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Analyzing Social Media Messaging on Masks and Vaccines: A Case Study on Misinformation During the COVID-19 Pandemic

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Abstract

Misinformation and disinformation during infectious disease outbreaks can hinder public health responses. This analysis examines comments about masks and COVID-19 vaccines on Twitter during the first six months of the COVID-19 pandemic. We conducted a content analysis of 6,600 randomly selected English-language tweets, examining tweets for health, political, of societal frames; inclusion of true information, false information, partially true/misleading information, and/or opinion; political components; risk frames; and use of specific types of rumor. We found false and partially false information in 22% of tweets in which we were able to assess veracity. Tweets with misinformation were more likely to mention vaccines, be political in nature, and promote risk elevating messages ($p<0.5$). We also found false information about vaccines as early as January 2020, nearly a year before COVID-19 vaccines became widely available. These findings highlight a need for new policies and strategies aimed to counter harmful and misleading messaging.

Keywords: Misinformation, COVID-19, Health Communication, Non-Pharmaceutical Interventions, Medical Countermeasures

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Introduction

Health-related misinformation and disinformation represent an increasingly urgent threat to public health practice.[1] The Centers for Disease Control and Prevention define misinformation as, "false information shared by people who do not intend to mislead others," and disinformation as, "false information deliberately created and disseminated with malicious intent."[2] Often, health-related misinformation and disinformation reduces trust in science and health authorities, limiting the reach and effectiveness of public health interventions.

The COVID-19 pandemic has increased attention on health-related misinformation. Researchers have explored the impact of new media channels on health misinformation, how COVID-19 has interacted with long-standing misinformation targets, including vaccines[3] and the challenges of countering misinformation in an environment flooded with information[4] The pandemic has also provided opportunities to employ different interventions in an attempt to mitigate the spread and impact of misinformation.[5] Findings from these efforts reinforce the challenge misinformation presents in an effective public health emergency response, and the importance of an early intervention when working to counter misinformation.

This manuscript focuses on the first six months of the pandemic, when individuals were still forming opinions and attitudes about the pandemic and the measures needed to stop it. During this time, many governments enacted novel non-pharmaceutical interventions (NPIs) to mitigate the spread of COVID-19, while the scientific community worked to develop medical countermeasures (MCMs) that could safely prevent and treat disease. As a result, masks – one particular type of NPI – and vaccines were frequent topics of interest.

We performed a content analysis of a sample of COVID-19-related tweets about masks and vaccines sent during the first six months of the COVID-19 pandemic. The first official notification about SARS-CoV-2 occurred on December 31, 2019, in Wuhan, China. Over the following six months, COVID-19 spread rapidly, causing over 6 million confirmed cases and 370,000 confirmed deaths.[6] Throughout this time, individuals used social media to seek and share early and emerging information about COVID-19 and potential interventions. Findings from this study can inform future public health preparedness and response activities by providing a clearer picture of the communication landscape during the early months of a large-scale health emergency.

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Methods

Study Design: We performed a content analysis of tweets referencing COVID-19 and masks or vaccines sent between January 1, 2020, and May 31, 2020.

Sample selection: We used the Twitter Application Programming Interface (API) to record a 1% sample of tweets that included the stem "COVID", "nCoV", or "corona." This search yielded 1,197,514 unique tweets referencing those stems. The majority of these tweets (92%) were sent between March and May 2020. We used the stems "mask*", "vaccin*", "immun*", and "shot" to further refine this pool of tweets into those referencing vaccines and masks. This search yielded 29,829 tweets, roughly 2.5% of the original sample. Of these tweets, the mask stem was seen in 12,415 tweets and the vaccine stems were seen in 17,414. From this sample we randomly selected 6,600 tweets (22%) to hand code for our data analysis. 1,610 tweets (24%) were excluded if content did not have a direct reference to COVID-19 vaccines or masks (e.g., tweets referencing non-COVID-19 vaccines or herd immunity without reference to COVID-19 vaccines), leaving a final set of 4,990 tweets for analysis. Researchers conferred on the exclusion of tweets when it was unclear if they met the criteria. Most tweets were reviewed on the Twitter website through an imbedded link; by following these links, we were able to determine if tweets had been suspended, deleted, or were otherwise unavailable. In these cases, a portion (140 characters) or all of tweet that had been saved from the Twitter API was viewed and coded.

Data Collection: Four members of the research team recorded basic descriptive information from each tweet (e.g., username, date sent, link availability) and coded for additional information using a set of dichotomous yes/no codes informed by current literature and previous content analyses.[1,7,8] The team (TS, ES, DH, MT) piloted the instrument prior to the coding process with a random sample of 240 tweets not included in the subsequent analysis. Kappa scores were used to measure interrater reliability for 625 tweets (9.5%) from the dataset coded by all researchers. All items included in this analysis showed adequate interrater reliability of greater than 0.79. Coders identified use of health, political, of societal frames; inclusion of true information, false information, partially true/misleading information, and/or opinion;[3] political components; risk frames;[9] use of specific types of rumor categories (i.e., scapegoating, false cures, misleading information about countermeasures or the disease, and conspiracies – including profiteering);[1,7] and topics specific to the COVID-19 pandemic, masks, and vaccines (see supplementary data).

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The authors individually coded the remaining tweets. Questions about codes were reviewed by at least one other member of the research team and typically two or more.

Data Analysis: We used descriptive statistics and Pearson's chi-square tests to assess differences between tweets with specific characteristics using Stata 15.1.

Results

Researchers were able to assess veracity in 56% of coded tweets, of which 78% shared true information, 11% shared partially true information, and 11% shared false information. The remaining 44% of tweets were considered jokes (5%), opinions without true or false information (17%), or were presented in a way where it was unclear whether the information provided was accurate (22%).

The first tweet sharing vaccine misinformation was shared on January 29, 2020, almost a full year before COVID-19 vaccines became widely available. When comparing tweets with misinformation to those presenting true information, tweets with misinformation were significantly more likely to mention vaccines (79.3% vs 49.6%, $p<0.001$), criticize public health (54.0% vs 2.2%, $p<0.001$), provoke discord (31.9% vs 0.7%, $p<0.001$), relate to politics (40.5% vs 26.5%, $p<0.001$), and contain risk elevating messages (74.8% vs 32.5%, $p<0.001$).

In total, 400 tweets (8%) mentioned rumors related to pre-identified rumor categories about scapegoating, false cures, misleading information about countermeasures or the disease, and conspiracies – including profiteering. Tweets with these rumor categories represented 69.4% of tweets that included misinformation in the sample. Rumors about the safety or efficacy of vaccines and masks were most prevalent, representing 44% of tweets with rumors.

We were able to use links to the original tweet online for 3,704 (74%) of the coded tweets. Of these, 493 (13.2%) had links that no longer connected directly to an existing tweet, generally due to account suspension, changes to user account preferences, or tweet deletion. The research team found that 211 (43%) of unavailable tweets were published by suspended accounts. When comparing unavailable tweets that were published by suspended accounts with those that were unavailable but not from suspended account, tweets from suspended accounts more often

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promoted discord (23.7% vs 12.6%, $p<0.05$), provided risk elevating messaging (59.2% vs 44.7%, $p<0.05$), were critical of public health (48.8% vs 27.0%, $p<0.05$), and shared misinformation (47.4% vs 27.3%, $p<0.05$) .

Discussion

Results show a mix of accurate and misleading information and highlight the need for new policies and strategies aimed to counter harmful messaging.

This analysis also reflects previous research on misinformation and disinformation in COVID-19 and other health emergencies,[1,] with similar themes and focal points, potentially highlighting common areas that public health communicators should be prepared to address. Tweets with political framing, especially those that were critical of political leadership, and tweets mentioning vaccines were significantly associated with misinformation. These findings underscore the use of high profile and topical health events as vehicles for other social, political, or monetary goals.

Identification of misleading information about potential future vaccines shortly after the disease emerged and long before candidate vaccines could even be tested highlights the need for anticipatory de-bunking and even pre-bunking efforts for expected vaccine misinformation.[10] Without active efforts to manage misleading information early, misleading information can fester and multiply with little information to counter it.

Additional analysis of suspended tweets shows that some progress has been made in removing false information from Twitter, however whether the speed and breadth of this effort is adequate is uncertain. Despite efforts to remove tweets with misinformation, large numbers of misleading tweets remained. Further efforts to control the spread of health-related misinformation and disinformation are needed.

This study is subject to several limitations. First, while the research team worked collaboratively to understand nuanced tweet language, some tweets were hard to interpret, may have required contextual information to understand, or may have been understood differently than users intended. The use of multiple coders to review items under question helped to reduce opportunities for this to occur. Additionally, the research team reviewed unique tweets and did not evaluate retweets due to the data collection approach. Furthermore, the sample was small

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compared to the volume of tweets circulating about COVID-19 and may not be representative of all tweets about COVID-19 during that time. Only English-language tweets were included, which may have led to bias in the sample. Additionally, Twitter is limited as a data source for public opinion about topics given its non-representative user base. Further, coding content as jokes may have been limited by coder interpretation and understanding of context. Lastly, while this research provides an initial investigation of these phenomena, additional research could better explore the framing of these issues through more nuance coding schemes.

This assessment of public communication about masks and vaccines during the first six months of the COVID-19 pandemic highlights the need for novel strategies to communicate in infodemics and in environments of misinformation and disinformation. Misleading information spreads early in a public health event, and efforts to control its spread are limited in reach and breadth. These results show a clear need for pre-bunking to address the challenges of health-related misinformation and disinformation. Lessons from the COVID-19 pandemic should inform public health communication strategy and policy efforts to address health-related misinformation and disinformation during future health emergencies.

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