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Social media communication and public engagement in different health crisis stages: The framing of COVID-19 in Chinese official media

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Abstract

Effective government social media communication plays a crucial role in mitigating public panic amid various public health crises, such as the H1N1 pandemic, the Ebola epidemic, the Zika epidemic, and the ongoing COVID-19 pandemic. A research gap exists in investigating government official social media communication strategies and effects on public engagement at specific COVID-19 crisis stages. This study examines the COVID-19 communication strategies the Chinese government used and the corresponding effects on public engagement at different COVID-19 crisis stages on social media. The Crisis and Emergency Risk Communication Model, Framing Theory, and Situational Crisis Communication Theory are combined to develop a conceptual framework. Content analysis and coding were performed on two dimensions: health content theme (four sub-dimensions) and transparent communication style (three sub-dimensions). Public engagement was measured by the number of shares, comments, and likes. The results indicate a strong need for disease prevention information at the initial event/maintenance and resolution stages, while reassurance and government actions are highly valued at the resolution stage. Interactive features promote public engagement in key crisis stages.

Keywords

Content theme, COVID-19 crisis, Public engagement, Social media, Transparent communication style

Introduction

Social media are considered crucial channels to prevent public fear, facilitate public cooperation, and foster effective government communication during the COVID-19 crisis (Q. Chen, Min, et al., 2020; La et al., 2020). The research objective of this study is to investigate how the Chinese government communicates with the public using health content themes and transparent communication styles at different stages of the COVID-19 crisis and what impacts it generated on public engagement on its official social media platform. The significance of this research lies in the understanding of the dynamics of social media communication during the different COVID-19 crisis stages, enabling governmental organizations to better

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respond to public concerns, adjust communication strategies, and make informed decisions to contain the COVID-19 crisis and other public health crises. The theoretical framework employed in this study is integrated from previous studies pertaining to health contents and transparent communication styles and underpinned by the Crisis and Emergency Risk Communication (CERC) model, Framing Theory, and Situational Crisis Communication Theory (SCCT). This study facilitates the innovate application of the CERC model to the field of government social media health crisis communication and contributes to the integration of the CERC model with Framing Theory and SCCT by developing a theoretical framework of health contents and transparent communication styles for government social media communication practices during the COVID-19 outbreak.

This study targets the Chinese context as China was the first country to experience an outbreak of COVID-19 and the first to impose preventive measures in response but took less time to contain the spread of the virus compared with many other countries (S. Chen, Yang, et al., 2020; Hsiang et al., 2020; C. Wang et al., 2020; Xinhuanet, 2020; Xu & Li, 2020). The number of social media users in China reached 989 million at the end of 2020 according to China Internet Network Information Center (2021). In China, social media have become the main channel for the public to acquire COVID-19-related information and get informed about governmental decisions and regulations (Luo et al., 2021; Y. Yang et al., 2021). In the early COVID-19 outbreak, many COVID-19-related studies on government social media communication in Chinese contexts emerged (e.g. Q. Chen et al., 2021; Li et al., 2022; Liao et al., 2020; Luo et al., 2021; Ngai et al., 2020; Zhao et al., 2020). However, these studies considered the COVID-19 crisis as a whole without identifying the dynamics of the COVID-19 outbreak across specific crisis stages. Crises have developmental features from the beginning of preventing stage and crisis development, moving through the eruption of some triggering event and into post-crisis and clean-up stages (Coombs, 1995; Reynolds et al., 2002). An investigation about specific social media communication strategies and corresponding impacts during the different crisis stages is therefore highly warranted to provide insights for effectively coping with subsequent COVID-19 waves and other potential future health crises both in China and abroad.

To achieve the research objective, the study focuses on the government-owned social media platform *People's Daily* Sina Weibo account for data collection. *People's Daily* is one of the earliest and most visited official social media sites in China (Ho, 2019; Ngai et al., 2020), making it a representative platform for examining government social media communication during the COVID-19 crisis. The sampling period includes three stages of the crisis, excluding the precrisis stage, which had no COVID-19-related social media posts. A total of 3732 posts related to COVID-19 from 1 December 2019 to 19 March 2020 was collected. A two-stage sampling method was employed to select a representative sample of 900 posts from different crisis stages (300 posts from each stage). The public responses, including the number of shares, comments, and likes, to these posts on *People's Daily* Sina Weibo account were analyzed quantitatively. Content analysis was employed to investigate the COVID-19 communication in the sampled posts, focusing on four health content themes (i.e. actions, new evidence, reassurance, and disease prevention) and three transparent communication styles (i.e. accessibility to external sources, disclosure of government activities and decisions, and dissemination of data reports).

Literature review

Mediated communication includes the transmission of information through diverse media channels, spanning traditional platforms like television, radio, and newspapers, as well as contemporary online websites and social media (Ambe et al., 2005; W. Liu et al., 2020; Thatcher & Brown, 2010). These media outlets, both traditional and digital, serve as primary conduits for disseminating critical information during times of crisis. In crisis situations, the public predominantly relies on these channels to receive essential updates, directives, and alerts (W. Liu et al., 2020). The way information is presented through these media channels significantly influences public perceptions and responses (Chong & Druckman,

2007). Within the context of the COVID-19 crisis in China, social media play a central role in information dissemination and reaching a broad audience (Ngai et al., 2020; Ngai et al., 2022). Social media platforms, such as Weibo and WeChat, function as amplifiers for messages originating from official organizations, facilitating swift information sharing across diverse segments of the population. Social media also foster interactive communication, enabling dialogue between the public and authorities (Zaharna & Huang, 2022). This two-way interaction proved invaluable in gauging public sentiment, addressing concerns, and dispelling misconceptions in real time (Ngai et al., 2022).

Social media platforms serve not only as channels for disseminating information but also as influential tools for shaping the narratives that revolve around crises; they also facilitate connections among individuals during critical circumstances (Ngai et al., 2020). Furthermore, social media-mediated communication is essential for countering misinformation (Coombs & Holladay, 2014). By strategically framing crisis-related information on social media, authorities can combat the spread of false narratives and disseminate accurate information during crises. However, it is crucial to acknowledge that social media can be both allies and challenges. While they are indispensable for sharing crisis-related information, they can also amplify crises, incite panic, and disseminate misinformation. The COVID-19 crisis exemplified how information, whether accurate or misleading, can be disseminated rapidly through social media (Ngai et al., 2022).

Understanding the interplay between mediated communication and crisis communication is essential for guiding future crisis responses (Ngai et al., 2022). Mediated communication serves as the practical means through which crisis management principles are executed, offering a vehicle for coordinated and consistent messaging during crises and providing insights into how messages are disseminated and received. Crisis communication delineates how information should be conveyed through media outlets, enabling organizations to utilize media effectively in disseminating accurate information, managing public perception, and preserving public trust during crises. Crisis communication professionals must be acutely aware of media effects and incorporate them into their message crafting (Van Dijck & Alinejad, 2022).

In mediated communication studies, Framing Theory assumes critical importance in comprehending how mediated communication operates in crisis scenarios (Shih et al., 2008). It delves into how media shapes public perceptions by emphasizing certain aspects of an issue. Research has established that media framing, involving the selection and emphasis of particular issue aspects, can significantly influence the public perception of a crisis (Chong & Druckman, 2007). In this study, the way Chinese official media strategically framed COVID-19 as a public health crisis has the potential to mobilize public support for stringent preventive measures and inculcate a sense of collective responsibility. Through the establishment of an authoritative narrative, Chinese official media can also mitigate the impact of misleading information and maintain control over the crisis narrative (Ngai et al., 2022).

In crisis communication studies, two key frameworks, namely the CERC model and the SCCT, are generally identified to guide effective crisis communication practices during public health crises (e.g. Coombs, 2022; Zahry et al., 2023). The CERC model provides structured guidelines for crisis communication across different crisis stages and underscores the importance of using mediated communication to mitigate crisis consequences (Reynolds & Quinn, 2008). SCCT, on the contrary, posits that crisis communication strategies should be adapted based on the perceived severity of a crisis (Coombs, 2007). In the early stages of a crisis, mediated communication ensures the timely dissemination of information, aligning with SCCT's recommendation for immediate and transparent communication during high-severity situations. As the crisis unfolds, mediated communication permits adaptable messaging, allowing authorities to adjust their narratives, emphasize containment efforts, and convey positive developments. Moreover, SCCT emphasizes the importance of reputation management, underlining the role of consistent communication across different crisis stages in maintaining credibility (Coombs & Holladay, 2014). Consistent mediated communication, as advocated by SCCT, helps organizations preserve their reputation and credibility through the accurate and strategic

dissemination of information via media channels, and ensures timely communication with a broad audience affected by a crisis (Coombs & Holladay, 2014).

The present study acknowledges that effective communication by Chinese authorities during the COVID-19 crisis necessitates a synthesis of knowledge and principles from both mediated communication and crisis communication domains. Its primary objective is to gain insight into how the interplay of mediated communication via social media and crisis communication strategies influences public engagement at different phases of the COVID-19 crisis. This study draws upon Framing Theory, the CERC model, the SCCT, and prior empirical research to offer valuable perspectives for advancing future research and practical applications.

Different stages of health crisis communication

Reynolds and Seeger (2005) reveal several time frames in a crisis that require different response strategies. They claim that the development of a crisis is predictable and systematic. Crisis communication management from a systematic perspective can provide a comprehensive picture for governmental organizations to prepare for subsequent responses and handle crises efficiently. World Health Organization (WHO) suggests that every nation develop a pandemic plan that includes different crisis management stages for communication with the public (Yu et al., 2006). By developing different communication strategies and examining effectiveness at various crisis stages, governments will be better positioned to understand the crisis and take adequate measures to mitigate the influence of the crisis (Flynn & Lenaghan, 2007).

Crisis and emergency risk communication model for government communication

One of the challenges governments faced when dealing with public health crises was how to tailor effective communication to help the public understand crises, feel safe, and take preventive actions (Reynolds & Seeger, 2005). The Centers for Disease Control and Prevention (CDC) recognized the importance of government communications via official media to empower the public and reduce detrimental impacts (Veil et al., 2008) and proposed the CERC model that highlights specific strategic communication objectives in crisis stages to help governments develop "strategic, broad-based, responsive, and highly contingent" communication plans to manage crises and communicate essential information to the public during health crises (Reynolds & Seeger, 2005, p. 49). The model includes five crisis stages that distinctively reflect the nature of risk emergency, crisis eruption, maintenance, recovery, and evaluation in a health crisis and manifest communication efforts needed to accomplish each of the five crisis stages (Lachlan et al., 2016; Reynolds & Quinn, 2008).

Reynolds and Quinn (2008) suggest that CERC should be at the heart of the government's responses to a pandemic as it incorporates principles of effective communication strategies in responding to the pandemic outbreak and provides technical methods for evaluating effects. It also allows governments to look into a pandemic crisis systematically and differentiate each crisis stage clearly to develop specific communication strategies (Reynolds & Quinn, 2008).

The applicability of the CERC model in the COVID-19 crisis

Powell (2021) and Bernard et al. (2021) highlight governments' difficulties in effective communication during the COVID-19 crisis and indicate the need to investigate the applicability of the CERC for the COVID-19 crisis in different countries. Given that the CERC model is theoretically grounded on public health crisis communication literature, we suggest that governments consider it as a strategic framework for communication in different stages of the COVID-19 crisis.

A major concern on whether the CERC was applicable in a health crisis like the COVID-19 outbreak is that the CERC was often employed as a framework for examining a public health crisis with a well-delineated and sufficiently clear crisis cycle (CDC, 2014; WHO, 2017). In fact, similar concerns would emerge when we consider applying other crisis communication frameworks or models in the

analysis of the COVID-19 outbreak which is a health crisis with recurring cycles and differs from the relatively straightforward, temporally bounded crisis with non-recurring features framed in most crisis communication models (Barbieri Góes & Gallo, 2021; Borrego-Salcido et al., 2023; Rakhshan et al., 2023). For example, researchers frequently utilize the Social-Mediated Crisis Communication (SMCC) model to investigate crises characterized by natural disasters or political movements with well-defined start and end dates. SMCC recognizes the presence of various public audiences on social media during a crisis, including influentials who create and share information, followers who consume it, and inactive members who seek information from other sources or indirectly encounter it on social media (Austin et al., 2012). The model explains the distribution of crisis information in both direct (e.g. from social media influentials to their followers) and indirect manner (e.g. followers disseminating information through word-of-mouth communication) and highlights the importance of tailoring messaging to different individuals (Jin & Liu, 2010). Splendiani and Capriello (2022) applied the SMCC model to examine information dissemination on Twitter during earthquakes in Italy between 24 August 2016 and 18 January 2017. They discovered that most tweets from local governments centered around daily statements by politicians, lacking developed messaging strategies to engage social media followers and inactive members, and recommended that relevant social media influencers deliver customized messages on key topics to engage the public and foster positive images. Mak and AO (2019) employed the SMCC model to analyze the emotional responses of social media users toward Lancôme Hong Kong during the Hong Kong Umbrella Movement from 2 June to 31 August 2016. They observed a shift in followers' emotional attachment from Lancôme to messages from social media influencers such as corporations, politicians, and celebrities and highlighted the significant role of traditional media in disseminating crisis information on social media.

Similarly, in addressing enterprise-specific emergencies within well-defined crisis periods, researchers often reference the theory of image restoration discourse which includes five broad categories of image repair strategies: denial, evasion of responsibility, reducing offensiveness of the event, corrective action, and mortification (Benoit, 1997). For instance, Benoit and Czerwinski (1997) examined the response of U.S. Air to a fatal plane crash near Pittsburgh, Pennsylvania, in 1994. They found the communication strategies employed by U.S. Air to be ineffective as they failed to address the issues raised by the mass media. In addition, Benoit (2018) investigated the image restoration efforts of United Airlines following the forceful removal of a passenger in 2017 and emphasized the importance of timely response in the digital media age, the use of corrective action, and consistency with official messages.

The aforementioned theories, like other relevant theoretical frameworks, have commonly been applied to address crises over a specific time frame through the means of mass media or communication mediated by social media platforms. Considering that the COVID-19 pandemic appeared to be recurring many times in different countries (e.g. the fourth wave in Singapore as of December 2022, the eighth wave in Japan as of November 2022, the seventh wave in Iran as of July 2022) (*Kyodo News*, 2022; *South China Morning Post*, 2022; United Nations, 2022), and several variants of COVID-19 viruses (e.g. Omicron, Delta, Alpha) were found worldwide in the past 3 years, those crisis communication models commonly used in previous studies managing various crises may not be readily and directly applied to a resurgent, ongoing, and global-scale crisis like the COVID-19 pandemic. The persistence and recurrence of the COVID-19 crisis underscore the need for an innovative perspective to review and employ conventional crisis communication models. As the COVID-19 crisis is still ongoing, we decided to break the whole COVID-19 crisis into different waves and only focus on the first wave of the COVID-19 crisis in China which is also the first COVID-19 outbreak in the world as a relatively complete crisis cycle.

China demonstrated its proactive response by implementing the first lockdown regulations during the COVID-19 outbreak worldwide (Z. Sun, Zhang, et al., 2020). The country faced numerous challenges, including a significant number of confirmed

cases, high hospitalization and mortality rates, and strain on the health care system (The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020; S. Yang et al., 2020). However, the epidemic was successfully curbed and brought under control by late March 2020, with no new locally confirmed cases reported (Xinhuanet, 2020). Evaluating the government's crisis communication strategies during this period is crucial for enhancing future crisis management efforts (MacKay et al., 2021). With the emergence of new COVID-19 variants, uncertainties regarding potential subsequent waves persist (Quinn et al., 2021). Developing effective social media communication strategies based on experiences from the first wave is essential to alleviate public fear in the future. Some countries have displayed limited capabilities in crisis management during subsequent waves of the pandemic (Coccia, 2020, 2021a, 2021b, 2021c). Inadequate learning from the first wave has resulted in ambiguous and delayed communication responses in these countries. Researchers play a critical role in providing evidence-based suggestions for effective crisis management across diverse regions and cultures (Coccia, 2020, 2021a, 2021b, 2021c). The data collected and analyzed from the first wave in China offer valuable insights into effective communication guidelines within specific timelines. These insights can further benefit governments and organizations globally in managing diverse populations during crises (Yazdizadeh et al., 2020). Hence, we argue that the CERC model is applicable to the first wave of the COVID-19 crisis as it encompasses all crisis stages and has practical implications.

The use of the CERC model in social media crisis communication

The use of social media in public health crises is emphasized in several risk and crisis communication guidelines (Y. Wang et al., 2021). For example, the CDC (2014) and WHO (2017) highlight social media's role in engaging the public, facilitating two-way communication, monitoring public opinion, and supporting timely responses during health emergencies. The accelerated importance of social media has drawn extensive attention from researchers, and they have started to apply crisis communication models to social media in different crisis contexts (e.g. Hao & Wang, 2020; Z. Wang & Ye, 2018; Yao & Wang, 2020).

While the CERC model has been utilized to examine government communication during natural disasters and epidemics, its application in government social media communication during the COVID-19 outbreak remains understudied. Recent studies emphasize the need to adapt the CERC model on social media contexts to address unforeseen and uncontrollable health emergencies such as the COVID-19 crisis (Bernard et al., 2021; Fissi et al., 2022; Y. Wang et al., 2021). As highlighted by Y. Wang et al. (2021), the unprecedented nature of the COVID-19 crisis necessitates the adoption of innovative crisis communication models tailored to specific contexts to understand communication dynamics. Furthermore, although the CERC model emphasizes different communication strategies across the five stages, limited knowledge exists regarding how these strategies are constructed in terms of specific content themes, communication styles, and their impact on public engagement. Addressing this research gap, the present study aims to investigate how the Chinese government communicates and engages with the public on its official social media during various stages of the COVID-19 crisis underpinned by the CERC model.

The framing of the COVID-19 crisis in government social media communication

Health content theme. Framing theory suggests that how information presented to the public affects the choices the public makes about how to process the information (Chong & Druckman, 2007). As Entman (1993) indicates, framing allows media "to select some aspects of a perceived reality and make them more salient in a communication text" (p. 20). In this way, the media has influences over how the public views reality (De Vreese, 2005). The crisis stage of CERC requires that government and health organizations develop framed messages about how to avoid or reduce harm, take appropriate action, and make such messages more pertinent to the public. In this regard, health content themes refer to how messages are

framed by health-related topics and explicit meanings so that the public can understand them quickly and clearly. The appropriate message framed by various health content themes at the right time (e.g. different crisis stages) through the right channel (e.g. social media) can affect the public's perceptions of health issues, contribute to a positive attitude and behavior, and facilitate trust-building between governments and the public (Lachlan et al., 2016).

In health communication studies, many researchers (e.g. Higgins et al., 2006; B. F. Liu & Kim, 2011; Shih et al., 2008) uncover several content themes generally employed in health crises to frame messages. Nevertheless, there are no commonly accepted content themes directly applicable to the COVID-19 crisis. A review of previous content themes proposed for handling health crises and developing integrated ones applied in the current context is highly warranted. Shih et al. (2008) proposed a "framing typology for media coverage of epidemic diseases" (p. 149), including six content themes: consequence, uncertainty, action, reassurance, conflict, and new evidence, to describe journalists' focus across different stages of the bird flu crisis. The study sheds light on using specific content themes to examine media focus in health crises and recommends researchers adopt such themes in different health settings. Inspired by this study, B. F. Liu and Kim (2011) summarized health crisis frames (namely action, conflict, new evidence, reassurance, and uncertainty) and general health issues frames (i.e. disease detection, disease prevention, health care services, lifestyle risk factors, and scientific discovery) to indicate framing options for governmental organizations and corporate in the 2009 H1N1 pandemic crisis. They found that both governmental organizations and corporate frequently adopted the health crisis frame on social media during this crisis, but governmental organizations employed the general health issues frame more than corporate. However, the use of either of the frames separately may undermine the usefulness of information and impede the effectiveness of crisis communication. For example, disease prevention, as one of the dimensions in the general health issues frame, could provide important information to help the public effectively respond to a health crisis. Thus, the government should emphasize health crisis frames and general health issues simultaneously when dealing with a health crisis. The primary focus of the two studies lies in the framing of content themes through traditional mass media, thus leaving a gap in understanding the impact of these content themes on new media platforms, particularly in the age when the public is easily interconnected through social media.

As articulated by Zaharna and Huang (2022), digital communication via social media, driven by interactivity, connectivity, and dialogues, has brought about transformative changes in people's lives. In this digitalized landscape, every element is intricately interconnected, shifting the paradigm from information-centricity to a concept known as "relations-as-communication." Communication is less about agency or control and becomes centered on navigating the connectivity and interactivity facilitated by digitalization. In this context, content themes constructed on social media platforms can maximize the impact of media frames by leveraging social networks, thereby mobilizing collective actions in a more efficient manner.

The impact of media frames, particularly in the context of relation-based and connection-based communication, becomes strikingly evident during the COVID-19 crisis in China. Schneider (2021) delves specifically into the role of digital media, with a particular focus on the online video-sharing platform Bilibili, in influencing public sentiment and responses during the COVID-19 crisis in China. The research reveals that specific media frames were adept at easily mobilizing nationalist sentiments throughout the crisis. Content themes characterized as "hip" and oriented toward youthful audiences played a crucial role in shaping online audiences' perceptions and behaviors during the pandemic. In addition, their study underscores the necessity of adapting communication frames to resonate with diverse age groups and demographic segments. The concept of "viral villages of community sentiment" is also explored, shedding light on how these communities fostered conformity. This study offers insights into how governments and authorities can effectively utilize socially connected

communication frames to address the challenges posed by the COVID-19 crisis.

Ngai et al. (2020) acknowledged the significance of framing the COVID-19 crisis within the context of government communication on social media and integrated the 11 frames of health crisis and general health issues proposed by B. F. Liu and Kim (2011) into 6 content themes, namely action, new evidence, reassurance, disease prevention, health care services, and uncertainty, to examine the Chinese government social media communication on the COVID-19 crisis. The study provides insights into the use of different health content themes to enable social media users to be engaged with government communication during the COVID-19 crisis in the Chinese context. However, the results may vary in different crisis stages. The impact of these content themes could be further investigated based on the developmental features of a crisis. Thus, the first research question was developed:

> *Research Question 1 (RQ1).* What were the health content themes employed in different crisis stages of the COVID-19 on social media?

Transparent communication style. Effective messages should be designed to persuade people to change their attitudes and behaviors (Raamkumar et al., 2020). Style refers to the way content is designed and presented. The style of social media communication affects public engagement and trust (Ngai et al., 2020). For example, using a narrative style in disease prevention, social media posts had a positive impact on engendering comments and likes by the Chinese public (Ngai et al., 2020).

According to SCCT, crises are unfavorable events that lead stakeholders to assign blame for potentially involved subjects and pose reputational threats to an organization (Coombs, 2007; Patriotta et al., 2011). SCCT indicates that previous reputation affects how crisis communication efforts are perceived (Coombs, 2007). Given that little was known about the COVID-19 virus in late 2019 and early 2020 and that the Wuhan government in China was blamed by the public for its delayed response and opaque information about the crisis, the public's need for transparent government-related information became urgent. SCCT suggests that organizations adopt a transparent communication style to minimize reputational damage, legitimize behavioral intentions, and prevent negative word-of-mouth in contrast to a non-transparent communication style that may cause misinformation and undermine public trust in governmental authorities (Coombs & Holladay, 2014). The transparent communication style relates to multifarious concepts, but most concepts perceive it as visibility, completeness, inferability, and understandability of information (Grimmelikhuijsen et al., 2013; Michener & Bersch, 2013; Song & Lee, 2016). As Meijer (2013) suggests, perceived transparency generally refers to "the availability of information about an actor that allows the other actors to monitor the workings or performance of the first actor" (p. 430). In government crisis communication fields, a transparent communication style plays a crucial role in nurturing the crisis management system, which in turn, shapes the government's reputation in the eyes of the public and establishes the legitimacy of regulations (Grimmelikhuijsen et al., 2013).

Initially, governments can communicate with the public transparently by uncovering updated information about a crisis (Grimmelikhuijsen & Welch, 2012). However, publicly available information is increasingly unable to meet the public expectations of transparent communication as the public requires up-to-date information on government activities and decisions (Song & Lee, 2016) and hopes to be enabled to access, monitor, and evaluate governments' actions. Disclosure of government activities and decisions represents governments' acceptance of responsibility and the decision to alleviate problems, which is a core strategy for effective crisis communication (Halachmi & Greiling, 2013). Such actions are intended to make the decision-making process visible to attain the public's understanding and trust (Grimmelikhuijsen et al., 2013). Furthermore, governments are responsible for ensuring that parties interested in governments' activities and decisions can actively participate in acquiring and providing information during crises (Cotterrell, 2000). The mutual understanding of messages communicated is of great necessity for transparent communication (Albu & Wehmeier, 2014). Social media, in this sense, can help governmental organizations be more

transparent by enabling the public to keep up-to-date on government activities and decisions (Ngai et al., 2022). Over the past decade, governments' use of social media has shifted from a propaganda style to a transparent communication style to engage the general public better (Bonson et al., 2019). Transparency in social media represents "the openness and freedom to obtain information related to public interests on social media" (Wijaya et al., 2021, p. 744). It is crucial to facilitate interactions between governments and the public and improve government credibility and reputation (Matei et al., 2015). Thus, the second research question was put forward:

Research Question 2 (RQ2). What were the transparent communication styles employed in different crisis stages of the COVID-19 on social media?

Given the participatory nature of social media, researchers have paid attention to its interaction between governments and citizens, which resulted in public engagement (Agostino & Arnaboldi, 2016). Different levels of public engagement in terms of likes, shares, and comments are crucial indicators for assessing government communication effectiveness during health crises (Ngai et al., 2020). "Like" indicates the public's interest and the popularity of messages; "Share" suggests a recommended behavior that connects governments' messages to one's social network; "Comment" allows the public to express their responses in a specific way and make direct conversation with governments (Ngai et al., 2020). When there is a high level of public engagement, the public's negative emotions will be minimized, and the understanding and trust in governments will be improved (Stark & Taylor, 2014). Our last research questions inquire into the impact of health content themes and transparent communication styles on public engagement at different stages of COVID-19:

Research Question 3a (RQ3a). Did the health content themes impact public engagement at different stages of the COVID-19 crisis?

Research Question 3b (RQ3b). Did transparent communication styles impact public engagement at different stages of the COVID-19 crisis?

Materials and methods

Data collection and sampling period

We selected the government-owned social media platform—*People's Daily's* Sina Weibo account for data collection. Sina Weibo has been considered one of the most influential social media platforms in delivering the COVID-19-related information to the public during the pandemic (Zhao et al., 2020). *People's Daily* is the government-owned official newspaper under the Central Committee of the Communist Party of China for disseminating government-related information to the Chinese public (Ho, 2019). With over 110 million followers on Sina Weibo, *People's Daily* is one of China's most visited and earliest official social media sites (Ngai et al., 2022). During the COVID-19 outbreak, the *People's Daily* social media account has become the major channel for disseminating up-to-date information on COVID-19, disclosing official actions and decisions, and promoting preventive measures to the public (Ngai et al., 2020). Many previous studies (e.g. Luo et al., 2021; Ngai et al., 2022; G. Wu et al., 2022) have used *People's Daily* as a representative platform to examine the Chinese government's social media communication during the COVID-19 crisis.

This study also took into account certain health-related organizational accounts (e.g. the National Health Commission). However, these accounts had fewer followers, received minimal public responses, and posted less frequently compared to *People's Daily* during the COVID-19 first wave. The lack of active communication and insufficient information from these health-related organizations may impede effective communication efforts by the Chinese government and constrain the dissemination of pertinent information to a larger audience. Y. Wu and Shen (2022) suggested that central government media (e.g. *People's Daily*) positively influenced public compliance with preventive measures during

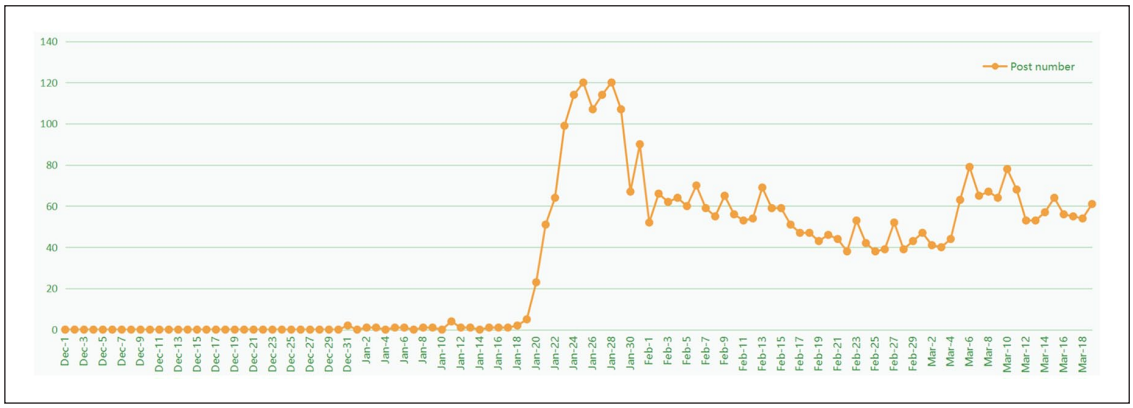

Figure 1. The trend of post numbers in the COVID social media communication by *People's Daily*.

the COVID-19 crisis. These media outlets were perceived to have high political trust and played a crucial role as the primary voice of the Chinese Communist Party. Messages conveyed through central government media were more likely to increase information acceptance and persuade the public to adhere to government-recommended preventive measures (H. Liu & Raine, 2016).

The sampling period should have included five stages based on the CERC model. However, the preliminary observation of this study indicated that the social media communication on stage one (i.e. precrisis: before 1 December 2019) was absent (i.e. no COVID-19-related social media post found); hence we decided to exclude the precrisis stage. A text corpus containing all posts on Sina Weibo's *People's Daily* concerning COVID-19 from 1 December 2019 to 19 March 2020 was constructed. The full corpus comprises multiple categories designed to facilitate systematic post tracking and analysis. These categories include date and time stamps, post titles, and main text contents, all of which serve the purpose of facilitating precise post identification. In addition, the corpus includes information on the total sentence count, the number of sub-dimensions related to the health content theme, and the transparent communication style, all of which are crucial for accurate and standardized coding and the generation of consistent data. Furthermore, the corpus incorporates metrics for the number of shares, comments, and likes received by each post, which are essential for conducting association tests between government COVID-19 social media communication and public engagement. In total, the corpus contains 3732 social media posts pertaining to the COVID-19 crisis, providing the foundation for subsequent coding and analysis. We selected this period from 1 December 2019 to 19 March 2020 because the first COVID-19 confirmed case was identified on 1 December 2019 and China reported no new locally confirmed cases on the mainland for the first time on 19 March 2020 (Huang et al., 2020). For China, this period represents the first wave of the COVID-19 crisis to some extent. The preliminary observation showed that different numbers of posts were found in the COVID social media communication by *People's Daily* during this period, as shown in Figure 1.

Figure 1 exhibited that the social media communication was almost absent in stage two (i.e. initial event) but increased rapidly after 20 January (i.e. the maintenance stage when the Chinese State Council officially announced the management of COVID-19 as a public health emergency issue on its website; Xinhuanet, 2020). Therefore, we decided to combine the initial event stage and maintenance stage to represent the period of preliminary social media communication from the Chinese government. Finally, the three crisis stages are confirmed, including the

Stages in the first wave of the COVID-19 crisis	Start time	End time
The initial event/maintenance stage	1 December 2019/20 January 2020	31 January 2020
The resolution stage	1 February 2020	23 February 2020
The evaluation stage	24 February 2020	19 March 2020

initial event/maintenance, resolution, and evaluation. According to the features of each stage indicated in the CERC model, the timeline is as follows in this study:

The initial stage of the COVID-19 outbreak commenced on 1 December 2019 when the first confirmed case was identified (Huang et al., 2020). The maintenance stage began on 20 January 2020 when human-to-human transmission was confirmed, and the Chinese State Council declared COVID-19 as a public health emergency (Ngai et al., 2020). The resolution stage began on 1 February 2020, marked by the Chinese premier expressing the government's determination to combat the epidemic and step up control measures (Xinhuanet, 2020). The evaluation stage started on 24 February 2020 when the number of confirmed cases significantly reduced. The China CDC published a comprehensive analysis of over 70,000 cases, and government officials engaged in discussions with international counterparts regarding China's effective measures (Xinhuanet, 2020). This stage ended on 19 March 2020 when China reported no new local cases for the first time, suggesting a significant milestone in the global battle against the COVID-19 (Xinhuanet, 2020).

Subsequently, we input the keywords "**新型冠状病毒**" (COVID-19), "**新冠**" (abbreviation of COVID-19 in Chinese), "**疫情**" (pandemic), "传染病" (epidemic), and "**不明肺炎**" (unidentified pneumonia) on the Sina Weibo search engine. All online posts related to COVID-19 were manually extracted from Sina Weibo's account of *People's Daily*. In total, 3732 posts were collected.

Sample size and sample data collection

Given the different number of posts yielded in different stages (i.e. 3732 in total with 1100 at the initial event/maintenance stage, 1270 at the resolution stage, and 1362 at the evaluation stage) and the manpower demand in manual coding of the posts in different stages, we have decided to use a two-stage sampling method to harvest a representative number of posts from different stages for manual coding and comparison. First, we employed the sample size calculator developed by the Australian Statistics Bureau to estimate a sample size of 900 out of the 3732 posts in this study (with the confidence level set at 95%, confidence interval at 0.028, and a standard error at 0.015). The confidence level chosen by us, in this case, was 95%, a commonly used confidence level in statistical analysis, indicating a high degree of confidence in the results. The chosen confidence interval of 0.028 represents the margin of error allowed in the estimates. In this context, it means that we want to be within 0.028 units of the true population parameter. The standard error is a measure of the variability or dispersion of the data in the population. A lower standard error indicates less variability. In this case, the chosen standard error is 0.015, which is relatively low, suggesting that we aim for precise estimates.

After determining the appropriate sample size (900 posts) using the sample size calculator, we employed stratified random sampling which involves dividing the population into subgroups based on certain characteristics that are relevant to the research. It is often employed when the population consists of subgroups with distinct characteristics. It allows researchers to ensure a proportional representation of these subgroups in the sample. In this case, the subgroups are the three crisis stages: initial event/maintenance stage, resolution stage, and evaluation stage. The purpose of stratification is to ensure that each subgroup is represented in the sample in a proportion that reflects their presence in the population. It helps ensure that the sample is not only of the desired size but also that it accurately reflects the composition of posts at different stages of a crisis.

By allocating an equal number of samples (i.e. 300 posts) to each subgroup, we ensure that each stage is equally represented in the final sample, which is to help prevent biases that could arise if, for example, one stage had a much larger sample size than the others. After dividing the population into three subgroups and determining the desired sample size for each, we have randomly selected posts from each subgroup. This random selection process ensures that each post within a given crisis stage has an equal chance of being included in the sample. Randomness is a fundamental principle in sampling to reduce selection bias. By randomly selecting posts from each subgroup, we have minimized the risk of unintentional bias and increased the likelihood of representative sampling.

There are a total of 1100 posts at the initial event/maintenance stage, 1270 posts at the resolution stage, and 1362 posts at the evaluation stage, respectively. We numbered each post in chronological order and used Integer Set Generator (https://www.random.org/) to randomly make sets of non-repeating integers to decide which post should be selected. Because of the equal allocation and random selection within each subgroup, we can reasonably assume that a balanced representation of posts from each crisis stage was obtained. This balance allows us to make inferences about the entire population of posts, confident that the distribution of posts across stages in the sample mirrors the distribution in the larger population. In sum, 900 posts were sampled (i.e. 300 at the initial event/maintenance stage, 300 at the resolution stage, and 300 at the evaluation stage) and we drew the sample of 900 to represent the government social media communication during the first wave of the COVID-19 crisis in China. Their corresponding public responses (i.e. number of shares, comments, and likes) on *People's Daily*'s Sina Weibo account were harnessed for quantitative content analysis.

Content analysis and coding scheme

Content analysis was employed to investigate COVID-19 communication in the 900 *People's Daily*'s Sina Weibo account posts at the three crisis stages. Content analysis is widely used in communication and linguistic studies (Boettger & Palmer, 2010), aiming to investigate the occurrences of words, sentences, and descriptors in contexts to gain a comprehensive understanding of a communication process (Downe-Wamboldt, 1992). Researchers could develop a framework drawn from prior literature and conduct coding through content analysis (Downe-Wamboldt, 1992).

This study amalgamated six content themes employed by Ngai et al. (2020) and consolidated them into four distinct themes: actions, new evidence, reassurance, and disease prevention to scrutinize the government's communication toward health-related information through its official social media during various stages of the COVID-19 crisis. These content themes find their origins in the frameworks established by Shih et al. (2008) and B. F. Liu and Kim (2011), which were specifically tailored to guide media and governmental organizations in managing public health crises, such as epidemics and pandemics. Shih et al. (2008) and B. F. Liu and Kim (2011) underscore the crucial role of mediated communication and government communication via media channels in informing the public, molding public perceptions, and fostering public trust during public health crises. These content themes, such as actions, reassurance, new evidence, and disease prevention, when delivered through government-mediated communication, serve to alleviate negative public emotions, sustain social stability, and empower the public to undertake timely preventive measures.

In the context of the COVID-19 public health crisis, Ngai et al. (2020) closely examined social media coverage reflecting the Chinese government's stance. They drew inspiration from the studies of Shih et al. (2008) and B. F. Liu and Kim (2011). Shih et al. (2008) delve into the framing of public health epidemics, identifying key frames, including consequence, action, uncertainty, reassurance, conflict, and new evidence. These framing themes provide a foundational understanding of how epidemics are portrayed in the media and underscore the role of media framing in shaping public perceptions of epidemics. B. F. Liu and Kim (2011) contribute valuable insights by analyzing how governmental organizations framed the 2009 H1N1 pandemic through both social and traditional media. They provided a framework including general crisis, disaster, health crisis, and general health issue frames. Their

research indicates a predominant use of the health crisis frame during the H1N1 pandemic while emphasizing the importance of framing the pandemic as a general health issue to better prepare the public for timely and effective responses.

In the Ngai et al.'s (2020) work, a compelling argument was presented in favor of utilizing an integrated framework of content themes derived from the framing typology for media coverage of epidemic diseases proposed by Shih et al. (2008) and the general health issue frame and health crisis frame of government-mediated communication on the H1N1 pandemic, as proposed by B. F. Liu and Kim (2011). This integrated framework was applied in the context of government social media communication during the COVID-19 public health crisis and comprised six dimensions, namely action, new evidence, reassurance, disease prevention, health care services, and uncertainty. These six frames were identified as essential drivers in influencing public perceptions and responses to the COVID-19 crisis on social media.

In our own study, we have consolidated these six frames into four overarching themes: actions, new evidence, reassurance, and disease prevention frames. These themes represent typical mediated communication efforts from the government's perspective and are specifically tailored to address public health crises. These themes also align with the information strategies recommended by the WHO (2005) for media outlets, which include providing accurate and transparent data, promoting appropriate attitudes and behaviors, and helping prevent public fear. In addition, the selected themes serve as a valuable lens through which to assess the content disseminated through social media platforms and its impact on public responses to the COVID-19 crisis. By identifying and analyzing these health content themes, health communicators and researchers can develop effective strategies for information dissemination and the promotion of public health.

Disease prevention is commonly emphasized in crisis management due to its role in preventive measures, medical knowledge, and reducing the risk of infection (Jones et al., 2010). Reassurance, aimed at reassuring the public and alleviating anxiety through emotional support, contributes to the government's successes in combating crises (B. F. Liu & Kim, 2011). New evidence that refers to a discovery of a health issue, such as the origin of a virus, the mechanism of an infection, and epidemiological characteristics, advances understanding of crises and serves as a reference for future academic studies (B. F. Liu & Kim, 2011; P. Sun, Lu, et al., 2020). We categorized action, health care service, and uncertainty as "actions" since they all focus on what organizations or health professionals could do to respond to a crisis (Ngai et al., 2020) and redefined "actions" as any past or current crisis response actions, behaviors and explanation of governments, health organizations, and health professionals (B. F. Liu & Kim, 2011). By constantly responding to health-related concerns and sharing coping strategies, governments can establish credibility and reliability (Lachlan et al., 2016). These health content themes are essential in addressing health crises and require further investigations regarding their usage during specific health crisis stages. Accordingly, the study codes the above health content themes exhibited in the government's COVID-19 communication into four sub-dimensions on a sentence basis: "*Actions*" (henceforth C1); "*New evidence*" (henceforth C2); "*Reassurance*" (henceforth C3); "*Disease prevention*" (henceforth C4).

With the proliferation of social media, transparent communication styles can be identified as accessibility to external sources and disclosure of complete information to the public (Grimmelikhuijsen & Welch, 2012; Ngai et al., 2022; Song & Lee, 2016). For example, social media users can access additional details by interacting with features like hashtags and links (Men et al., 2018). "Timely and transparent dissemination of accurate, science-based information about the pandemic and the progress of the response" (Reynolds et al., 2007, p. 15) is also critical to developing a transparent communication style. Disseminating accurate and scientific data reports on pandemics can remind the public of the ongoing situation and enhance public awareness (Ngai et al., 2022). The present study builds on these prior studies and codes the transparent communication style into three sub-dimensions on a sentence basis, namely, "*Accessibility to external sources via interactive features*" (henceforth T1); "*Disclosure of government activities and decisions*" (henceforth T2); "*Dissemination of data reports*" (henceforth T3).

Sentences not employing the transparent communication style will be assigned to the category of "others" (i.e. absence of the transparent communication style). The coding process focuses on the appeal and format of each sentence regarding the communication style. Sentences that include interactive elements such as hashtags and links are classified as T1. If sentences incorporate government events or policy-related terms, they are coded as T2. Similarly, sentences that present information through numeric data are categorized as T3. To determine whether the health content theme and transparent communication style were presented, a codebook with two dimensions, seven sub-dimensions, and descriptors has been developed (see Table 1). The related examples extracted from the collected posts can be found in the Supplemental material.

Concerning RQ1 and RQ2, we investigated the differences in health content theme and transparent communication style by *People's Daily* in its social media communication of three stages during the COVID-19 crisis. We calculated the percentage distribution for each of the sub-dimensions of the health content theme and transparent communication style in each of the 900 posts and only recorded the dominant sub-dimensions for representativeness and prominence. Regarding RQ3, we employed the dominant sub-dimension of the health content theme and transparent communication style for performing the analysis of covariance (ANCOVA) tests on public engagement. We recorded the number of shares, comments, and likes of the sampled posts to investigate the relationship between government communication on *People's Daily* and its impact on public engagement at the three crisis stages.

Inter-rater checking

The coding was conducted by the first author, the primary coder, and a well-trained coder who possesses a postgraduate degree in communication. The second coder was repeatedly trained on coding dimensions and sub-dimensions and public engagement to ensure inter-rater reliability on the coding scheme. Any disagreement between the author and the second coder was discussed in the coding process, especially in the decision of the dominant sub-dimension of the health content theme and transparent communication style. The measure of inter-rater reliability was based on the co-coding of 180 posts from the data pool (20% of the total number of posts sampled; Boettger & Palmer, 2010). For all categories, the average agreement was higher than 0.95, and the average Cohen's kappa was greater than 0.9, indicating an almost perfect agreement (Hallgren, 2012). Please refer to the Supplemental material for the inter-rater checking results of all categories.

Statistical analyses

Percentage distribution calculation was employed to examine the differences in the use of health content themes and transparent communication styles in the COVID-19 social media communication (RQ1 and RQ2). Average audience engagement metrics were then included as covariates due to their potential associations with the dependent variable and influences on the study outcomes (Statology, 2020). Social media engagement metrics provide insights into the level of resonance and interaction people have with posted content, thereby reflecting the effectiveness of organizational social media strategies (Newberry, 2022; Sehl & Tien, 2022). Various methods exist to calculate engagement metrics, while the most common approach is calculated as total engagement (i.e. the sum of all interactions, for example, shares, comments, likes) divided by total followers (117 million followers in *People's Daily* when the data was collected) and multiplied by 100% (Keyhole, 2022; Newberry, 2022; Sehl & Tien, 2022). Thus, one-way ANCOVA, an extension of the one-way analysis of variance (ANOVA), was employed to investigate the differences in the number of shares, comments, and likes associated with the sub-dimensions of health content themes and transparent communication styles during the three stages of the COVID-19 crisis (RQ3). The use of ANCOVA allows for the examination of the adjusted mean (adjusted for the covariate) and statistical control over a covariate that could impact the final results, offering an advantage over ANOVA (Statistics.laerd.com, n.d.).

Table 1. The major dimensions, sub-dimensions, and descriptors of the codebook.

Dimensions to frame the government social media communication during the COVID-19 crisis	Sub-dimensions included within the dimensions	Descriptions of each sub-dimension	Keywords/indicators to capture each sub-dimension
Health Content Theme	Actions	The government, health organizations, or health professionals' responses to the COVID-19 crisis	E.g., Policy, Assistance, Solution, Suggestions, Explanation, Guidelines
	New Evidence	Helpful discoveries of the COVID-19	E.g., Transmission route, Vaccine, Variant, Treatment approaches
	Reassurance	Narratives or stories that suggest: successes in combating COVID-19; the public's positive emotions; inspiring and cheering expressions	E.g., Success, Victory, Wining, Touching, Inspiring, Encouraging, Positive, Comfortable, Cheering, Happiness, Joyousness, Braveness
	Disease Prevention	Preventive and safety measures; medical knowledge	E.g., Mask, Washing Hands, Keep Hygiene, Doing Exercise, Respiratory Symptoms, Close Contacts, Medical Treatment Process, Home Protection
Transparent Communication Style	Accessibility to External Sources via Interactive Features	The provision of extra information and additional access to other useful pages	E.g., Link, Hashtag, and Other Interaction Signs, such as @, →, and ☜
	Disclosure of Government Activities and Decisions	The indication of timely and updated information on the government-related motions, practices, and trends	E.g., Campaign, Activity, Action, Meeting, Decision, Seminar, Rule, Regulation
	Dissemination of Data Reports	Accurate, scientific, and daily information about the situation of the COVID-19	E.g., The Number of New Confirmed Cases, Death Cases, and Cured Cases
Others	Absence of the Transparent Communication Style	Irrelevant to any sub-dimensions of the transparent communication style	/

Results

To answer RQ1, the findings suggested that regarding the initial event/maintenance stage, C1 most frequently emerged (36%). C2 (35%) and C3 (20%) ranked second and third, respectively, while C4 was the least used sub-dimensions (9%). With regard to the stage of resolution, C3 was more frequently employed (36.7%), followed by C1 (27.3%), C2 (23%), and C4 (13%). For the stage of evaluation, both C2 (38.7%) and C3 (32%) were adopted frequently, followed by C1 (27%) and C4 (2.3%). Please refer to Table 2 for details.

The results of RQ2 indicated that the dominant sub-dimensions of the transparent communication style (i.e. T1, T2, and T3) were mostly built at all crisis stages, with 270 at the initial event/maintenance stage, 273 at the resolution, and 290 at the evaluation stage. Out of 270 posts at the initial event/maintenance stage, most posts used T3 (40.7%) at this stage, while several posts adopted T1 (27.3%) and T2 (22%), respectively. In contrast, most posts

Table 2. The percentage distribution of the dominant sub-dimensions of the health content themes at three stages of the COVID-19 crisis.

The dominant sub-dimensions of the health content theme	Initial event/ maintenance stage (*N* = 300)		Resolution stage (*N* = 300)		Evaluation stage (*N* = 300)	
	N	%	*N*	%	*N*	%
C1: Actions	108	36	82	27.3	81	27
C2: New evidence	105	35	69	23	116	38.7
C3: Reassurance	60	20	110	36.7	96	32
C4: Disease prevention	27	9	39	13	7	2.3

Table 3. The percentage distribution of the dominant sub-dimensions of the transparent communication style dimension at three stages of the COVID-19 crisis.

The dominant sub-dimensions of the transparent communication style	Initial event/ maintenance stage (*N* = 300)		Resolution stage (*N* = 300)		Evaluation stage (*N* = 300)	
	N	%	*N*	%	*N*	%
T1: Accessibility to external sources via interactive features	82	27.3	118	39.3	110	36.7
T2: Disclosure of government activities and decisions	66	22	53	17.7	54	18
T3: Dissemination of data reports	122	40.7	102	34	126	42
Others: Absence of transparent communication style	30	10	27	9	10	3.3

with T1 emerged at the resolution stage (39.3%), followed by T3 (34%) and T2 (17.7%). The results at the evaluation stage exhibited that T3 was more frequently employed (42%) than T1 (36.7%) and T2 (18%). Please refer to Table 3 for details.

To evaluate the levels of impact on public engagement from the individual dominant sub-dimension of the health content theme and the transparent communication style in *People's Daily* social media posts at three stages of the COVID-19 crisis (RQ3), we first categorized each of the 900 posts (i.e. 300 at the initial event/maintenance stage; 300 at the resolution stage; and 300 at the evaluation stage) to a specific sub-dimension according to the most dominant sub-dimension present in the post (see "*N*" column in Tables 2 and 3). For instance, concerning the health content theme at the resolution stage, we assigned 82/300 posts to the (C1) *Actions*, 69/300 posts to (C2) *New evidence*, 110/300 posts to (C3) *Reassurance*, and 39/300 posts to (C4) *Disease prevention*. Regarding the transparent communication style dimension at the resolution stage, we assigned 118/300 posts to (T1) *accessibility to external sources via interactive features*, 53/300 to (T2) *disclosure of government activities*, and 102/300 to (T3) *dissemination of data reports.* The same categorization was conducted for the other two crisis stages, respectively. We then calculated the mean (henceforth M) number of shares, comments, and likes as well as average audience engagement metrics for each dominant sub-dimension at the three crisis stages and performed multiple comparisons using one-way ANCOVA and post-hoc Tukey tests to determine the differences in the levels of impact on public engagement.

The study employed a one-way ANCOVA to assess whether there were statistically significant differences among independent groups with respect to a dependent variable. In accordance with the procedural guidelines outlined by Grande (2016) and Laerd Statistics, we conducted an examination of the normality of residuals pertaining to each category of the independent variables, specifically the health content theme and transparent communication style

to ensure the robustness and validity of the ANCOVA results. We first calculated the residuals for each category within the health content theme and transparent communication style. Residuals represent the differences between the actual counts of shares, likes, or comments and the values predicted by our ANCOVA model considering the covariates and independent variables. Subsequently, separate sets of residuals were created for each category, and Shapiro–Wilk tests were performed to evaluate the approximate normal distribution of these residuals. While we observed that the residuals within each category did not exhibit perfect normality, they did demonstrate an approximate normal distribution.

It is noteworthy that the ANCOVA assumption regarding the normality of residuals does not necessitate strict adherence to perfect normality, as the test is relatively robust to deviations from normality to a certain extent, as elucidated by Laerd Statistics. We thus maintained that this particular assumption had been met. The fulfillment of this assumption is of paramount significance as it underpins the validity of the ANCOVA results, thereby facilitating accurate inferences pertaining to the influence of categories within the health content theme and transparent communication style on the number of shares, likes, and comments on social media posts while accounting for covariates.

Prior to conducting the one-way ANCOVA, it is imperative to ensure that several key assumptions are met in addition to the assumption of normality checking. To ascertain the fulfillment of these assumptions, we referred to tutorials provided by Laerd Statistics (https://statistics.laerd.com/spss-tutorials/ancova-using-spss-statistics.php). A total of nine assumptions were meticulously evaluated: (1) The dependent variable and covariate variables should be measured on a continuous scale. (2) The independent variable should consist of two or more categorical, independent groups. (3) Independence of observations should be established, signifying no interdependence between observations within or between groups. (4) The absence of significant outliers must be confirmed. (5) The residuals should exhibit an approximate normal distribution for each category of the independent variable (already tested). (6) Homogeneity of variances needs to be established. (7) A linear relationship between the covariate and the dependent variable should be evident at each level of the independent variable. (8) Homoscedasticity must be verified. (9) Homogeneity of regression slopes, implying no interaction between the covariate and the independent variable, should be ascertained. These assumptions were verified by referring to relevant SPSS Statistics tutorials and through discussions within our research team.

Effect size provides information about the practical significance of research findings beyond statistical significance (Cohen, 1988). It represents the proportion of variance in the dependent variable that is accounted for by the independent variables and covariates, thereby enabling researchers to evaluate the strength and magnitude of the observed relationships (Dieleman et al., 2015; Keshmiri et al., 2020). The effect size in the ANCOVA analysis was determined using partial eta squared (η^2), a commonly employed value that indicates the impact level of independent variables and covariates on the dependent variable. According to Cohen (1988), Dieleman et al. (2015), and Keshmiri et al. (2020), effect sizes of approximately 0.01, 0.06, and 0.14 are conventionally considered small, medium, and large effects, respectively. It should be noted that all reported effects were statistically significant at a level of $p < 0.05$.

Table 4 compares the mean numbers of shares, comments, and likes for posts of the dominant subdimensions of the health content theme at three stages of the COVID-19 crisis after controlling for average audience engagement metrics. With respect to the initial event/maintenance stage, ANCOVA results indicated that a significant difference was found in the mean of shares (F (3, 296) = 6.344, $p < 0.0001$, partial eta squared = 0.061 (medium)), the mean of comments (F (3, 296) = 8.605, $p < 0.0001$, partial eta squared = 0.080 (medium)), and mean of likes (F (3, 296) = 3.829, $p = 0.010$, partial eta squared = 0.037 (small)). Post-hoc Tukey results suggested that the posts of C4 (M = 15,725) had significantly higher shares than posts of C1 (M = 4811, $p = 0.004$) and C2 (M = 3501, $p = 0.049$). A higher number of comments was found for the post of C2 (M = 6854) in contrast to

Table 4. Comparison of the mean numbers of shares, comments, and likes for posts of the dominant sub-dimensions of the health content themes after controlling for average audience engagement metrics at three stages of the COVID-19 crisis.

Crisis stage	C1 Mean of shares	C2 Mean of shares	C3 Mean of shares	C4 Mean of shares	df	*F*	*Partial eta squared*
Initial event/Maintenance	4811	3501	9916	15,725	3, 296	6.344****	0.061
Resolution	2846	1818	3448	4344	3, 296	4.327**	0.042
Evaluation	1121	3442	9481	8416	3, 296	1.605	0.016
	C1 Mean of comments	C2 Mean of comments	C3 Mean of comments	C4 Mean of comments	df	*F*	*Partial eta squared*
Initial event/Maintenance	6168	6854	4746	4269	3, 296	8.605****	0.080
Resolution	4803	4635	3675	3956	3, 296	1.572	0.016
Evaluation	2705	2515	2118	2206	3, 296	1.570	0.016
	C1 Mean of likes	C2 Mean of likes	C3 Mean of likes	C4 Mean of likes	df	*F*	*Partial eta squared*
Initial event/Maintenance	121,140	121,764	117,457	112,125	3, 296	3.829**	0.037
Resolution	76,092	75,288	74,618	73,441	3, 296	0.874	0.01
Evaluation	43,421	39,046	33,405	34,381	3, 296	1.450	0.015

Note. C1: Actions, C2: New evidence, C3: Reassurance, C4: Disease prevention.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, ****$p < 0.0001$ (Ngai et al., 2020; Ngai et al., 2022).

C3 (M = 4746, $p < 0.0001$) and C4 (M = 4269, $p = 0.001$). Similarly, the posts of C1 have significantly higher likes (M = 121,140) than the posts of C4 (M = 112,125, $p = 0.016$). Regarding the stage of resolution, ANCOVA results exhibited that a significant difference was witnessed in the mean of shares (F (3, 296) = 4.327, $p = 0.005$, partial eta squared = 0.042 (small)). Post-hoc Tukey results indicated that a higher number of shares was noted for the posts of C4 (M = 4344) as opposed to the posts of C2 (M = 1818, $p = 0.007$).

Table 5 revealed the comparison of the mean numbers of shares, comments, and likes for posts of the dominant sub-dimensions of the transparent communication style dimension at three stages of the COVID-19 crisis after controlling for average audience engagement metrics. Concerning the initial event/maintenance stage, ANCOVA results indicated a significant difference in the mean of shares (F (3, 296) = 9.270, $p < 0.0001$, partial eta squared = 0.086 (medium)), the mean of comments (F (3, 296) = 4.589, $p = 0.004$, partial eta squared = 0.045 (small)) and the mean of likes (F (3, 296) = 6.932, $p < 0.0001$, partial eta squared = 0.066 (medium)). Post-hoc Tukey results suggested that the posts of T1 (M = 13,148) had significantly higher shares than that of T2 (M = 2663, $p < 0.0001$) and T3 (M = 3286, $p < 0.0001$). A higher number of comments was noted for the posts of T3 (M = 6576) compared with that of T1 (M = 5044, $p = 0.005$). Similarly, the posts of T2 have significantly higher likes (M = 123,189) than the posts of T1 (M = 113,921, $p = 0.001$). For the resolution stage, ANCOVA results revealed that a significant difference was noted in the mean of shares (F (3, 296) = 7.575, $p < 0.0001$, partial eta squared = 0.072 (medium)) and the mean of comments (F (3, 296) = 4.323, $p = 0.005$, partial eta squared = 0.042 (small)). Post-hoc Tukey results exhibited that a higher number of shares was witnessed for the posts of T1 (M = 4192) as opposed to the posts of T3 (M = 1801, $p < 0.0001$), while a higher number of comments was found for the posts

Table 5. Comparison of the mean numbers of shares, comments, and likes for posts of the dominant sub-dimensions of the transparent communication style dimension after controlling for average audience engagement metrics at three stages of the COVID-19 crisis.

Crisis stage	T1 Mean of shares	T2 Mean of shares	T3 Mean of shares	df	*F*	*Partial eta squared*
Initial evet/Maintenance	13,148	2663	3286	3, 296	9.270****	0.086
Resolution	4192	2649	1801	3, 296	7.575****	0.072
Evaluation	9138	3395	3205	3, 296	1.844	0.018
	T1 Mean of comments	T2 Mean of comments	T3 Mean of comments	df	*F*	*Partial eta squared*
Initial event/Maintenance	5044	6261	6576	3, 296	4.589**	0.045
Resolution	3746	5964	4076	3, 296	4.323**	0.042
Evaluation	2116	2611	2635	3, 296	1.688	0.017
	T1 Mean of likes	T2 Mean of likes	T3 Mean of likes	df	*F*	*Partial eta squared*
Initial event/Maintenance	113,921	123,189	122,251	3, 296	6.932****	0.066
Resolution	73,799	73,124	75,861	3, 296	3.074	0.030
Evaluation	33,749	45,789	39,163	3, 296	1.706	0.017

Note. T1: Accessibility to external sources via interactive features, T2: Disclosure of government activities and decisions, T3: Dissemination of data reports. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, ****$p < 0.0001$ (Ngai et al., 2020; Ngai et al., 2022).

of T2 (M = 5964) in contrast to the posts of T1 (M = 3746, $p = 0.004$) and T3 (M = 4076, $p = 0.028$).

Discussion

Our findings have uncovered that the Chinese government employed a variety of health content themes and transparent communication styles to communicate about the COVID-19 during the three distinct stages on social media, resulting in varying degrees of public engagement. The results present an opportunity to delve into the necessary communication strategies and the underlying rationales in each COVID-19 crisis. In this section, we expound upon the specific communication strategies emphasized and the corresponding public responses observed during each of the three crisis stages of COVID-19. The aim is to enhance the comprehension of researchers regarding the underlying rationale behind the adoption of diverse health content themes and transparent communication styles at each stage and inform practitioners of their future communication practices.

Strong need for disease prevention information at the initial event/maintenance and resolution stages

We found that at the initial event/maintenance and resolution stages, disease prevention had the highest impact on the number of shares, although it was the least frequently used sub-dimension. We argued that the impact might be due to its role in reducing uncertainty and alleviating anxiety by providing the public with preventive and safety measures to avoid the risk of infection (Higgins et al., 2006; Shih et al., 2008). At the beginning of the initial event stage, the public had little understanding of COVID-19, and they had to broadly search for relevant information online to address their concerns (Zhao et al., 2020). At the maintenance stage (i.e. 20 January 2020), evidence indicated human transmission of COVID-19 (Huang et al., 2020), and the Chinese State Council officially announced COVID-19 as a public health crisis on its website (Xinhuanet, 2020). COVID-19 was viewed as a new infectious disease with no effective treatment found and no vaccine developed at that time,

causing a large-scale panic nationally (Huang et al., 2020) at this stage. Even at the resolution stage, the public concern for COVID-19 variants and the transmission mode of COVID-19 still exists. When such an epidemic occurred and spread, the public was eager to seek relevant preventive information and medical knowledge online to alleviate their fear and anxiety (Y. Chen et al., 2019).

The public tends to respond quickly and actively engage in information sharing when a health crisis occurs (Lachlan et al., 2016; Reynolds & Quinn, 2008). The online behavior "share" involves a recommended action of disseminating the post to others, which can reach a large audience (Kim & Yang, 2017). The public was likely to share disease prevention information to help other online users better understand the COVID-19 situation. Therefore, the highest impact on the number of shares engendered by disease prevention is reasonable.

Reassurance and government actions are highly valued at the resolution stage

Our results reveal that reassurance had the highest frequency of use at the resolution stage, as exemplified in the following post: "*New confirmed cases outside Hubei province have dropped for eleven consecutive days. Stay strong Hu Bei! Stay strong China! We can win this battle together!*" (No. post 520). The resolution stage is vital in a health crisis as it reveals governments' determination and confidence to cope with the crisis and win the "battle." During this stage, governmental organizations begin to take further actions with adjustments to the previous measures. Information exchanges will be strengthened, more frequent discussions about new evidence of the pandemic can be witnessed, and more strict control efforts will be implemented (Lachlan et al., 2016; Reynolds & Quinn, 2008). As the Chinese premier at that time said, "*The Chinese government has the resolution to win the battle against the epidemic*" (Xinhuanet, 2020).

The government needs to convey the determination and confidence to the public to stabilize the crisis situation. In the meantime, the public needs emotional support to allay anxiety and regain faith. Emotional support, as a key component of health communication strategies during public health crises (Jewett et al., 2023; Zahry et al., 2023), involves offering words of reassurance, acknowledging the emotional struggles that people are facing, and providing a sense of togetherness and solidarity. In the context of the COVID-19 pandemic, where public emotions are heightened, and the psychological impact is profound, it is imperative for governmental organizations to be responsive to the emotional needs of the public (Zhu & Hu, 2023). In China, particularly during the resolution stage of the COVID-19 crisis, when social distancing and isolation measures are prevalent, government communication that recognizes shared emotions and provides emotional support can foster a sense of confidence and cohesion among the public which contributes to the psychological resilience of the public. Reassurance, as a critical component of emotional support, involving the provision of uplifting narratives and the emphasis on evidence-based successes in combating the crisis, is integral and indispensable to the government social media communication at the resolution stage of the COVID-19 crisis (B. F. Liu & Kim, 2011; Ngai et al., 2020). Therefore, the frequent utilization of reassurance during this stage is both anticipated and necessary.

At the resolution stage, it is also worth noting that actions engendered the highest number of shares, comments, and likes compared with other health content themes; disclosure of government decisions and activities had the highest impact on the number of comments, in contrast to other transparent communication styles. Zhao et al. (2020) confirmed that Chinese public's search volume of the epidemic information (e.g. disease prevention) on Sina Weibo was decreasing after February 1 (i.e. the resolution stage in our study). The public's attention was shifted to governmental responses such as medical assistance and quarantine rules (Zhao et al., 2020) because the number of new confirmed cases began to decrease (Xinhuanet, 2020). The public was no longer paying close attention to the daily data reports and new dynamics to reduce uncertainty (Zhao et al., 2020). Instead, they were eager to know governmental policies and regulations (e.g. working schedule, public transportation, and social distancing) to guide their behaviors and restore normalcy. Hence, these

indicators (i.e. shares, likes, and comments) exhibited the public's particular attention to the government's crisis responses.

From the government's perspective, disclosure of governmental actions and decisions through social media enables the government to keep the public informed of any updates, which contributes to a high level of transparency and positive feedback toward governments (Halachmi & Greiling, 2013; Song & Lee, 2016). We found a range of positive comments under the posts on the government's rapid responses and decisions, such as "*The Hubei government's response was quite timely*," "*Thanks for the help of the central government*," and "*These regulations are very effective and show the government's resolution to fight against the epidemic*." In this regard, the government can continue to enhance transparency and public trust by actively disseminating information about the latest actions and decisions in subsequent COVID-19 waves and other health crises.

Interactive features promote public engagement in key crisis stages

Our results also present the strong effect of accessibility to external features via interactive features (e.g. hashtags and links) on shares at the initial event/maintenance and resolution stages. We argue that it was owing to the distinctive function of interactive features to promote information and engage the public on social media. For example, Hashtags lead the public to COVID-19 topics where the public can have synchronous conversations, exchange views with others, and share detailed information about COVID-19 from time to time (Kang, 2014; Men et al., 2018). Similarly, links enable the public to connect with other social communities and increase information adequacy (Men et al., 2018). Posts that exceed 140 words are not allowed to be published on Sina Weibo. Hence, the causes and consequences of a COVID-19-related issue may not be explained clearly in a post. Links add extra information to a complex issue and increase the value of corresponding posts, thereby improving post sharing.

In contrast to traditional one-way communication channels, social media facilitate two-way interactions, enabling immediate feedback and public inquiries (Zaharna & Huang, 2022). During global public health crises, such as the multifaceted COVID-19 pandemic, which necessitates intricate health communication practices and swift responses, the interactive features inherent to social media platforms play a key role in expediting communication between the public and governmental organizations and facilitating rapid mobilization (Ngai et al., 2022). These features include comments, direct messaging, hashtags, polls, hyperlinks, and live chat functionalities, which empower individuals to seek clarifications, express concerns, and receive responses from health authorities. Health communication professionals, in turn, harness these tools to assess public knowledge, dispel misconceptions, and educate the public regarding preventive measures, symptoms, and treatment options (Van Dijck & Alinejad, 2022). Furthermore, those interactive attributes foster the formation of online communities and support groups where individuals can forge connections, share their experiences, and offer one another emotional solace during public health crises (Schneider, 2021). We recommend that governmental organizations acknowledge the shifting landscape of mediated communication toward public health crises and fully exploit the advantages offered by social media to effectively implement health communication strategies that actively engage with the public and respond to these crises in a timely and efficient manner.

Conclusions and future research

This study contributes to the innovative use of the CERC model in crisis communication literature by expanding its applicability in the government social media communication on the COVID-19 crisis in the Chinese context and combining it with communication theories to foster the understanding of government social media communication on public engagement during different crisis stages of the COVID-19 outbreak. We developed a framework to test the health content theme and transparent communication style that engage the public at the initial event/maintenance stage, resolution stage, and evaluation stage, respectively. The insights yielded from our findings can help governmental organizations understand the public's concerns at different

COVID-19 periods and determine which communication strategy can be employed to raise the public's health awareness, improve their emotions, and persuade them to take action at various crisis stages.

The examination of health content themes and transparent communication styles in this research is constrained to the analysis and interpretation of 900 social media posts posted on Sina Weibo between 1 December 2019 and 19 March 2020. These posts were chosen to represent the government's social media communication efforts during the first wave of the COVID-19 crisis in China. Future studies may benefit from a more comprehensive collection of social media posts, including subsequent waves of the COVID-19 crisis at varying time intervals within China. The division of the entire period into three distinct crisis stages, as undertaken in this study, is rooted in our own rationale. However, it is possible that alternative timelines may yield different results, and further research could explore diverse means of categorizing crisis stages to assess whether similar effects can be observed. This study exclusively focused on Sina Weibo as the chosen platform to represent government official social media communication. Future investigations may extend their scope to include other social media platforms such as WeChat, Bilibili, and TikTok, as well as traditional media channels to offer a more comprehensive view of government-mediated communication throughout the COVID-19 crisis.

Moreover, the findings from our study can serve as an empirically supported framework or guideline for subsequent research exploring government social media communication in response to various health crises in the Chinese context. For instance, the study highlights that disease prevention information tends to reach a broader audience through users' sharing during the initial event/maintenance stage. Subsequent research can delve into how government organizations construct disease prevention information, including the provision of medical knowledge and preventive measures via social media. Given the limited public understanding of health crises during their early stages, studies can also scrutinize the dynamics of public responses prompted by such mediated communication.

Similarly, the research identifies that disclosing government decisions and activities represents transparent mediated communication and is more likely to evoke positive public responses toward the government. Future investigations may reference this dimension to identify government efforts in transparent communication during health crises and analyze how governments elucidate policies and regulations to engage with the public. Considering that public trust in governments may be impacted during health crises and that social media public engagement can reflect public perceptions, this study recommends that health communication and crisis communication researchers scrutinize indicators of public engagement on social media platforms, including shares, likes, comments, and individual dialogue contents so as to gain insights into public attitudes and trust building.

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Supplemental material

Supplemental material for this article is available online.

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