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# Misinformation Dissemination in Twitter in the COVID-19 Era

Twitter offers a potentially novel investigation line to evaluate self-perception and awareness in the context of the public health response to the coronavirus disease (COVID-19) pandemic. Studies have shown that Twitter content may provide crucial insights into the ongoing public health crisis.<sup>1,2</sup> However, some studies suggest that Twitter may play an important role in propagating misinformation in previous epidemics such as the Zika, Ebola, and yellow fever virus outbreaks.<sup>3-5</sup> In the COVID-19 era, scientists and clinicians use Twitter to echo scientific evidence, especially toward an academic audience. However, in nonacademic contexts, the effect of Twitter in the COVID-19 era on public perception, whether beneficial or harmful, remains unknown. We hypothesize that there may be significant variation in signals of Twitter related to COVID-19 in nonacademic contexts.

We extracted all Tweets and hashtags related to COVID-19 using keywords (e.g., “covid,” “covid-19,” “corona,” “coronavirus,” “positive,” “test,” “tested,” “feel,” “I,” “we,” “my,” “us,” “our”) between April 1, 2020, and June 1, 2020 using Twitter’s application programming interface (API). Two investigators reviewed 25% of the extracted tweets to develop an initial conceptual framework. Then, three investigators reviewed an additional 25% of extracted tweets to refine an initial conceptual framework. Ultimately, we then identified the final coding framework with two investigators, and disagreements were resolved by discussion among the coauthors to establish a consensus. All analyses performed in this study relied on public, anonymized data and adhere to the terms and conditions, terms of use, and privacy policies of Twitter. Data mining was performed with R version 3.2.3 and subsequently with Python version 3.4.2.

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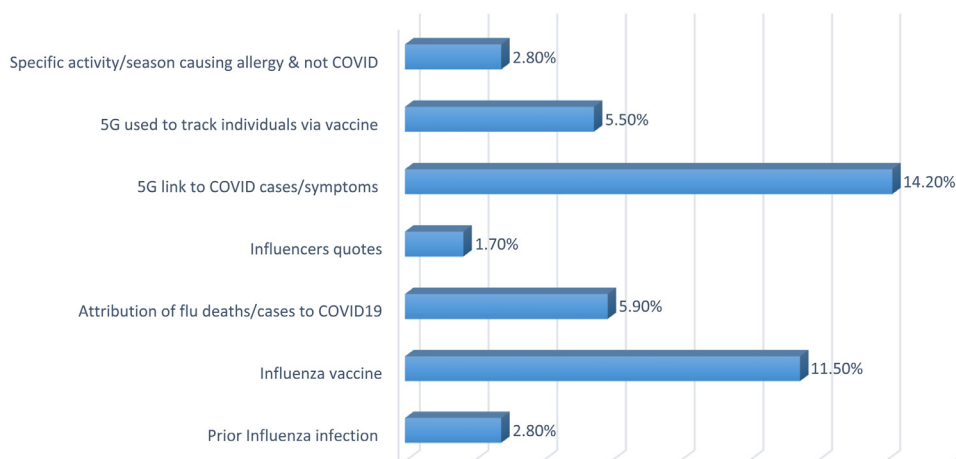
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After excluding tweets due to retweeting, subject irrelevance, and academic source tweets, we analyzed 13,596 nonacademic tweets associated with COVID-19. We identified seven important categories of individuals’ attributions of COVID-19: 1) influenza vaccine could lead to positive COVID test results (11.5%); 2) the attribution of influenza deaths or cases to COVID19 (5.9%); 3) prior influenza infections could cause a positive COVID test (2.8%); 4) influencers that quoted “Flu shot leads to positive COVID test” (1.7%); 5) 5G networks could be a link to COVID-19 cases or symptoms (14.2%); 6) 5G is used to track individuals with a vaccine (5.5%); and 7) specific activities or seasonal effects causing allergies, which is not COVID-19 infection (2.8%). The rest are nonspecific tweets (Figure),

To our knowledge, this is the first study using Twitter to identify individuals’ self-reporting of COVID-19 perceptions and attributions in nonacademic settings. Our results demonstrate that tweets related to the COVID-19 pandemic in nonacademic settings may be a valuable sources of public health research, especially related to misinformation dissemination. Interestingly, after manual review, we found that tweets related to the COVID-19 pandemic in nonacademic contexts primarily contain unverifiable information or blatant misinformation.

First, we found that several tweets contained misinformation regarding the relationship between influenza infection and COVID-19. There is no evidence suggesting that prior influenza infection may lead to a higher susceptibility of COVID-19 infection. However, it is possible that individuals with an influenza infection may be coinfecting with COVID-19 concomitantly. Some small studies and case reports demonstrate the possibility of coinfection of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and influenza A virus.<sup>6,7</sup> Additionally, a recent study does suggest higher rates of coinfection between SARS-CoV-2 and other respiratory pathogens.<sup>8</sup>

Secondly, we found that some individuals believe that having received the influenza vaccine can lead to a positive COVID test. Interestingly, a randomized controlled trial showed that children who received the trivalent inactivated influenza vaccine had an increased risk of infection from



**Figure** Percentage of Tweets related to patients' perception and attributed to COVID-19.

the coronaviruses sub-types NL63, HKU1, 229E, and OC43 (relative risk: 4.40; 95% confidence interval [CI]: 1.31–14.8).<sup>9</sup> Additionally, another study found that coronavirus infection rates in individuals who received the influenza vaccine were significantly higher than in unvaccinated individuals (odds ratio [OR] = 1.36; 95% CI 1.14, 1.63,  $P < 0.01$ ).<sup>10</sup> However, those results may be partially due to various confounding variables such as pharmaceutical company sponsoring, geographic variability, climate, or immune-related ethnicity. Notwithstanding, COVID-19 is an evolving disease, and there has been no robust clinical evidence linking the influenza vaccine and SARS-CoV-2 infection.

Third, misinformation regarding the possible mislabeling of influenza or allergy-related deaths or cases as a COVID-19 death or case is relatively common among non-academic tweets. There is some evidence that asthma, mainly poorly controlled asthma, may increase the risk of virus-induced asthma exacerbations. However, there is no substantial evidence to support the claim that patients with allergies, influenza, or asthma are at an increased risk for COVID-19 infection or infection-related death.<sup>11</sup> Most importantly, a recent single-center study in Wuhan, China, showed that a history of allergies might not be a risk factor for the SARS-CoV-2 infection.<sup>12</sup>

Last, we found two main categories of tweets related to the 5G COVID-19 conspiracy theory. The belief is that 5G networks and regional COVID-19 infections and outbreaks are in some way causally related. Similar to 3G and 4G networks, 5G wireless networks involve low-latency communications and essentially increase base station capacity and perceived quality of service.<sup>13</sup> One online article claimed that 5G in some way accelerates or triggers the new coronavirus infection by suppressing the immune system via the transmission of radio waves.<sup>14</sup> However, there is no evidence to support this claim. Additionally, this theory fails to explain as to why the SARS-CoV-2 virus is rapidly spreading in countries where no 5G networks exist.

This study has certain limitations. First, we could not identify the clinical characteristics of Twitter users, such as

educational status, socioeconomic status, occupation, cultural factors, or influencer level. Second, although we manually reviewed the data gathered, this research question's hypothesis might be subject to selection biases, leading to an overrepresentation of tweets containing misinformation rather than novel reports. Also, we intentionally excluded academic tweets, which may influence in nonacademic settings that we did not capture in this study.

Twitter may provide an essential resource for public health research and a virtual platform for sharing academic data and research in an ever-changing COVID-19 pandemic. However, the spread of misinformation and unverifiable information are significant limitations to the use of Twitter, especially in non-academic contexts and users.

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## References

1. Sinnenberg L, Buttenheim AM, Padrez K, Mancheno C, Ungar L, Merchant RM. Twitter as a tool for health research: a systematic review. *Am J Public Health*. 2017;107:e1–8.
2. Paul MJ, Dredze M. A model for mining public health topics from Twitter. Technical Report. Johns Hopkins University; 2011.
3. Miller M, Banerjee T, Muppalla R, Romine W, Sheth A. What are people tweeting about Zika? An exploratory study concerning its symptoms, treatment, transmission, and prevention. *JMIR Public Health Surveill*. 2017;3:e38.
4. Oyeyemi SO, Gabarron E, Wynn R. Ebola, Twitter, and misinformation: a dangerous combination? *BMJ*. 2014;349:g6178.
5. Ortiz-Martínez Y, Jiménez-Arcia LF. Yellow fever outbreaks and Twitter: rumors and misinformation. *Am J Infect Control*. 2017;45:816–7.
6. Khodamoradi Z, Moghadami M, Lotfi M. Co-infection of Coronavirus disease 2019 and influenza A: a report from Iran. *Arch Iran Med*. 2020;23:239–43.
7. Azekawa S, Namkoong H, Mitamura K, Kawaoka Y, Saito F. Co-infection with SARS-CoV-2 and influenza A virus. *IDCases*. 2020;20 [e00775-e00775].
8. Kim D, Quinn J, Pinsky B, Shah NH, Brown I. Rates of Co-infection between SARS-CoV-2 and other respiratory pathogens. *JAMA*. 2020;323:2085–6.
9. Cowling BJ, Fang VJ, Nishiura H, et al. Increased risk of non-influenza respiratory virus infections associated with receipt of inactivated influenza vaccine. *Clin Infect Dis*. 2012;54:1778–83.
10. Wolff GG. Influenza vaccination and respiratory virus interference among Department of Defense personnel during the 2017-2018 influenza season. *Vaccine*. 2020;38:350–4.
11. Jackson DJ, Busse WW, Bacharier LB, et al. Association of respiratory allergy, asthma, and expression of the SARS-CoV-2 receptor ACE2. *J Allergy Clin Immunol*. 2020;146:203–206.e3.
12. Zhang JJ, Dong X, Cao YY, et al. Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China. *Allergy*. 2020;75:1730–41.
13. Agiwal M, Roy A, Saxena N. Next generation 5G wireless networks: a comprehensive survey. *IEEE Communications Surveys & Tutorials*. 2016;18:1617–55.
14. Bateman S. Coronavirus: activists in bizarre claim 5G could be acting as 'accelerator' for disease. Available at: <https://www.dailystar.co.uk/news/weird-news/coronavirus-fears-5g-wifi-networks-21728189>. Accessed July 15, 2020.