Content analysis: Crisis and Emergency Risk Communication and Emotional Appeals in COVID-19 public health messaging in Singapore

Shirley S. Ho, Agnes S. F. Chuah, Vanessa S. Ho, Sonny Rosenthal, Hye Kyung Kim, Shannon S. H. Soh

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Shirley S. Ho[1] PhD; Agnes S. F. Chuah[1] PhD; Vanessa S. Ho[1] BA; Sonny Rosenthal[1] PhD; Hye Kyung Kim[1] PhD; Shannon S. H. Soh[2] BSc

[1]Wee Kim Wee School of Communication and Information Nanyang Technological University Singapore SG
[2]School of Biological Sciences Nanyang Technological University Singapore SG

Corresponding Author:
Shirley S. Ho PhD
Wee Kim Wee School of Communication and Information
Nanyang Technological University
31 Nanyang Dr, 02-37
Singapore
SG

Abstract

Background: Although COVID-19 is no longer a global health emergency, it remains pervasive in Singapore, a city-state situated in Southeast Asia, with periodic waves of infection. Complementing disease management, strong communication strategies are critical in the government's response to the pandemic to keep the public updated and equip them in protecting themselves.

Objective: Grounded in the crisis and emergency risk communication (CERC) framework and emotional appeals, this study aims to analyze public health communication strategies in Singapore during the COVID-19.

Methods: Quantitative content analysis was conducted on 696 Facebook posts and 83 website articles published by Singapore public health institutions between January 2020 and September 2022.

Results: Results show that the CERC framework can be applied to the phases of the pandemic in Singapore, and increasing communication about message themes such as inquisitive messaging and clarification can enhance communication strategies. The use of emotional appeals also varies over time and should be carefully employed as they are context-specific.

Conclusions: Theoretically, this study contributes to the frameworks of CERC and emotional appeals by exploring the application and changes of CERC message types and emotional appeals at different phases. The findings can provide practical guidance for authorities and communication practitioners in developing effective communication strategies.

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Keywords: COVID-19; crisis and emergency risk communication; CERC; emotional appeal; content analysis; public health; Facebook; social media; Singapore

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Introduction

Singapore effectively managed COVID-19, which is evident from the World Health Organisation (WHO) lauding its "all-of-government" approach[1]. This approach[1,2] entails collaboration among different government agencies[2]. While COVID-19 is no longer a global health emergency, Singapore continues to experience periodic infection waves[3]. During the pandemic, Singapore government charted its response to COVID-19 in stages, as detailed in a white paper[4]. Avenues for public health communication in Singapore include government websites and Facebook pages. Websites serve as a one-stop communications channel, while Facebook is one of Singapore's most widely used social networking platforms[5]. However, studies on the government's use of Facebook for public health communication during the pandemic are limited.

Singapore’s success in managing the pandemic can be attributed to its small population, concentrated political authority, high political trust[6], state-supported media, and prior 2003 SARS outbreak experience[7]. Despite this, Singapore faced criticism for the high number of COVID-19 cases in foreign worker dormitories due to the lack of communication[6]. Studies[8–13] have shown that media messages can shape public knowledge, attitudes, and preventive behaviors during pandemics in Singapore. It is worthwhile to study Singapore’s public health communication during COVID-19 as it can highlight areas for improvement and offer insights for similar countries in future crisis. This study has four objectives. First, to characterize the themes of public messages during the COVID-19 using the Crisis & Emergency Risk Communication (CERC) framework. Second, to examine how these message themes changed across different pandemic phases. Third, to identify the types of emotional appeals used. Fourth, to analyze how emotional appeals changed across the COVID-19 phases.

Crisis and emergency risk communication (CERC)

CERC is well-suited for evaluating Singapore’s public communication strategies during the COVID-19 pandemic, as it evolves in stages and involves both risk and crisis communications.

CERC consists of five stages: pre-crisis, initial, maintenance, resolution, and evaluation. Communication during the *pre-crisis* stage focuses on educating the public about potential adverse events and risks to prepare them for the subsequent stages[14]. During the *initial* stage, communication messages focus on reducing uncertainty, conveying empathy, and the general understanding of the crisis. The *maintenance* stage reiterates misinformation, ongoing risks, and mitigation strategies[15]. The *resolution* stage involves communicating how the emergency was handled, while the *evaluation* stage assesses response effectiveness[15].

The CERC framework assumes that crises develop in a linear way. However, due to the variability of diseases, crises may not follow the sequence of the outlined stages[14]. While CERC suggests five stages, the pre-crisis stage does not apply to COVID-19 as it was not a known disease. The length of each stage may also vary, as a prolonged crisis state may occur[14]. For example, COVID-19 has a prolonged CERC maintenance stage as the virus mutated several times during the pandemic[16]. This has resulted in repeated tightening and easing of COVID-19 measures in Singapore[4].

CERC themes

Drawing on existing literature[17–19], this study categorized the CERC message themes into four categories: *risk and crisis information, self-efficacy and sense-making, preparations and uncertainty reduction*, and *advisories and alerts*. Risk and crisis information refers to information that educate the public about potential threats[14]. This category consists of a sub-theme, *pandemic intelligence.* It refers to messages containing basic information about the pandemic, including case numbers[18], to raise awareness of the current situation.

Self-efficacy and sense-making involves messages that help people to understand the situation and reflect their ability to change their behaviors[18]. This category includes three sub-themes: *personal preventive measures and mitigation, social and/or common responsibility,* and *inquisitive messaging*. Personal preventive measures and mitigation refers to messages about measures or

precautions that people can take to protect themselves from COVID-19. Social and/or common responsibility includes messages on measures or precautions that can be taken at the community level to prevent the spread of COVID-19 or show care[20]. Inquisitive messaging addresses the public's questions to better understand the situation[18].

Preparations and uncertainty reduction include messages on how to act appropriately during the pandemic[14]. Drawing reference to Malik et al.[18], preparations and uncertainty comprises four sub-themes: *clarification, events, campaigns and activities*, *showing gratitude*, and *reassurance*. Clarification refers to messages addressing misunderstandings and untrue claims about the pandemic[20]. Events, campaigns and activities include messages promoting communication campaigns for awareness, relief, or treatment. Showing gratitude refers to expressing appreciation to those involved in managing the virus, such as frontline workers[19]. Reassurance consists of messages that allay the public's fears.

Advisories and alerts refer to messages that provide crucial warnings and specific advice about diseases. There are two sub-themes: *risk groups* and *general advisories and vigilance*. Risk groups refer to messages targeting vulnerable groups, such as people with pre-existing conditions and seniors who are at greater risk of contracting COVID-19[20]. Messages on general advisories and vigilance include information on what to do in certain situations, such as returning to the workplace.

COVID-19 phases and social media use in Singapore

The Singapore government segmented the COVID-19 pandemic into four phases: *early days of fog, fighting a pandemic, rocky transition*, and *learning to live with COVID-19*[4], which correspond to the CERC stages (see Table 1). However, empirical investigation is needed to examine if the message themes were conveyed appropriately across these stages, especially on social media. The CERC framework has been used to evaluate public health communications on social media, such as Facebook[17,21]. Vijaykumar et al.[22] found that information disseminated by Singapore public health institutions on Facebook were similar in content, but differ in focus. MOH focused on situational

updates and National Environment Agency (NEA) elaborated on preventive measures. However, the study only focused on public communication by these two agencies. To gain a broader understanding of crisis communications in Singapore, this study examines public communication by multiple government agencies in Singapore. Hence, we ask:

RQ1: To what extent are the CERC message themes present in Singapore's online public health messaging during the COVID-19 pandemic?

RQ2: How do the CERC message themes change across different phases during the COVID-19 pandemic?

While CERC is extensively studied, there is limited research linking it with emotional appeals, a gap scholars find crucial to address. Meadows et al.[23] argued that investigating the emotional tones of the public during different outbreak phases aids in developing effective public health messages. This is echoed by Xie et al.[24], who found that emotional appeals effectively engaged audiences. In addition to analyzing CERC message themes, this study also aims to study the use of emotional appeals in public health communication during COVID-19.

Emotional appeals

Emotional appeals can persuade people to perform an intended behavior by evoking specific emotion[25]. They are widely used in health communications[26] and each type elicits varying responses. For example, people are divided on humor appeals; some think it undermines the subject's seriousness, while others find it useful[27]. The choice of emotional appeals depends on the context and the target audience[28]. During the COVID-19 pandemic, key emotional appeals included hope, humor, fear, anger, guilt, and nurturance appeals[29,30].

Hope appeals emphasize efficacy and can be empowering when paired with actionable advice. During health crises, transparent communication about uncertainties and hopeful messages can enhance support for measures implemented[30]. WHO recommends using hope appeals to combat pandemic fatigue[31]. Hope appeals are effective communication strategy across different cultures. In

collectivist countries like Singapore, hope appeals can focus on emerging stronger from COVID-19 as a community. *Humor appeals* employ techniques like clownish humor, irony and satire[32], aiming to reduce negative emotions and promote positivity[33]. However, they also noted for potentially reducing social responsibility[34] and perceived crisis risk[35]. Humor appeals should be employed tactfully especially during the critical phrases where increased perceived risk and social responsibility are crucial.

Fear appeals are the most widely studied emotional appeals. A message with fear appeals induces fear when a situation is seen as threatening to one's physical or mental health and is perceived as uncontrollable[36]. It evokes fear about the harm that will befall them if they do not adopt the recommended behavior[37]. The arousal triggered would create a desire to avoid the perceived threat and to adopt the suggested behavior, such as mask wearing and vaccination. Upon encountering the message, the audience would evaluate the severity and susceptibility of the threat, and their ability to overcome the threat, and subsequently taking the recommended action[38].

Anger appeals motivate people to carry out actions requiring more effort and commitment[39]. The anger activism model suggests that when coupled with a sense of efficacy, a person made to feel anger would feel motivated to perform a behavior[39]. Anger was one of the least used appeals in organizational YouTube videos during COVID-19[24]. *Guilt appeals* consist of two components—material to evoke guilt and an action to reduce guilt[40]. The material can highlight discrepancies between the audience's standards and their behavior[41], which could effectively influence health-related attitudes[42]. However, excessive guilt can be counterproductive and less persuasive[43], as shown by Matkovic et al.[44], where guilt appeals failed to influence handwashing intention during the pandemic.

Nurturance appeals are defined as appeals that evoke a sense of caretaking, and effectively target parents[36]. Nurturance appeals were the most dominant emotional appeal in advertising materials using COVID-19 as a theme[29]. Given the dynamic nature of a crisis, it is important to

employ suitable emotional appeals at appropriate times, for effectiveness. A few studies focused on how emotional appeals were employed in the communication messages during the COVID-19 pandemic (e.g. a study by Mello et al.[45]). Hence, we ask:

RQ3: What are the types of emotional appeals used in Singapore's online public health messaging during the COVID-19 pandemic?

RQ4: How does the use of emotional appeals in Singapore's online public health messaging change across different CERC phases during the COVID-19 pandemic?

Methods

To answer our research questions, we conducted a quantitative content analysis on public Facebook posts and publicly accessible website articles from key Singapore government institutions involved in public health communication during the COVID-19 pandemic. Specifically, we compiled and analyzed content from Gov.sg, representing the Singapore government, as well as institutions such as the Ministry of Health (MOH), the Ministry of Sustainability and the Environment (MSE), the National Environment Agency (NEA), and the Health Promotion Board (HPB).

Ethical Considerations

Before commencing data collection for content analysis, we sought approval from the University's Integrity Review Board (IRB) under Exempt Category 4. This category pertained to secondary research utilizing existing or publicly accessible datasets, such as those found on social media. The exemption criteria included sources of individually identifiable information that were already in existence or publicly available. Obtaining IRB approval ensured that the research adheres to ethical standards, protecting the privacy and rights of individuals whose data was being analyzed. This step was crucial in maintaining the integrity and ethical compliance of the research project.

Data Collection and Sampling

Upon receiving IRB approval, we employed a Python script to crawl Facebook posts containing specified keywords related to COVID-19 from 1 January 2020 to 30 September 2022.

Concurrently, we manually compiled relevant website articles from the same timeframe through keyword searches on the institutions' websites. These keywords included: “2019-nCoV, SARS-CoV-2, Sars-CoV-2, Wuhan Coronavirus, Wuhan coronavirus, wuhan coronavirus, Wuhan virus, wuhan virus, Wuhan Virus, Covid-19, covid-19, novel coronavirus, COVID, Covid, covid.” Articles and posts unrelated to the public health communication about COVID-19[1] were excluded.

This initial screening yielded a total of 1,114 Facebook posts and 85 relevant website articles. The data were then randomly sampled with a confidence level of 99% and a +/-3% margin of error, resulting in the final 696 Facebook posts and 83 website articles selected for detailed analysis.

Codebook and Coding Scheme

We developed the codebook based on the CERC message themes adapted from previous literature[18]. These themes encompassed (a) pandemic intelligence, (b) personal preventive measures and mitigation, (c) social and/or common responsibility, (d) inquisitive messaging, (e) clarification, (f) events, campaigns and activities, (g) request for contributions, (h) showing gratitude, (i) reassurance, (j) risk groups, and (k) general advisories and vigilance. Additionally, six emotional appeals adapted from previous studies[29,36,46,47] were included in the codebook. These emotional appeals included (a) fear appeals, (b) guilt appeals, (c) anger appeals, (d) hope appeals, (e) humor appeals, and (f) nurturance appeals. Each Facebook post, including all text and visual elements, and everything visible on the webpages were coded as one unit of analysis respectively. Examples of the message themes and emotional appeals were included in the codebook, with COVID-19 content from public health institutions in Singapore marked with “[Example from data]” at the end of the example (see Table 2).

Intercoder Reliability

We recruited three coders to code the data. Prior to actual coding, the coders undertook two rounds of training, practice sessions for coding, intercoder reliability, and discussions to refine the

[1] Facebook posts and website articles excluded were those that solely focused on situational updates such as the number of cases and clusters, call-out to subscribe for updates, mentions of COVID-19 as time frame where other activities or programs were the main topic, not COVID-19 focused, speeches by public figures, and press release.

codebook. During practice sessions, coders coded the same units of analysis to ensure a common understanding of the codebook. The units of analysis (n = 60) for the training and practice sessions were the materials that had not been sampled. After achieving consensus, the coders coded 10% of the data, and intercoder reliability was tested. The process was repeated until we achieved an average Krippendorff's α value of 0.78. The Krippendorff's α ranged from 0.70 to 1.00, demonstrating an acceptable intercoder reliability, as it exceeded the 0.70 standard established in the literature[48]. Subsequently, the data was split equally and coded by the coders.

Statistical Analyses

To answer RQ1 and RQ3, a series of descriptive statistics were conducted using *SPSS software version 29*. For RQ2 and RQ4, Chi-square tests were performed to examine the relationships among CERC themes, emotional appeals, and COVID-19 phases. Notably, 24 website articles lacking publication dates were excluded from the Chi-square tests as we could not classify them into any COVID-19 phases.

Results

Our sample showed that most of the messages about COVID-19 were communicated by Gov.sg (n = 394, 50.6%), followed by Ministry of Health (MOH; n = 261, 33.5%), National Environment Agency (NEA; n = 90, 11.5%), Ministry of Sustainability and Environment (MSE; n = 18, 2.3%), and Health Promotion Board (HPB; n = 16, 2.1%) (see Table 3).

RQ1 asked about the CERC message themes employed by the Singapore government during the COVID-19 pandemic. Our sample (Table 4) showed that most of the messages disseminated during the pandemic were about personal preventive measures and mitigation (n = 522, 67%), followed by general advisories and vigilance (n = 445, 57.1%), pandemic intelligence (n = 266, 34.1%), social and/or common responsibility (n = 131, 16.8%), risk groups (n = 118, 15.1%) and event, campaigns, and activities (n = 105, 13.5%). A small number of messages showed gratitude (n = 54, 6.9%), inquisitive messaging (n = 31, 4.0%), clarification (n = 31, 4.0%), and reassurance (n =

31, 4.0%). Request for contributions (n = 5, 0.6%) was least communicated.

RQ2 asked how the CERC message themes changed across different phases during the COVID-19 pandemic. As shown in Table 5, the communication message themes changed across the COVID-19 phases. Chi-square tests revealed significant changes in message themes across the phases, including pandemic intelligence (χ^2 (3) = 18.19, p < .001). Specifically, messages on pandemic intelligence were more frequently posted during the maintenance stages – fighting a pandemic and rocky transition – compared to other phases (see Table 5 and Figure 1). Similarly, the results showed that message themes, such as personal preventive measures and mitigation (χ^2 (3) = 29.18, p < .001), events, campaigns, and activities (χ^2 (3) = 27.91, p < .001), and general advisories and vigilance (χ^2 (3) = 15.46, p < .001), changed significantly across different COVID-19 phases. These message themes were frequently employed in Singapore's online public health messaging during the fighting a pandemic phase and rocky transition phase (maintenance stage).

Chi-square tests showed that message themes on social and/or common responsibility (χ^2 (3) = 29.97, p <.001) and showing gratitude (χ^2 (3) = 21.05, p <.001) changed across different COVID-19 phases. Messages on social and/or common responsibility were frequently communicated to the public during the fighting a pandemic period (maintenance stage), while messages on showing gratitude were often communicated during the early days of fog (initial stage) and fighting a pandemic period (maintenance stage). Message theme on risk groups (χ^2 (3) = 17.77, p <.001) also changed across different COVID-19 phases, messages about risk groups were frequently mentioned during the rocky transition period (maintenance stage).

RQ3 asked about the types of emotional appeals used in the messages communicated by the Singapore government to the public during the COVID-19 pandemic. Our data (Table 6) showed that hope (n = 37, 38%) and humor (n = 36, 37.1%) appeals were most frequently used in the communication messages during the COVID-19 pandemic, followed by nurturance appeals (n = 17, 17.5%). Anger appeals (n = 4, 4.1%), fear appeals (n = 2, 2.1%), and guilt appeals (n = 1, 1%) were

employed in the messaging strategies with a very low frequency.

RQ4 asked how the use of emotional appeals in messages communicated by the Singapore government change across different phases of the COVID-19 pandemic. Chi-square tests (Table 6) showed that emotional appeals – fear, anger, humor, and nurturance appeals – changed across phases. Messages containing fear appeals were only disseminated during the learning to live with COVID-19 period (χ^2 (3) = 17.41, p < .001). Messages containing anger appeals were employed during the fighting a pandemic period and learning to live with COVID-19 period (χ^2 (3) = 8.44, p < .05). Humor appeals were employed across all the phases of COVID-19 at different levels of frequency (χ^2 (3) = 8.34, p < .05). Messages containing nurturance appeals were also mostly communicated to the public during the learning to live with COVID-19 period (χ^2 (3) = 49.85, p <.001).

Discussion

This study examined public health communication strategies in Singapore during the COVID-19 pandemic, by applying the CERC framework and emotional appeals. We found that the communication strategies employed by the Singapore public health institutions aligned with the CERC framework. However, our analysis suggested that CERC message themes such as inquisitive messaging and clarification can be conveyed more, particularly at the earliest stage of the crisis. This is in line with CERC recommendations, and it also helps in verifying the abundance of information available when there is an infodemic. The COVID-19 phases in Singapore outlined by the government also aligned with the CERC stages. We found that different emotional appeals were employed at various COVID-19 phases in differing situations, evident in how nurturance appeals were used to encourage child vaccination, aligned with literature showing that nurturance appeals can effectively target parents. Despite this, certain emotional appeals can be used more frequently at various COVID-19 phases. We observed that Singapore's communication strategy aligned with the frameworks of CERC and emotional appeals, with a few areas for improvement as discussed below.

Consistent with Malik et al.'s study[18], our findings revealed that the Singapore public health institutions' communication themes focused more on personal preventive measures and mitigation as

well as general advisories and vigilance. For example, the tele-befriending and tele-counselling services, such as The Seniors Helpline, were established to help seniors who face mental distress during the lock-down period. Overall, the Singapore government effectively communicated the message themes recommended by the CERC framework. This is evident from how the framework recommends informing the public about what they can do to protect themselves, the risks of the disease, and the actions that the public health institutions are taking to manage the situation. Meanwhile, the request for contribution theme was the one communicated the least, likely due to the Singapore public health agencies having sufficient resources to tide over the pandemic. The Singapore government had issued multiple budgets and grants from the onset of COVID-19 to protect individuals and businesses in Singapore. These monetary payouts include one-off as well as recurring cash grants for individuals whose livelihoods were affected by the pandemic[49]. There was also assistance targeted towards lower-income households. Examples of this include the COVID-19 Recovery Grant, where Singaporean Citizens or Permanent Residents could receive up to S$700 for three months if they faced an income loss of at least 50%[49]. The grants were successful in reducing the inequality in Singapore[50].

A shortcoming of the public health institutions' communication strategies was that messages on clarification was communicated less frequently. This was in line with existing literature showing how health organisations may have insufficient posts addressing misinformation[18,51]. While steps were taken to clarify misinformation and address the public's questions, there can be more such messaging as COVID-19 is also an infodemic[1,52,53]. Infodemics occur when a large amount of information is rampant, including those that might be inaccurate or confusing[54]. Aligned with Reynolds and Seeger's[15] argument that communications during the initial phase should aim to reduce uncertainty, the Singapore public health institutions can enhance messaging on clarification and inquisitive messaging at the earliest stage of the crisis to prevent outrage and confusion in times of emergency. This is considering that the health institutions would be communicating new information,

in the form of pandemic intelligence and general advisories and vigilance, where greater uncertainty may ensue. Separately, the frequency of reassurance messaging can be increased, with the CERC framework encouraging such messaging to be conveyed during the initial and maintenance stages[14]. This can help to assure the public that the health institutions are handling the situation and managing the public's emotions in times of uncertainty[15].

We found that the communication message themes employed by the public health institutions changed across different phases of COVID-19 in Singapore. This finding supported the CERC framework, which suggested that different message themes should be communicated to the public at different stages of a pandemic[24]. For example, we observed that messages on pandemic intelligence were communicated less frequently at the initial stage (Early Days of Fog; January 2020 – March 2020) of the COVID-19 pandemic, where little was known about the disease. As COVID-19 test kits became available, the Singapore government could trace the number of daily cases and better understand the spread of the virus. This enabled them to learn and develop mitigation strategies to control the disease. Hence, there has been a greater focus on communicating messages on pandemic intelligence (e.g., the kickoff of COVID-19 vaccination) at the maintenance stage (i.e., Fighting a Pandemic: April 2020 – April 2021; Rocky Transition: May 2021 – November 2021) than in other stages. Similarly, as scientists gradually gain more information about the virus, personal preventive measures and mitigation strategies were implemented by the public health institutions and more frequently communicated to the public at the maintenance stage (i.e., Fighting a Pandemic: April 2020 – April 2021; Rocky Transition: May 2021 – November 2021). This is in line with CERC's recommendations to provide more explanations about preventive measures and mitigation strategies during the maintenance stage[20].

Our results showed that positive emotional appeals (e.g., hope and humor appeals) were more frequently employed in COVID-19 communication strategies. This is in line with Xie et al.'s study[24], which found that positive emotions such as hope were commonly used in videos on COVID-19.

They also posited that positive emotions can be beneficial to public engagement at the start of a pandemic to balance out the public's negative emotions. Hence, the Singapore public health institutions may have taken this approach to neutralize the public's uncertainty. While other studies acknowledge that positive emotional appeals should be leveraged, they also suggested for negative emotional appeals to be used as both types of messages can engage the public in taking up preventive behaviors[51,55]. Positive emotional appeals, if overused or applied at inopportune times, can backfire, such as humor appeals possibly lowering perceived risk and social responsibility, and may also result in the public not internalizing the intended message or not taking it seriously[56]. In addition, emotional appeals have different effectiveness for different demographics. For example, older populations prefer emotional appeals that avoid negative emotional outcomes, as compared to younger populations[57]. Hence, health institutions can consider integrating a mix of emotional appeals for more effective messaging in future public health crises or pandemics.

This study found that the emotional appeals used varied over time, with their use being context-specific, depending on the situation and state of the disease. For example, nurturance appeals were not employed at the early stage of the COVID-19 communication but were frequently used during the period of learning to live with COVID-19. This coincided with the first shipment of pediatric doses for the vaccination in end-December 2021[58], when the government started encouraging parents to bring their children for vaccination. Humor appeals were employed with different frequencies across the stages, which could be due to the fluctuating severity of the crisis. Our studies revealed that humor appeals were used in less-pressing messages, such as encouraging the public to take up preventive behaviors, that were more culturally appropriate especially during the stressful pandemic. For example, a sitcom character most Singapore residents are familiar with, Phua Chu Kang, was used in COVID-19 campaign videos on responsible behavior during the pandemic, and later, to boost the local vaccination drive. While humor appeals were employed in the communication messages across different stages of COVID-19 pandemic in Singapore, it is

recommended that other countries should employ the same strategy tactfully as there are many factors that could influence the effectiveness of humor appeals, such as relevance and timeliness[59]. Hence, humor appeals need to be applied in good judgement to avoid unintended outcomes.

On the other hand, fear and guilt appeals were less frequently applied in communication messages during the COVID-19 pandemic in Singapore. This demonstrates the Singapore health institutions' careful use of negative emotion appeals in a tense pandemic situation where most people were confined at home during the "circuit breaker" period. Such negative appeals could lead to higher mental stress and compromise social cohesion if overused. This also explains why fear appeals were employed in the later phase of the pandemic (i.e., during the "Learning to Live with COVID-19" phase) when the situation was more relaxed, and most management measures had been eased. Hence, the public health authorities should consider the political and cultural landscape as well as the appropriate junctures when applying emotional appeals in their communication strategies in future.

Implications, limitations, and conclusion

Theoretically, this study contributes to the existing literature on both the CERC model and emotional appeals. Apart from exploring how CERC model and emotional appeals were applied in Singapore's public health communication, this study is one of the few examining the relationship between CERC stages and the use of emotional appeals, especially in the context of COVID-19. This study provides insight on how to employ a balanced mix of communication strategies for effective public health communications.

The practical implication of this study is two-fold. First, in the local context, the findings of this study could inform Singapore public health practitioners in developing more comprehensive messages during an emerging health crisis. Understanding how CERC message themes and emotional appeals were employed in the public communication strategies during the COVID-19 pandemic could help the relevant authorities identify their strengths and shortcomings. For example,

our finding on the lack of clarification messages is a pointer for public communication during the pandemic, especially during the widespread of misinformation about COVID-19 vaccination for children aged 5 to 11 in Singapore[60]. As such, the local health authorities can learn from our findings to be better equipped to formulate communication strategies in handling unpredictable and emerging health pandemics in the future.

Second, for other nations, especially those with high population density, the health authorities can emulate Singapore's communication strategies during the COVID-19 pandemic to structure their communication strategies during the health crisis. In particular, Singapore's "all-of-government" approach, which involves the collaboration of various government agencies in communicating key messages during crises, is a useful communication strategy. Drawing from Singapore's approach, other countries could chart their responses in stages during a crisis and structure timely public health messaging by incorporating the CERC message themes together with the appropriate emotional appeal. However, as this study considers the CERC message themes and phases, and emotional appeals, in the context of Singapore, the approach should be adapted with care given the differences in local governance and culture of each country as the messages may be received differently, thus affecting communication strategies. The "all-of-government" approach may also need to be tailored as a result.

This study has several limitations. First, this study did not collate Facebook posts and website articles from all the public health institutions and only focused on those that provided pressing information about COVID-19 that are applicable to all members of the public. We did not analyze content from government institutions with more targeted messaging, due to the large volume of content for analysis. We also did not analyze other media sources such as TV, radio, newspapers, online news, and other social media content beyond Facebook due to cross-posting of content. As this might not provide a complete picture of COVID-19 messaging in Singapore, future research could examine social media posts a wider range of government institutions. Second, website articles

without publication dates were excluded from the analyses for RQ1 and RQ2 as we were unable to categorize the data into any of the COVID-19 phases in Singapore. Third, we did not analyze social media responses (i.e., likes, shares, and comments) as such information was unavailable for website articles. Future research could examine social media responses for a greater understanding of CERC themes and emotional appeals in the context of COVID-19. Fourth, the findings of this study might not be generalizable to countries that are very different from Singapore due to the country's specific sociopolitical traits, such as its high population density and strong central government. Nonetheless, given its exemplary management of COVID-19, it is worthy of documenting its practice to offer useful insights into future pandemic management. While other countries can learn from Singapore's approach, there may be a need to tailor the communication strategies according to their characteristics.

Fifth, this study did not specifically focus on messages containing severity and susceptibility as neither theme was encompassed in the CERC model employed in this study. Given that severity and susceptibility are important aspects of risk perception, future research should examine these message themes in relation to the CERC model. In addition, the present study did not examine the extent to which messaging conveyed acute risks from COVID-19 (e.g., hospitalization and death) and chronic risks from COVID-19 (e.g., Post-acute sequelae of COVID-19 [PASC]). Further study can be conducted to delve into the differences as these may have impacted public willingness to engage in prevention and mitigation behaviours. Finally, while this study examined CERC themes and emotional appeals used across CERC phases, we did not dive into the interaction between CERC themes and emotional appeals. This is a possible area for future studies.

This study examined public health messaging during COVID-19 pandemic in Singapore. The public health authorities in Singapore have taken a strategic and systematic approach in public health communication coupled with the use of emotional appeal to encourage the public to engage in protective behaviours.

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Conflicts of Interest

There are no known conflicts of interest associated with this publication.

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Table 1

White paper stages.

CERC stages	White paper stage	Definition
Initial phase	Early Days of Fog: January 2020 – March 2020	- COVID-19 was first presented as a global health crisis as an unknown virus. - Singapore detected its first few cases (Prime Minister's Office, 2023) - The Singapore government uses the color coded Disease Outbreak Response System Condition (DORSCON) (MOH, 2013), to reflect the disease situation in Singapore. The DORSCON level was raised from green to yellow, and subsequently to orange. - This matches the initial phase of CERC, as the virus had already evolved into a crisis. In this period, uncertainty about the new disease was rife which is characteristic of the initial phase (Reynolds & Seeger, 2014).
Maintenance stage	Fighting a Pandemic: April 2020 – April 2021	- This phase begins with Singapore entering a "circuit breaker" phase on 7 April 2020, with increased safe distancing measures to reduce the spread of COVID-19 (Ministry of Health, 2020), as the situation continued to worsen. - Work from home was mandated, and dining in was prohibited. - Vaccinations were first made available for healthcare workers, then for seniors (PMO, 2023).

		- This corresponds to the maintenance stage proposed by CERC, as the COVID-19 situation in Singapore began to stabilize, with Singapore exiting Circuit Breaker and gradually relaxing other safe management restrictions.
Maintenance stage	Rocky Transition: May 2021 – November 2021	- Singapore learns to live with endemic COVID-19. - The newly discovered COVID-19 “Delta” variant caused a large increase in cases, supporting that the “Zero COVID” strategy would not be practical in Singapore. - There were multiple tightening and easing of measures during this period, in response to the fluctuating COVID-19 cases (PMO, 2023). - This also corresponds to the maintenance stage, as outlined by CERC.
Resolution stage	Learning to Live With COVID-19: December 2021 – Present	- This phase saw further relaxation of safe management measures. Other measures such as mask requirements and border measures were eased. - The DORSCON level was stepped down from Orange to Yellow (PMO, 2023). - There was a marked return to normality (CDC, 2018). - Hence, this stage corresponded with the resolution stage proposed in the CERC.

Table 2

Sample content given in codebook.

CERC message theme	Example

Risk and crisis information	
Pandemic intelligence	“Regular testing is key to early detection of possible COVID-19 infection. From 1 Oct 2021, we will publish on the MOH website a map of areas frequented recently by a larger number of confirmed COVID-19 cases. We hope this can help guide your movement and activities. We have also opened 8 Regional Screening Centres and 3 Quick Test Centres on Saturdays and Sundays, so that individuals with acute respiratory symptoms may get a free confirmatory PCR test.” [Example from data]
Self-efficacy and Sense-making	
Personal preventive measures and mitigation	“If you know a senior who needs support for their mental health and wellbeing, help is readily available. Amidst the COVID-19 pandemic in the past year or so, we have been working to provide those who need help, including our seniors, with access to mental health and wellness services while staying safe. Seniors who face mental distress, for example, if they feel lonely or anxious, can use tele-befriending and tele-counselling services, such as The Seniors Helpline (1800 555 5555). Seniors can also sign up with CareLine (to register, call 6340 7054), which is a 24/7 social

	support hotline providing tele-befriending services as well as emergency response to seniors in distress. Our Public Healthcare Institutions currently provide video consultation services for the management and follow up of mental health conditions in suitable patients, including seniors. Patients can tap on the Community Heath Assist Scheme (CHAS) subsidies and their MediSave for video consultations for mental health conditions such as anxiety and major depression, under the Chronic Disease Management Programme. Many seniors have utilised these services. We will continue to promote the use of digital and tele-solutions to enable individuals to access mental wellness services in a convenient and safe manner." [Example from data]
Social and/or common responsibility	"We all have a part to play in keeping our seniors safe. Here are some tips on how we can protect our seniors from being exposed to COVID- 19." Post is accompanied by infographics in this Facebook post. [Example from data]
Inquisitive messaging	"We understand that there have been some questions about the effectiveness of the COVID-19 vaccines in reducing the risk of serious illness. To address this, we introduced a new chart in our COVID-19 press release earlier this week. By calculating the 7-day moving average of critically ill cases and deaths per 100,000 population,

	we can see that the risks of non-fully vaccinated cases becoming seriously ill or dying is at least 8x higher than that of fully vaccinated cases. The risks are even higher for seniors 60 and above. The evidence is clear: Vaccination protects you. Please get your COVID- 19 vaccination and booster dose, and encourage others to do so too." [Example from data]
Preparations and uncertainty reduction	
Clarification	"The Ministry of Health (MOH) is aware of a video circulating on social media which contains misinformation regarding the COVID-19 vaccination exercise for children aged 5 to 11, including claims that the vaccine is experimental and unsafe for children, and that in the event of any severe adverse event (SAE) post-vaccination, it is "not the Government's problem." [Example from data]
Events, campaigns and activities	"Still have doubts about the COVID-19 vaccination? These seniors had their concerns too. Learn more about their vaccination journey. Get vaccinated. It reduces the risk of infection and protects seniors from serious illness. Seniors can walk in at any vaccination centre, polyclinics and selected GPs for vaccination today. #IGotMyShotSG" [Example from data]
Request for contributions	"We're always looking out for our passengers when on board the plane...This applies here as well, because we need to let the public know about the rules and regulations." – Leonard Wang,

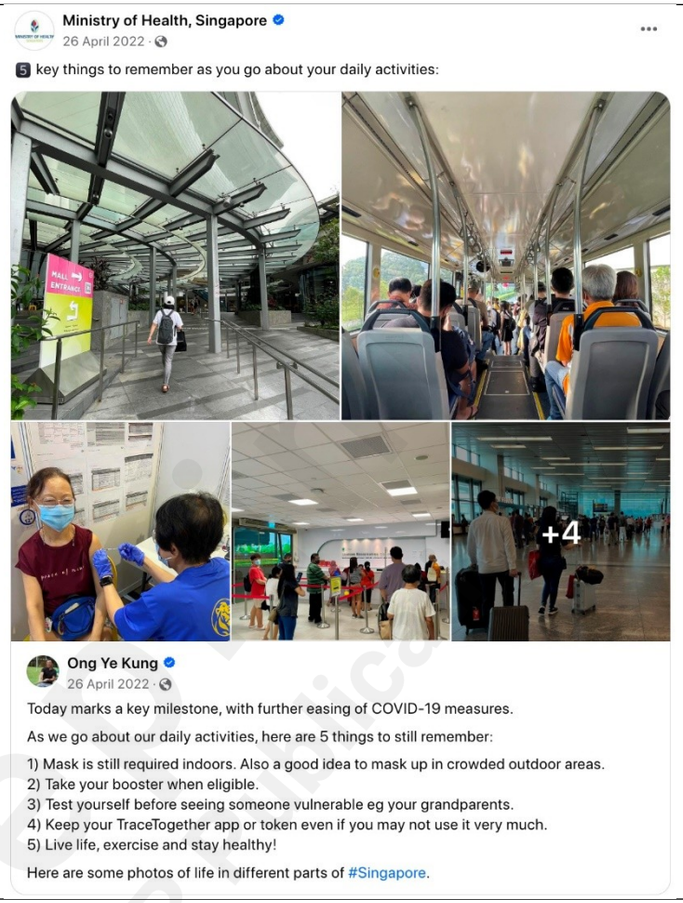
	Jetstar crew and SG Clean Ambassador To ensure that patrons comply with #SafeDistancing measures, Leonard, and his fellow ambassadors, make repeated rounds in public places, such as wet markets and hawker centres. Let's minimise the spread of COVID-19 by taking the #SafeDistancing measures seriously, and cooperating with our #SGCleanAmbassadors and #NEAOfficers. We welcome more volunteers and partners from the community to join the #SGCleanAmbassadors Network. If you're interested, sign up at http://go.gov.sg/sgcleanambassadors" [Example from data]
Showing gratitude	"A huge thank you to our healthcare family for providing our patients with the best care possible during this period. We salute you for your professionalism and steadfast commitment. We are heartened that many Singaporeans have rallied around our healthcare family to show them your support. Thank you for your acts of kindness and generosity!" [Example from data]
Reassurance	"With our stable COVID-19 situation, we are in good position to ease more measures and reopen more economic and social activities. Our four-stage transition roadmap towards becoming a COVID-19 resilient nation is possible with your cooperation." [Example from data]
Advisories and alerts	
Risk groups	"Together with the MSF Singapore, we will implement additional support measures for all homes serving the elderly to further reduce the risk of COVID-19 exposure for staff and residents. These homes serve highly vulnerable and frail seniors, who are at higher risk of

	developing serious health complications if infected with COVID-19. We will prioritise testing for residents and staff in all homes serving the elderly to ensure that any COVID-19 infections in the Homes are detected as early as possible for treatment, as well as to limit transmission. This new support measure complements existing measures on safe distancing and movement restrictions within the Homes, which had been put in place earlier." [Example from data]
General advisories and vigilance	"The Multi-Ministry Taskforce (MTF) had earlier announced a calibrated path for resumption of more economic and social activities under Phase 3 (Heightened Alert) from 12 July 2021 onwards. However, the new infection clusters that emerged in this past week have been a setback to the efforts of our people in the battle against COVID-19. We have to act quickly now to contain the spread of the virus in our community, but recognising that a good proportion of our population are now fully vaccinated. To mitigate further community spread, we will tighten community safe management measures for higher-risk indoor, mask-off settings with effect from 19 July 2021 through 8 August 2021 (both dates inclusive). - Dining-in at F&B establishments will be dialled back to groups of up to 2 persons from the current groups of up to 5 persons. Fully vaccinated individuals, those who have recovered from COVID-19 (within 270 days), unvaccinated persons with a valid negative pre-event testing

	result for the duration of his dining-in, or a child aged 12 years and below, will be eligible to dine-in in a group of up to five persons in an F&B establishment. - Group sizes will be limited to 2 persons for hawker centres, food courts and coffee shops as a default. - We will be reducing the group size for indoor high-intensity mask- off activities to no more than 2 persons, in classes of up to 30 persons including the instructor, without the need for testing or vaccination. - Work-from-home will continue to remain the default arrangement. Social and recreational gatherings at the workplace will be disallowed and work-related events should continue to not serve F&B at the event itself. Read more in the press release: https://www.moh.gov.sg/.../updates-on-phase-3-(heightened..." [Example from data]
Emotional appeals	
Fear appeals	"With our high vaccination and booster rates, some have asked if we still need Vaccination-Differentiated Safe Management Measures (VDS). We first implemented VDS to protect those who are unvaccinated, especially those who are ineligible for vaccination, to minimise their infection risk. This remains important today.

	I shared some key data yesterday in Parliament. Compared to vaccinated and booster adults, non-fully vaccinated adults infected with the Omicron variant – which supposedly is milder than Delta – are: • up to 18 times more likely to require ICU care; and • 38 times more likely to die from COVID-19 infection. During the recent Omicron wave, the 3% of adults who were partially vaccinated or unvaccinated contributed to 20% of our ICU cases, occupied two-thirds of our ICU beds, and made up about 30% of those who passed away. Vaccination remains key to keeping us safe." [Example from data]
Guilt appeals	"We've kept the number of community cases low - now's not the time for a self-inflicted blow. If you feel unwell with flu-like symptoms, go to a doctor and stay home afterwards. Do not go to work, do not go to school. Protect yourself and your loved ones Tips on keeping COVID-19 safe: https://www.gov.sg/features/how-tos" Read the Facebook post – one key phrase emphasizing guilt appeal is "whoever's around you may regret that day. [Example from data]
Anger appeals	"**Response to HTD's call to disrupt operations at paediatric vaccination centres** The Ministry of Health (MOH) is aware that a group called "Healing the Divide", founded by

	Ms Iris Koh, has exhorted parents through a message on their Telegram channel on 27 December 2021, to visit the paediatric vaccination centres to overwhelm on-site medical staff with questions. Such an act will greatly disrupt operations at our paediatric vaccination centres, and amounts to an instigation of harassment of the medical staff. It is a very serious matter, and MOH has therefore made a police report. We urge everyone to exercise social responsibility and not be misled by the promptings of the group, which has a history of sharing misleading information about COVID-19 and its vaccines. The Health Sciences Authority (HSA) and other regulatory authorities around the world have approved the Pfizer-BioNTech/Comirnaty COVID-19 vaccine for use in children aged 5 to 11, after comprehensive clinical trials. This is no different from how other drugs have been approved for use. Designated paediatric vaccination centres have been set up island-wide to administer safe vaccinations for children. Should you have questions about the COVID-19 paediatric vaccination exercise, please visit https://www.moe.gov.sg/faqs-covid-19-infection for more information." [Example from data]
Hope appeals	Read the Facebook post below. [Example from data]



Humor appeals	"Love unmatched is love unhatched. This is all thanks to Wozzie Mozzie – the *Wolbachia*-carrying male *Aedes* mosquitoes! A female *Aedes aegypti* mosquito can lay about 300 eggs in its lifetime. But when they

	mate with male *Wolbachia-Aedes* mosquitoes, all these resulting eggs do not hatch. Continuous releases of male *Wolbachia-Aedes* mosquitoes over time will lower the *Aedes* aegypti mosquito population and thus, reduce the risk of dengue Find out more about Project *Wolbachia* at go.gov.sg/wolbachia #ProjectWolbachias” *Note: Watch the video* https://www.facebook.com/watch/?v=1250420768746358
Nurturance appeals	“Multi-system inflammatory syndrome in children (MIS-C) is a serious complication of COVID-19 that can occur even when the COVID-19 infection is mild. Vaccination reduces the likelihood of COVID-19 infection and risk of severe complications, including MIS-C. Protect your child/ward by getting him/her vaccinated today. Simply walk in with your child/ward to any paediatric vaccination centre any day of the week, before 7pm. No prior appointment needed.” [Example from data]

Table 3
Distribution of posts by health organizations.

Organization	Number of posts
Gov.sg	394
Ministry of Health	261
Ministry of Sustainability and Environment	18
National Environmental Agency	90
Health Promotion Board	16
Total	779

Table 4

Distribution of CERC themes.

Themes	Number of posts	%
Risk and crisis information		
Pandemic intelligence	266	34.1
Self-efficacy and sense making		
Personal preventive measures and mitigation	522	67.0
Social and/or common responsibility	131	16.8
Inquisitive messaging	31	4.0
Preparations and uncertainty reduction		
Clarification	31	4.0
Events, campaigns, and activities	105	13.5
Request for contributions	5	0.6
Showing gratitude	54	6.9
Reassurance	31	4.0
Advisories and alerts		
Risk groups	118	15.1
General advisories and vigilance	445	57.1

Note: n = 799

Table 5

CERC themes across phases.

	Early Days of Fog (January 2020 – March 2020)		Fighting a Pandemic (April 2020 – Apil 2021)		Rocky Transition (May 2021 – November 2021)		Learning to Live with COVID-19 (December 2021 – Present)		Total		$\chi^2(3)$	*p*
	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)		
Risk and crisis information												
Pandemic intelligence	32 (28.3)	81 (71.7)	76 (27.3)	202 (72.7)	124 (43.4)	162 (56.6)	27 (34.6)	51 (65.4)	259 (34.3)	496 (65.7)	18.19	<.001
Self-efficacy and Sense-making												
Personal preventive measures and mitigation	62 (54.9)	51 (45.1)	161 (57.9)	117 (42.1)	217 (75.9)	69 (24.1)	58 (74.4)	20 (25.6)	498 (66.0)	257 (34)	29.18	<.001
Social and/or common responsibility	37 (32.7)	76 (67.3)	53 (19.1)	225 (80.9)	33 (11.5)	253 (88.5)	7 (9.0)	71 (91.0)	130 (17.2)	625 (82.78)	29.97	<.001
Inquisitive messaging	1 (0.9)	112 (99.1)	11 (4.0)	267 (96.0)	15 (5.2)	271 (94.8)	4 (5.1)	74 (94.9)	31 (4.1)	724 (95.9)	4.14	.25
Preparations and uncertainty reduction												
Clarification	7 (6.2)	106 (93.8)	4 (1.4)	274 (98.6)	15 (5.2)	271 (94.8)	4 (5.1)	74 (94.9)	30 (4.0)	725 (96.0)	7.63	.05
Events, campaigns, and activities	0 (0.0)	113 (100)	34 (12.2)	244 (87.8)	56 (19.6)	230 (80.4)	9 (11.5)	69 (88.5)	99 (13.11)	656 (86.9)	27.91	<.001

Request for contributions	1 (0.9)	112 (99.1)	4 (1.4)	274 (98.6)	0 (0)	286 (100)	0 (0)	78 (100)	5 (0.7)	750 (99.3)	5.06	.17
Showing gratitude	17 (15.0)	96 (85.0)	23 (8.3)	255 (91.7)	7 (2.4)	279 (97.6)	7 (9.0)	71 (91.0)	54 (7.2)	701 (92.8)	21.05	<.001
Reassurance	4 (3.5)	109 (96.5)	12 (4.3)	266 (95.7)	10 (3.5)	276 (96.5)	2 (2.6)	76 (97.4)	28 (3.7)	727 (96.3)	.62	.89
Advisories and alerts												
Risk groups	5 (4.4)	108 (95.6)	34 (12.2)	244 (87.8)	55 (19.2)	231 (80.8)	16 (20.5)	62 (79.5)	110 (14.6)	645 (85.4)	17.77	<.001
General advisories and vigilance	56 (46.9)	57 (50.4)	140 (50.4)	138 (49.6)	180 (62.9)	106 (37.1)	53 (67.9)	25 (32.1)	429 (56.8)	326 (43.2)	15.46	<.001

Note: n = 755. 24 website articles were excluded from the Chi-square tests as there were no publication dates.

Figure 1
CERC stages across phases.

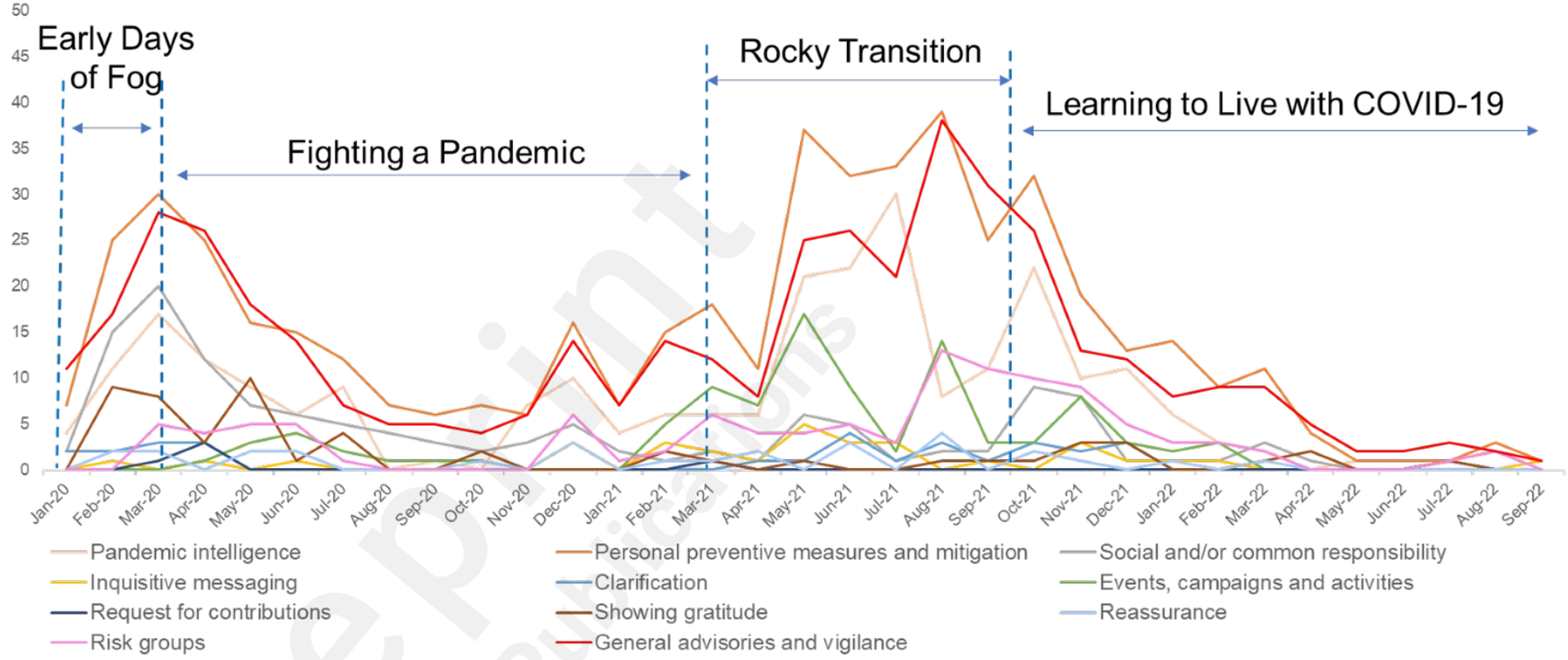


Table 6
Emotional appeals across COVID-19 phases.

	Early Days of Fog	Fighting a Pandemic	Rocky Transition	Learning to Live with COVID-19	Total	$\chi^2(3)$	*p*

	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)		
Fear appeals	0 (0)	113 (100)	0 (0)	278 (100)	0 (0)	286 (100)	2 (2.6)	76 (97.4)	2 (0.3)	753 (99.7)	17.41	<.001
Guilt appeals	0 (0)	113 (100)	1 (0.4)	277 (99.6)	0 (0)	286 (100)	0 (0)	78 (100)	1 (0.1)	754 (99.9)	1.72	.63
Anger appeals	0 (0)	113 (100)	2 (0.7)	276 (99.3)	0 (0)	286 (100)	2 (2.6)	76 (97.4)	4 (0.5)	751 (99.5)	8.44	.04
Hope appeals	4 (3.5)	109 (96.5)	16 (5.8)	262 (94.2)	11 (3.8)	275 (96.2)	6 (7.7)	72 (92.3)	37 (4.9)	718 (95.1)	2.87	.41
Humour appeals	7 (6.2)	106 (93.8)	20 (7.2)	258 (92.8)	7 (2.4)	279 (97.6)	2 (2.6)	76 (97.4)	36 (4.8)	719 (95.2)	8.34	.04
Nurturance appeals	0 (0)	113 (100)	1 (0.4)	277 (99.6)	5 (1.7)	281 (98.3)	10 (12.8)	68 (87.2)	16 (2.1)	739 (97.9)	49.85	<.001

Note: Total of posts with emotional appeals is n = 97. 24 website articles were excluded from the Chi-square tests as there were no publication dates.