videos (17%) in total and the study found that the large number of retweets and likes that Jokowi received is in the tweets with images and videos. The study by Liao (2020) also assessed public engagement and government responsiveness in the COVID-19 communication during the early epidemic stage based on Weibo data. The Municipal Health Commission (MHC) in several cities of China, including Wuhan, Zhuhai, Shanghai, and Beijing, and one city-level hospital in Sichuan Province, China were among the most active health sector accounts in Weibo. In the non-health

sector, the most active government agency was the Hubei Branch of the Red Cross Society of China, which is mainly responsible for encouraging donation to support affected people during the epidemic.

In terms of growth among different social media platforms, in Spain, Pérez-Escoda (2020) measured the social media public engagement of healthcare professionals and communication media specialized in health for a period of six months. Among YouTube, Instagram, and Twitter, the study found that for YouTube, practically all the profiles studied experienced an increase in the number of followers during the crisis trimester as compared to the previous trimesters.

## Discussion

### Lessons learned from the COVID-19 pandemic

There are 26 studies included in this review article, which generated five overarching key themes: (1) Twitter is among the most popular social media platforms used by both government and non-governmental agencies, (2) misinformation debunking is one of the major themes that emerged in social media risk communication, (3) city agencies, especially within the United States, had distinct coordination and external engagement patterns across cities, (4) insufficiency, incongruency, and inconsistency of information were also prevalent during the first stage of the pandemic, and (5) narrative style messages were found to be more popular in terms of engagement.

The majority of the studies analyzed the use of Twitter among government agencies during the pandemic, followed by other popular social media platforms such as Facebook and local social media platforms such as Weibo in China or Zalo in Vietnam. The frequency of posting highly corresponded to the development of the pandemic and the risk perception. Besides sharing information, government agencies also utilized social media to fight misinformation using falsehood correction posts. In general, the pandemic has further elucidated the need for clear communication between government agencies, other key stakeholders, local communities and the general public in response to a public health emergency.

Several government organizations have adopted misinformation debunking as one of their community and social measures for handling the COVID-19 situation. Falsehood corrections are crucial during this pandemic as a previous study found that misleading Facebook posts attained

more popularity than accurate posts during the Zika outbreak in the United States (Sharma, 2017). In addition, negative sentiments were generally prevalent in social media, an issue that needs to be addressed. This is in accordance with the study by Mamidi (2019) which further demonstrates that monitoring sentiments and emotions on social media can help government agency to improve their risk communication strategies on social media.

Social media can serve as a useful gateway to scientific information, however they can also spur the growth of misinformation and conspiracy theories at the same time (Hagen (2018),. For instance, false news on Twitter reaches more people than true information, thus creating rumor cascades Vosoughi (2018). Anticipating politicization of disease outbreaks, and the need for policymakers and social media companies to build partnerships and develop response frameworks in advance is also important as it could help optimize potential public health communication strategies Sell (2020). Reflecting on the rampant misinformation during the EVD outbreak, in some cases, erroneous tweets were corrected by a Nigerian government agency on Twitter. A major role of government agencies is to spread correct information and amend misinformation on how to deal with this emergency (Oyeyemi et al., 2014).

Moreover, another key result is the role of city agencies within the United States had distinct coordination and external engagement patterns across cities. The division of responsibility across city agencies has consequences for communication. For instance, in each of the three cities, many agencies share information about the pandemic response, while a few agencies did not point their followers to the city's resources related to the COVID-19 response. This will eventually impact public understanding of government action, in which users may have little to no insights on the city's far-reaching response to the current crisis. While each agency conveys important information, observing fragmentation and the separation of some agencies from a city's broader public health efforts emphasizes the consequences of functional fragmentation. By posting content from other city agencies and mentioning key stakeholders involved in the response, government agencies will be able to distribute public health information to a larger audience, thereby amplifying the pandemic response. Moving forward, social media managers for government social media accounts should be conscientious of the need for a whole government approach and the challenges of functional fragmentation (Hughes & Palen, 2012).

Insufficiency, incongruency, and inconsistency across critical message types in communicating COVID-19 were also prevalent during the first stage of the pandemic. It is important to note that

these factors can lead to distrust and fear. Evidence shows that a perceived lack of consistency, competence, fairness, objectivity, empathy, or sincerity in crisis response from the government could lead to distrust and fear. On the contrary, when the public perceives measures as having these characteristics, as well as clear and comprehensible messages delivered through accessible channels, people are able to make informed choices and adhere to the recommended practices (Betsch, Wieler, & Habersaat, 2020). As a result, using Twitter message dissemination analysis provides a fundamental approach for the understanding of health crises and risk communication of official agencies and stakeholders. This would also offer valuable insight in understanding to what extent sufficient, congruent, consistent, or coordinated risk and crisis communication can generate.

Narrative styles were found to be more popular in terms of engagement. Previous studies also found the benefit of a narrative style of communication, which fosters the public's identification and emotional involvement through the character's sharing in a story event (Green, 2006). This narratives will increase the public awareness of health risks and encourage them to take action to reduce the spread of the disease (Kim, Bigman, Leader, Lerman, & Cappella, 2012; Kreuter et al., 2010).

**Social media campaign trends during the COVID-19 pandemic**

Fragmentation of city government can be seen in risk communication on social media, as shown in the study by Wang (2020), Zeemering (2020), and Liu (2021). During a public health crisis such as the COVID-19 pandemic, it is expected that different levels of government have access to different types and amount of information at the ground level. This has resulted in several concerns over the issue of information asymmetry among public administrators, which eventually prevents them from making timely decisions and taking appropriate actions. Although from the perspective of public administration, a centralized government is often considered to be more efficient and face less institutional friction during the pandemic crisis response, the case of crisis coordination and the role of social media during COVID-19 in Wuhan, China highlighted otherwise. It shows that conflict between the central and local governments during a pandemic can occur.

This can be mitigated by the strategic use of social media, where social media provided critical and timely information for government response in dealing with the pandemic and serving the citizens' needs. It also helped the central government to monitor the local government's work, as

well as helped the local government to identify residents' needs in a timely manner and provide prompt assistance (Y. Li, Chandra, & Kapucu, 2020). Coordination across public agencies may contribute to a broader public understanding of city action in response to the pandemic. Interagency coordination is important for the effective management of multiagency disaster response, in which government and emergency management organizations serve as the focal components of disaster communication ecology (Liu, Xu, & John, 2021). In terms of key messages, different organizations and stakeholders had specific themes that corresponded to the stages of the pandemic. This is in accordance with previous studies that highlighted the major theme of most public health agencies' social media communication, which is mainly about "information," which includes health education, crisis updates, or broadcasting organizational programs and services (Bhattacharya, Srinivasan, & Polgreen, 2014; Neiger, Thackeray, Burton, Thackeray, & Reese, 2013).

**Effective use of social media for risk communication in the public health response during COVID-19**

The results showed that most organizations utilized Twitter as the most popular social media platform for their outreach efforts and to disseminate risk communication messages. It was shown that there have been changes in communication patterns, key themes, stakeholders' messages, trends, and others. As a result, it is important to use Twitter message dissemination analysis to gain an understanding of health crises and risk communication of official agencies and stakeholders. This would offer insights on information dissemination attributes, such as frequency, timing, message types, and co-ordination which are helpful to create a social media risk communication strategy (Wang, 2021)

This result also indicated that messages showing empathy and support have gained popularity as the epidemic evolved. This is in line with a recent commentary by Habersaat et al. (2020) that emphasized the importance of fostering resilience in communities. The lockdown measures have cultivated online communities as the spaces where such forms of resilience may emerge and take hold. From a psychological perspective, the study revealed that social media use plays the crucial role of a buffer as it manages and mitigates the forms of anxiety experienced during the pandemic. Therefore, social media should play a pivotal role in the risk communication strategies, primarily to foster resilience, facilitate coping strategies, and mitigate negative psychological effects.

The findings in this review are also in line with Austin & Jin (2017) which summarize three that public agencies can utilize social media in risk communication. The first is to provide information and instruction, which includes broadcasting updates, debunking misinformation, responding to public inquiries, and connecting the public to relevant information resources. Second is as a platform for community building, to promote resiliency and produce narratives that help boost community morale and cultivate a sense of togetherness. Studies found that longitudinal risk communication should not only be focused entirely on emergency risk communication and instructive message, but also must include sustained action across the broader population (Sutton 2020). Lastly, social media serves as a focal platform for interagency coordination and networking. This leverages social media's connective function, such as the retweet or mention features on Twitter, to coordinate with and mobilize action from other agencies, nonprofit and civil society organizations, businesses, or even individual citizens. In addition, the use of hashtag may also help to build interagency coordination and networking, which have been prevalent among agencies and stakeholders. Public health-oriented hashtag campaigns may help engage individuals and enable them to have a sense of belonging as a part of a larger collective body and to participate locally by contributing information about their local context.

**Limitations**

As a general premise, we did not expect to generate a large turnout of studies to qualify for this review, as this topic is still novel. An important limitation is that we only analyzed data from January 1 to December 31, 2020. As the pandemic is still ongoing, we may have missed newer studies on the topic. In addition, we only included studies written in English, which may not fully capture the situation in other countries. This will limit the generalizability of this study in global settings.

The majority of eligible studies included in the review analyzed the use of Twitter, followed by Facebook, YouTube, and local social media platforms such as Weibo and Zalo. Since Twitter was heavily discussed in this review compared to other social media platforms, this may have caused underrepresentation of other social media platforms and skewness towards Twitter in the analysis and lessons learned section. Thus, the lessons learned may be more applicable to Twitter compared to other social media platforms. Furthermore, organizations still use traditional news and mass media outlets to reach the public with information, updates, and guidance measures, which is evidence excluded from the review.

The categories of analysis used in this thesis were too broad and not all inclusive. For instance, individuals, groups, and social actors affected by risk, decisions, mitigation strategies, and/or processes were all referred as stakeholders without further classification. In addition, this thesis categorized stakeholders into two categories, government agencies and non-government agencies and other agencies. Each agency is unique and may differ in the scope of work, cultures, methods of communication, so results may not be generalizable. Other stakeholders categories are also not included (e.g., community leaders, family members, etc.) and may provide further insights in the future.

**Conclusion**

During a crisis that affects public health and livelihood such as COVID-19, technical information must be compiled and presented with meticulous attention to comprehension by different audiences. Unlike previous global pandemics, individuals nowadays are more interconnected than ever with instantaneous access to a flow of constant information, including access to social media. As risk communication calls for real-time exchange of information, social media allows timely and real-time resources to spread quickly through user networks.

This thesis has shown that government agencies and non-governmental organizations are both important stakeholders in risk communication on social media. In general, they utilized social media for both internal coordination of messages and external outreach on COVID-19. News media companies and outlets, healthcare organizations, healthcare professionals, transportation services, celebrities, influencers, and youth groups are also among the most prominent stakeholders in COVID-19 risk communication on social media. Communication strategies appear to be organization-specific, with each sector focusing on themes and trends that reflect the progressions of the pandemic and public response, as well as organizational goals and mission. Some of the key themes that emerge include preventive measures, situation update, disease information, public reassurance, falsehood correction, and expression of empathy and support.

Insufficiency, incongruency, and inconsistency across critical message types on COVID-19 were also prevalent during the first stage of the pandemic. In addition, not all organizations attempted to correct misinformation, which have been rampant on social media. In general, the pandemic has further elucidated the need for clear communication between key stakeholders, communities and the public in response to a public health emergency. Since community-based risk communication requires a two-way interaction, social media should play a pivotal role in the risk

communication strategies to encourage participatory communication processes, primarily to foster resilience, facilitate coping strategies, and mitigate negative psychological effects.

Lastly, organizations should be able to weigh in how far they should go in monitoring and addressing misinformation rather than being more proactive on social media in disseminating evidence-based information. In addition, organizations should have a robust social media policy to guide how staff members and partners communicate on a variety of social media accounts during a public health crisis. In particular, addressing misinformation and inconsistency should be integrated into this policy as part of communication preparedness as well as strengthening overall communication systems.

**Implications**

In summary, this review provides preliminary insights on social media-mediated risk communication during COVID-19, particularly as related to the use of social media by heads of government, government agencies, healthcare organizations, media, and other governmental and non-governmental organizations and stakeholders. This review provides valuable information for social media and communication professionals in the above organizations on how social media have been used during the pandemic as well as recommendations on how to effectively utilize these important media for risk communication. Findings from the review may also inform future research and organizational policies on the use of social media for risk communication strategies in pandemic and emergency settings. Planning for rapid coordination, use of common language, and targeted boosting of critical communication systems, so that we are prepared against all kinds of threats that emerge quickly and are poorly understood, will be important for a successful response to future public health emergencies.

**References**


Abrams, E. M., & Greenhawt, M. (2020). Risk Communication During COVID-19. *Journal of Allergy and Clinical Immunology: In Practice*, *8*(6), 1791–1794. https://doi.org/10.1016/j.jaip.2020.04.012

Ataguba, O. A., & Ataguba, J. E. (2020). Social determinants of health: the role of effective communication in the COVID-19 pandemic in developing countries. *Global Health Action*, *13*(1). https://doi.org/10.1080/16549716.2020.1788263

Austin, L. L., & Jin, Y. (2017). *Social media and crisis communication*. Taylor & Francis.

Barua, Z., Barua, S., Aktar, S., Kabir, N., & Li, M. (2020). Effects of misinformation on COVID-19 individual responses and recommendations for resilience of disastrous consequences of misinformation. *Progress in Disaster Science*, *8*, 100119. https://doi.org/10.1016/j.pdisas.2020.100119

Basch, C. E., Basch, C. H., Hillyer, G. C., & Jaime, C. (2020). The role of YouTube and the entertainment industry in saving lives by educating and mobilizing the public to adopt behaviors for community mitigation of COVID-19: Successive sampling design study. *JMIR Public Health and Surveillance*, *6*(2), 1–6. https://doi.org/10.2196/19145

Basch, C. H., Hillyer, G. C., Meleo-Erwin, Z. C., Jaime, C., Mohlman, J., & Basch, C. E. (2020). Preventive behaviors conveyed on YouTube to mitigate transmission of COVID-19: Cross-sectional study. *JMIR Public Health and Surveillance*, *6*(2), 3–8. https://doi.org/10.2196/18807

Beaunoyer, E., Dupéré, S., & Guitton, M. J. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behavior*, *111*, 106424. https://doi.org/10.1016/j.chb.2020.106424

Betsch, C., Wieler, L. H., & Habersaat, K. (2020, April 18). Monitoring behavioural insights related to COVID-19. *The Lancet*, Vol. 395, pp. 1255–1256. https://doi.org/10.1016/S0140-6736(20)30729-7

Bhattacharya, S., Srinivasan, P., & Polgreen, P. (2014). Engagement with Health Agencies on Twitter. *PLoS ONE*, *9*(11), 112235. https://doi.org/10.1371/journal.pone.0112235

Bista, S. B. (2020, May 6). Sapana Basnet Bista: Covid-19 and the neglect of people with disabilities in communication campaigns - The BMJ. Retrieved April 16, 2021, from The BMJ Opinion website: https://blogs.bmj.com/bmj/2020/05/06/sapana-basnet-bista-covid-19-and-the-neglect-of-people-with-disabilities-in-communication-campaigns/

Broom, D. (2020, April 22). Billions of people lack internet access during the coronavirus crisis | World Economic Forum. Retrieved November 21, 2020, from World Economic Forum

website: https://www.weforum.org/agenda/2020/04/coronavirus-covid-19-pandemic-digital-divide-internet-data-broadband-mobbile/

Burki, T. (2019). Vaccine misinformation and social media. *The Lancet Digital Health*, *1*(6), e258–e259. https://doi.org/10.1016/s2589-7500(19)30136-0

Burnett Heldman, A., Schindelar, J., & Weaver III, J. B. (2013). Social Media Engagement and Public Health Communication: Implications for Public Health Organizations Being Truly "Social." In *Public Health Reviews* (Vol. 35).

CDC. (2014). CERC: Other Communication Channels. *Crisis and Emergency Risk Communication (CERC) Manual*, 21.

Centers for Disease Control and Prevention (CDC). (2018, January 23). Crisis & Emergency Risk Communication (CERC). Retrieved November 20, 2020, from https://emergency.cdc.gov/cerc/

Cheung, E. Y. (2015). An outbreak of fear, rumours and stigma: psychosocial support for the Ebola Virus Disease outbreak in West Africa. *Intervention*, *13*(1), 70–76.

D'Souza, R. S., D'Souza, S., Strand, N., Anderson, A., Vogt, M. N. P., & Olatoye, O. (2020). YouTube as a source of medical information on the novel coronavirus 2019 disease (COVID-19) pandemic. *Global Public Health*, Vol. 15, pp. 935–942. https://doi.org/10.1080/17441692.2020.1761426

Depoux, A., Martin, S., Karafillakis, E., Preet, R., Wilder-Smith, A., & Larson, H. (2020, April 1). The pandemic of social media panic travels faster than the COVID-19 outbreak. *Journal of Travel Medicine*, Vol. 27. https://doi.org/10.1093/jtm/taaa031

Ding, H., & Zhang, J. (2010). Social media and participatory risk communication during the H1N1 flu epidemic: A comparative study of the United States and China. *China Media Research*, *6*(4), 80–91.

Drylie-Carey, L., Sánchez-Castillo, S., & Galán-Cubillo, E. (2020). European leaders unmasked: Covid-19 communication strategy through twitter. *Profesional de La Informacion*, *29*(5), 1–15. https://doi.org/10.3145/epi.2020.sep.04

Flores, R., & Asuncion, X. V. (2020). Toward an improved risk/crisis communication in this time of COVID-19 pandemic: a baseline study for Philippine local government units. *Journal of Science Communication*, Vol. 19, pp. 1–16. https://doi.org/10.22323/2.19070209

Francia, M. (2015). Social mobilizers empower 'hotspot'communities to fight Ebola in Sierra Leone. *New York, NY: United Nations Children's Fund (UNICEF)*.

Gillespie, A., Obregon, R., Asawi, R. El, Richey, C., Manoncourt, E., Joshi, K., … Quereshi, S. (2016). Social mobilization and community engagement central to the Ebola response in

West Africa: Lessons for future public health emergencies. *Global Health Science and Practice*, *4*(4), 626–646. https://doi.org/10.9745/GHSP-D-16-00226

Graffigna, G., Bosio, C., Savarese, M., Barello, M., & Barello, S. (2020). "#I-Am-Engaged": Conceptualization and First Implementation of a Multi-Actor Participatory, Co-designed Social Media Campaign to Raise Italians Citizens' Engagement in Preventing the Spread of COVID-19 Virus. *Frontiers in Psychology*, *11*(November). https://doi.org/10.3389/fpsyg.2020.567101

Green, M. C. (2006). Narratives and Cancer Communication. *Journal of Communication*, *56*(suppl_1), S163–S183. https://doi.org/10.1111/j.1460-2466.2006.00288.x

Gui, X., Wang, Y., Kou, Y., Reynolds, T. L., Chen, Y., Mei, Q., & Zheng, K. (2017). Understanding the Patterns of Health Information Dissemination on Social Media during the Zika Outbreak. *AMIA ... Annual Symposium Proceedings. AMIA Symposium*, *2017*, 820–829. Retrieved from https://t.co/yK9bSf2tho

Guidry, J. P. D., Jin, Y., Orr, C. A., Messner, M., & Meganck, S. (2017). Ebola on Instagram and Twitter: How health organizations address the health crisis in their social media engagement. *Public Relations Review*, *43*(3), 477–486. https://doi.org/10.1016/j.pubrev.2017.04.009

Habersaat, K. B., Betsch, C., Danchin, M., Sunstein, C. R., Böhm, R., Falk, A., … Butler, R. (2020). Ten considerations for effectively managing the COVID-19 transition. *Nature Human Behaviour*, *4*(7), 677–687. https://doi.org/10.1038/s41562-020-0906-x

Hagen, L., Keller, T., Neely, S., DePaula, N., & Robert-Cooperman, C. (2018). Crisis communications in the age of social media: A network analysis of Zika-related tweets. *Social Science Computer Review*, *36*(5), 523–541.

Hughes, A. L., & Palen, L. (2012). The evolving role of the public information officer: An examination of social media in emergency management. *Journal of Homeland Security and Emergency Management*, *9*(1).

Institute of Development Studies (IDS). (n.d.). Africa APPG inquiry: Community led health systems & the Ebola outbreak . Retrieved April 16, 2021, from http://www.ebola-anthropology.net/wp-content/uploads/2015/07/Africa-APPG-inquiry-IDS-submission.pdf

International Medical Corps (IMC) & International Rescue Committee (IRC). (2016). *Guidance Note on the Use of Oral Cholera Vaccines*.

Jaiswal, J., LoSchiavo, C., & Perlman, D. C. (2020, October 1). Disinformation, Misinformation and Inequality-Driven Mistrust in the Time of COVID-19: Lessons Unlearned from AIDS Denialism. *AIDS and Behavior*, Vol. 24, pp. 2776–2780. https://doi.org/10.1007/s10461-

020-02925-y

Joint statement by WHO, UN, UNICEF, UNDP, UNESCO, UNAIDS, ITU, UN Global Pulse, and IFRC. (2020, September 23). Managing the COVID-19 infodemic: Promoting healthy behaviours and mitigating the harm from misinformation and disinformation. Retrieved November 21, 2020, from World Health Organization website: https://www.who.int/news/item/23-09-2020-managing-the-covid-19-infodemic-promoting-healthy-behaviours-and-mitigating-the-harm-from-misinformation-and-disinformation

Kamiński, M., Szymańska, C., & Nowak, J. K. (2021). Whose Tweets on COVID-19 Gain the Most Attention: Celebrities, Political, or Scientific Authorities? *Cyberpsychology, Behavior, and Social Networking*, *24*(2), 123–128. https://doi.org/10.1089/cyber.2020.0336

Kim, H. S., Bigman, C. A., Leader, A. E., Lerman, C., & Cappella, J. N. (2012). Narrative Health Communication and Behavior Change: The Influence of Exemplars in the News on Intention to Quit Smoking. *Journal of Communication*, *62*(3), 473–492. https://doi.org/10.1111/j.1460-2466.2012.01644.x

Kreps, G. L. (2009). Applying Weick's model of organizing to health care and health promotion: highlighting the central role of health communication. *Patient Education and Counseling*, *74*(3), 347–355.

Kreuter, M. W., Holmes, K., Alcaraz, K., Kalesan, B., Rath, S., Richert, M., … Clark, E. M. (2010). Comparing narrative and informational videos to increase mammography in low-income African American women. *Patient Education and Counseling*, *81*(SUPPL. 1), S6–S14. https://doi.org/10.1016/j.pec.2010.09.008

Kudchadkar, S. R., & Carroll, C. L. (2020). Using Social Media for Rapid Information Dissemination in a Pandemic: #PedsICU and Coronavirus Disease 2019. *Pediatric Critical Care Medicine*, *21*(8), E538–E546. https://doi.org/10.1097/PCC.0000000000002474

La, V. P., Pham, T. H., Ho, M. T., Nguyen, M. H., Nguyen, K. L. P., Vuong, T. T., … Vuong, Q. H. (2020). Policy response, social media and science journalism for the sustainability of the public health system amid the COVID-19 outbreak: The vietnam lessons. *Sustainability (Switzerland)*, *12*(7). https://doi.org/10.3390/su12072931

Leach, M., Scoones, I., & Stirling, A. (2010). Governing epidemics in an age of complexity: Narratives, politics and pathways to sustainability. *Global Environmental Change*, *20*(3), 369–377. https://doi.org/10.1016/j.gloenvcha.2009.11.008

Li, H. O. Y., Bailey, A., Huynh, D., & Chan, J. (2020). YouTube as a source of information on COVID-19: A pandemic of misinformation? *BMJ Global Health*, *5*(5). https://doi.org/10.1136/bmjgh-2020-002604

Li, Y., Chandra, Y., & Kapucu, N. (2020). Crisis Coordination and the Role of Social Media in Response to COVID-19 in Wuhan, China. *The American Review of Public Administration*, *50*(6–7), 698–705. https://doi.org/10.1177/0275074020942105

Liao, J. Q., & Fielding, R. (2014). Uncertain news: Trust and preventive practices in respiratory infectious diseases. *European Psychologist*, *19*(1), 4–12. https://doi.org/10.1027/1016-9040/a000168

Liao, Q., Yuan, J., Dong, M., Yang, L., Fielding, R., & Lam, W. W. T. (2020). Public engagement and government responsiveness in the communications about COVID-19 during the early epidemic stage in china: Infodemiology study on social media data. *Journal of Medical Internet Research*, *22*(5). https://doi.org/10.2196/18796

Liu, W., Xu, W., & John, B. (2021). Organizational Disaster Communication Ecology: Examining Interagency Coordination on Social Media During the Onset of the COVID-19 Pandemic. *American Behavioral Scientist*. https://doi.org/10.1177/0002764221992823

Lwin, M. O., Lu, J., Sheldenkar, A., & Schulz, P. J. (2018). Strategic uses of facebook in zika outbreak communication: Implications for the crisis and emergency risk communication model. *International Journal of Environmental Research and Public Health*, *15*(9). https://doi.org/10.3390/ijerph15091974

Mamidi, R., Miller, M., Banerjee, T., Romine, W., & Sheth, A. (2019, April 1). Identifying key topics bearing negative sentiment on twitter: Insights concerning the 2015-2016 zika epidemic. *JMIR Public Health and Surveillance*, Vol. 5, p. e11036. https://doi.org/10.2196/11036

Mohamad, S. M. (2020). Creative Production of 'COVID-19 Social Distancing' Narratives on Social Media. *Tijdschrift Voor Economische En Sociale Geografie*, *111*(3), 347–359. https://doi.org/10.1111/tesg.12430

Ndlela, M. N. (2018). A Stakeholder Approach to Risk Management. In *Crisis Communication* (pp. 53–75). https://doi.org/10.1007/978-3-319-97256-5_4

Neiger, B. L., Thackeray, R., Burton, S. H., Thackeray, C. R., & Reese, J. H. (2013). Use of twitter among local health departments: An analysis of information sharing, engagement, and action. *Journal of Medical Internet Research*, *15*(8). https://doi.org/10.2196/jmir.2775

Ng, K.-H., & Lean, M.-L. (2012). The Fukushima Nuclear Crisis Reemphasizes the Need for Improved Risk Communication and Better Use of Social Media. *Health Physics*, *103*(3), 307–310. https://doi.org/10.1097/HP.0b013e318257cfcb

Ngai, C. S. B., Singh, R. G., Lu, W., & Koon, A. C. (2020). Grappling with the COVID-19 health crisis: Content analysis of communication strategies and their effects on public

engagement on social media. *Journal of Medical Internet Research*, *22*(8). https://doi.org/10.2196/21360

Oyeyemi, S. O., Gabarron, E., & Wynn, R. (2014, October 14). Ebola, Twitter, and misinformation: A dangerous combination? *BMJ (Online)*, Vol. 349. https://doi.org/10.1136/bmj.g6178

Paek, H.-J., Hilyard, K., Freimuth, V., Barge, J. K., & Mindlin, M. (2010). Theory-based approaches to understanding public emergency preparedness: implications for effective health and risk communication. *Journal of Health Communication*, *15*(4), 428–444.

Paulik, L. B., Keenan, R. E., & Durda, J. L. (2020, September 1). The Case for Effective Risk Communication: Lessons from a Global Pandemic. *Integrated Environmental Assessment and Management*, Vol. 16, pp. 552–554. https://doi.org/10.1002/ieam.4312

Pérez-Escoda, A., Jiménez-Narros, C., Perlado-Lamo-de-Espinosa, M., & Pedrero-Esteban, L. M. (2020). Social Networks' Engagement During the COVID-19 Pandemic in Spain: Health Media vs. Healthcare Professionals. *International Journal of Environmental Research and Public Health*, *17*(14), 5261.

Poonia, S. K., & Rajasekaran, K. (2020, July 1). Information Overload: A Method to Share Updates among Frontline Staff during the COVID-19 Pandemic. *Otolaryngology - Head and Neck Surgery (United States)*, Vol. 163, pp. 60–62. https://doi.org/10.1177/0194599820922988

Potts, L. (2013). *Social media in disaster response: How experience architects can build for participation*. Routledge.

Prayoga, K. (2020). How jokowi communicates with the public during covid-19 crisis: An analysis of tweets on twitter. *Jurnal Komunikasi: Malaysian Journal of Communication*, *36*(2), 434–456. https://doi.org/10.17576/JKMJC-2020-3602-26

Raamkumar, A. S., Tan, S. G., & Wee, H. L. (2020). Measuring the Outreach Efforts of Public Health Authorities and the Public Response on Facebook during the COVID-19 Pandemic in Early 2020: Cross-Country Comparison. *Journal of Medical Internet Research*, *22*(5). https://doi.org/10.2196/19334

Rubyan-Ling, D. (2015). *Briefing Paper: Diaspora communications and Health seeking behaviour in the time of Ebola: findings from the Sierra Leonean community in London Ebola Response Anthropology Platform*. 25. Retrieved from http://www.ebola-anthropology.net/key_messages/diaspora-communications-and-health-seeking-behaviour-in-the-time-of-ebola-findings-from-the-sierra-leonean-community-in-london-2/

Rufai, S. R., & Bunce, C. (2020). World leaders' usage of twitter in response to the COVID-19

pandemic: A content analysis. *Journal of Public Health (United Kingdom)*, *42*(3), 510–516. https://doi.org/10.1093/pubmed/fdaa049

Sadasri, L. M. (2020). Micro-celebrity participation and risk communication in Indonesia. *Pacific Journalism Review : Te Koakoa*, *26*(2), 53-71v. https://doi.org/10.24135/pjr.v26i2.1135

Schiavo, R. (2014). *Health communication: From theory to practice* (Vol. 217). John Wiley & Sons.

Schiavo, R., May Leung, M., & Brown, M. (2014). Communicating risk and promoting disease mitigation measures in epidemics and emerging disease settings. *Pathogens and Global Health*, *108*(2), 76–94.

Sell, T. K., Hosangadi, D., & Trotochaud, M. (2020). Misinformation and the US Ebola communication crisis: Analyzing the veracity and content of social media messages related to a fear-inducing infectious disease outbreak. *BMC Public Health*, *20*(1), 550. https://doi.org/10.1186/s12889-020-08697-3

Seltzer, E. K., Horst-Martz, E., Lu, M., & Merchant, R. M. (2017). Public sentiment and discourse about Zika virus on Instagram. *Public Health*, *150*, 170–175. https://doi.org/10.1016/j.puhe.2017.07.015

Sharma, M., Yadav, K., Yadav, N., & Ferdinand, K. C. (2017). Zika virus pandemic—analysis of Facebook as a social media health information platform. *American Journal of Infection Control*, *45*(3), 301–302. https://doi.org/10.1016/j.ajic.2016.08.022

Sutton, J., Renshaw, S. L., & Butts, C. T. (2020). The First 60 Days: American Public Health Agencies' Social Media Strategies in the Emerging COVID- 19 Pandemic . *Health Security*, hs.2020.0105. https://doi.org/10.1089/hs.2020.0105

Toppenberg-Pejcic, D., Noyes, J., Allen, T., Alexander, N., Vanderford, M., & Gamhewage, G. (2019). Emergency Risk Communication: Lessons Learned from a Rapid Review of Recent Gray Literature on Ebola, Zika, and Yellow Fever. *Health Communication*, *34*(4), 437–455. https://doi.org/10.1080/10410236.2017.1405488

Tumpey, A. J., Daigle, D., & Nowak, G. (2018). Communicating During an Outbreak or Public Health Investigation | Epidemic Intelligence Service | CDC. Retrieved April 16, 2021, from The CDC Field Epidemiology Manual website: https://www.cdc.gov/eis/field-epi-manual/chapters/Communicating-Investigation.html#box12-2

U.S. Department of Homeland Security, S. and T. D. (2013). *System Assessment and Validation for Emergency Responders (SAVER) Innovative Uses of Social Media in Emergency Management Prepared by Space and Naval Warfare Systems Center Atlantic*. Retrieved from https://www.dhs.gov/sites/default/files/publications/Social-Media-EM_0913-

508_0.pdf

UNICEF. (2015). *Communication for Development: Responding to Ebola in Liberia*. Retrieved from https://www.unicef.org/cbsc/files/Communities_took_the_matter_in_their_own_hands-Lofa(4).pdf

van Deursen, A. J. A. M. (2020). Digital inequality during a pandemic: Quantitative study of differences in COVID-19-related internet uses and outcomes among the general population. *Journal of Medical Internet Research*, *22*(8). https://doi.org/10.2196/20073

van Dijck, J., & Alinead, D. (2020). Social Media and Trust in Scientific Expertise: Debating the Covid-19 Pandemic in The Netherlands. *Social Media+ Society*, *6*(4), 2056305120981057.

Vinck, P., Pham, P. N., Bindu, K. K., Bedford, J., & Nilles, E. J. (2019). Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: a population-based survey. *The Lancet Infectious Diseases*, *19*(5), 529–536. https://doi.org/10.1016/S1473-3099(19)30063-5

Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science*, *359*(6380), 1146–1151. https://doi.org/10.1126/science.aap9559

Vraga, E. K., & Bode, L. (2020, January 2). Defining Misinformation and Understanding its Bounded Nature: Using Expertise and Evidence for Describing Misinformation. *Political Communication*, Vol. 37, pp. 136–144. https://doi.org/10.1080/10584609.2020.1716500

Wahbeh, A., Nasralah, T., Al-Ramahi, M., & El-Gayar, O. (2020). Mining physicians' opinions on social media to obtain insights into COVID-19: Mixed methods analysis. *JMIR Public Health and Surveillance*, *6*(2), 1–10. https://doi.org/10.2196/19276

Wang, Y., Hao, H., & Platt, L. S. (2021). Examining risk and crisis communications of government agencies and stakeholders during early-stages of COVID-19 on Twitter. *Computers in Human Behavior*, *114*(June 2020), 106568. https://doi.org/10.1016/j.chb.2020.106568

World Health Organization. (n.d.). Stakeholders. Retrieved November 21, 2020, from World Health Organization website: https://www.who.int/about/who-we-are/stakeholders

World Health Organization. (2015, February). WHO | Sierra Leone: Increasing community engagement for Ebola on-air.

World Health Organization. (2018). *Managing epidemics: key facts about major deadly diseases*. Geneva.

World Health Organization. (2020). WHO Infodemic Management. Retrieved April 16, 2021, from https://www.who.int/teams/risk-communication/infodemic-management

World Health Organization. (2021). COVID-19 Global Risk Communication and Community

Engagement Strategy. *Interim Guidance*, (December 2020). Retrieved from file:///C:/Users/dr/Downloads/WHO-2019-nCoV-RCCE-2020.3-eng.pdf

Xu, Q., Shen, Z., Shah, N., Cuomo, R., Cai, M., Brown, M., … Mackey, T. (2020). Characterizing weibo social media posts from Wuhan, China during the early stages of the COVID-19 pandemic: Qualitative content analysis. *JMIR Public Health and Surveillance*, *6*(4). https://doi.org/10.2196/24125

Yu, J., Lu, Y., & Muñoz-Justicia, J. (2020). Analyzing spanish news frames on twitter during COVID-19—A network study of El País and El Mundo. *International Journal of Environmental Research and Public Health*, *17*(15), 1–12. https://doi.org/10.3390/IJERPH17155414

Zeemering, E. S. (2021). Functional fragmentation in city hall and Twitter communication during the COVID-19 Pandemic: Evidence from Atlanta, San Francisco, and Washington, DC. *Government Information Quarterly*, *38*(1), 101539. https://doi.org/10.1016/j.giq.2020.101539

Zeng, R., & Li, M. (2020). Social media use for health communication by the CDC in mainland China: National survey study 2009-2020. *Journal of Medical Internet Research*, *22*(12), 1–14. https://doi.org/10.2196/19470

Zimmerman, R. S., DiClemente, R. J., Andrus, J. K., & Hosein, E. N. (2016). *Introduction to global health promotion*. John Wiley & Sons.