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SHORT REPORT

Changes in legislator vaccine-engagement on Twitter before and after the arrival of the COVID-19 pandemic

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ABSTRACT

Widespread SARS-CoV-2 vaccine uptake will be critical to resolution of the COVID-19 pandemic. Politicians have the potential to impact vaccine sentiment and uptake through vaccine-related communication with the public. We used tweets (n = 6,201), abstracted from Quorum, a public affairs software platform, to examine changes in the frequency of vaccine-related communication by legislators on the social media platform, Twitter. We found an increase in vaccine-related tweets by legislators following the arrival of SARS-CoV-2 in the United States. In the pre-COVID-19 era the majority of vaccine-related tweets were generated by Democrat and state senators. The increase in tweets following the arrival of COVID-19, however, was greater among Republican and federal legislators than Democrat or state legislators. This suggests that legislators who were previously less engaged in public discussion of vaccination, became engaged following the arrival of SARS-CoV-2, which may have implications for COVID-19 vaccine uptake among their followers.

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The COVID-19 pandemic has resulted in around 30 million cases of infection and over 500,000 deaths in the United States.[1] Given the continued spread of COVID-19 and lack of available treatments, a widespread vaccination campaign will be a core component of an effective virus response. This may be challenging given that, as of September 2020, polling suggests that half of Americans would "definitely" or "probably" decline a SARS-CoV-2 vaccine.[2] As a result, increasing public awareness of, and confidence in, a SARS-CoV-2 vaccine will be an important prerequisite for an effective vaccination campaign.

Communication from public figures on health-related topics has been shown to increase engagement with, and uptake of, preventative health activities. For example, among fans that closely identify with Magic Johnson, his public announcement of his HIV diagnosis was associated with increased concern about HIV and intention to reduce high-risk sex behaviors.[3] Similarly, Katie Couric's television campaign to increase awareness about colorectal cancer was associated with higher rates of colonoscopy screening.[4] Additional research has found similar effects on mammography rates, cervical cancer screening, and intent to engage in COVID-19 preventative behavior in response to communication from public figures.[5–7]

Politicians represent a unique, and perhaps especially important, subgroup of public figures because they both communicate directly with the public and implement health-related policies.[8] Experimental research has found that parental willingness to vaccinate their children can be increased by watching short video clips of political figures discussing vaccination.[8] The net impact of these messages on willingness to vaccinate was independent of whether the videos endorsed vaccination or raised concerns about vaccine safety. Increases in legislator discussion of vaccination on social media, the most direct way that politicians engage the public, may thus increase engagement with the topic of vaccination among their followers.[9]

Previous studies have utilized social media data to describe COVID-19 discourse, for example using Twitter data to characterize SARS-CoV-2-related topics discussed by medical professionals online.[10] No studies, however, have examined politician social media posts about the pandemic, let alone whether the arrival of SARS-CoV-2 has changed legislator engagement in public discussion of vaccination on social media. The present study will characterize the degree to which legislators discussed vaccination on Twitter in the months leading up to, and following the arrival of, SARS-CoV-2 in the United States. We further sought to describe whether any shifts in vaccine engagement during the study period were driven by members of a particular political party or by federal versus state legislators.

This was a longitudinal analysis of US legislators' public social media activity before and during the SARS-CoV-2 pandemic. We used Quorum (www.quorum.us) to compile vaccine-related tweets produced by state or federal legislators between July 1, 2019 and June 30, 2020. Quorum is a public affairs software platform that stores policy-related documents including tweets produced by politicians. We defined tweets as

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vaccine-related if they contained any of the following terms in the body of the tweet or retweet: "vaccine", "vaccination", "immunization", "vax(x)", "antivax(x)", "anti-vax(x)", "antivax(x)er", "anti-vax(x)er", "vax(x)ine", "in(n)oculate", "in(n)oculation". This term list was generated based on a review of search terms included in existing literature about vaccine sentiment on Twitter.[11–13] All tweets generated by this search (n = 9,767) were manually reviewed and tweets that were unrelated to human vaccination were removed. The resulting dataset contained 6,201 vaccine-related tweets generated by 1,189 unique state and federal legislators. This study was exempted from Institutional Review Board approval due to the public availability of the data on Twitter and elsewhere.

We defined legislators as vaccine-engaged for a given month if they posted one or more tweets about vaccination during that time interval. Only legislators that posted at least one vaccine-related tweet during the study period were included in the dataset (supplemental Table 1 for the total number of Twitter-active legislators). We also generated similar variables to capture whether legislators were vaccine-engaged during the pre-COVID-19 and COVID-19 eras of our dataset. The arrival of COVID-19 in the United States was defined as February 1, 2020 based on a number of key events that occurred on or around that date including the World Health Organization's issuance of a Global Health Emergency (January 31, 2020) and the United States' declaration of a public health emergency (January 31, 2020) and restriction of global air travel (February 2, 2020).[14]

In order to account for changes in overall Twitter activity over time, we abstracted data about each legislator's total twitter activity per month. These data were used to calculate the percent of each legislator's total tweets that mentioned vaccination each month. To account for changes in the number of Twitter-active legislators over time, we calculated the percentage of all Twitter-active legislators that were vaccine-engaged per month. Information on legislator political party and status as a federal or state legislator (hereafter referred to as legislator level) was abstracted from Quorum. We defined tweets as COVID-related if they contained any of the following terms: "coronavirus", "corona virus", "SARS(-)CoV(-)2", "China virus", "Wuhan virus", "Chinese virus", "2019ncov", "kung flu", "COVID(_)19", "COVID-19", "COVID", and "corona".

We used summary statistics to describe 1) the number of vaccine-related posts per week, 2) the percent of total tweets that were vaccine-related per month, and 3) the percent of total Twitter-active legislators that were vaccine-engaged per month. We also used summary statistics to describe these trends across political party and legislator level (i.e., federal or state). We used chi square tests to examine the association between vaccine-engagement and characteristics of legislators (political party and legislator level).

Our search criteria resulted in 6,201 vaccine-related tweets that met inclusion criteria. These tweets were generated by 1,189 unique state and federal legislators. The majority of the tweets (74.7%, n = 4,633) were generated by Democrats. Republicans were responsible for 24.3% (n = 1,505) of vaccine-related tweets and all other legislators were responsible for 1.0% of tweets (n = 63). State legislators were responsible for 70.6% (n = 4,376) of tweets and federal legislators were responsible for 29.4% (n = 1,825). Most tweets (62.6%, n = 3,882) were generated in the COVID-19 era. Of the vaccine-related tweets generated after the arrival of COVID-19, 50.9% (n = 1,976) also mentioned a COVID-related term in the body of the tweet. See Table 1 for tweet frequency in the pre-COVID-19 versus COVID-19 eras by political party and legislator level.

When we examined combinations of legislator level and political party we found that vaccine-related tweets in the pre-COVID-19 era were most likely to be generated by Democratic state legislators (77.2%, n = 1,789) and least likely to be generated by Republican federal legislators (2.5%, n = 58, excluding independent legislators). In the COVID-19 era, the difference between the Democratic state and Republican federal legislators was smaller; Democratic state legislators produced 43.2% of vaccine-related tweets and Republican federal legislators produced 14.7% of vaccine-related tweets (Table 1).

The number of vaccine-related tweets increased briefly in August 2019 during National Immunization Month and following the assault of Richard Pan, a California State Senator, by an anti-vaccine activist. Tweets increased again starting in February 2020 and peaked in March 2020 (Figure 1). When we examined the percent of each legislator's tweets that were vaccine-related each month, similar trends emerged (Figure 2). We found that Republicans devoted fewer of their tweets to vaccination pre-COVID-19 but increased their vaccine-related tweeting to a greater relative extent than did Democrats after the arrival of COVID-19 (Figure 2a). Similarly, federal officials tweeted about vaccination at lower rates than state officials prior to the pandemic but increased their percentage of tweets devoted to vaccination to a greater relative extent than did state senators (Figure 2b).

When legislator engagement was examined over the study period, we found a similar increase in vaccine-engagement following the arrival of COVID. The percent of Twitter-active legislators that were vaccine-engaged per month (i.e., tweeted one or more times about vaccination during a given month) increased beginning in February with a peak in March at 13.4% (Figure 3). When these trends were examined by subgroup, we found lower pre-COVID-19 engagement among Republicans than Democrats (Figure 3a). Chi-square tests revealed that 73.6% of Republicans versus 55.4% of Democrats in the sample went from non-vaccine-engaged pre-COVID-19 to vaccine-

Table 1. Frequency of tweets in the pre-COVID-19 era and COVID-19 era by political party and legislator level.

	Total *Number (% of total)* n = 6,201	Pre-COVID-19 era *Number (% of pre-COVID)* n = 2,319	COVID-19 era *Number (% of post-COVID)* n = 3,882
Political party			
Democrat	4,633 (74.7%)	2,016 (86.9%)	2,617 (67.4%)
Republican	1,505 (24.3%)	293 (12.6%)	1,212 (31.2%)
Other	63 (1.0%)	10 (.4%)	53 (1.4%)
Legislator level			
State	4,376 (70.6%)	2,034 (87.7%)	2,342 (60.3%)
Federal	1,825 (29.4%)	285 (12.3%)	1,540 (39.7%)
Party and legislator level			
Democrat, state	3,466 (55.9%)	1,789 (77.2%)	1,677 (43.2%)
Republican, state	875 (14.1%)	235 (10.1%)	640 (16.5%)
Other, state	35 (.6%)	10 (.4%)	25 (.6%)
Democrat, federal	1,167 (18.8%)	227 (9.8%)	940 (24.2%)
Republican, federal	630 (10.2%)	58 (2.5%)	572 (14.7%)
Other, federal	28 (.5%)	0 (0%)	28 (.7%)

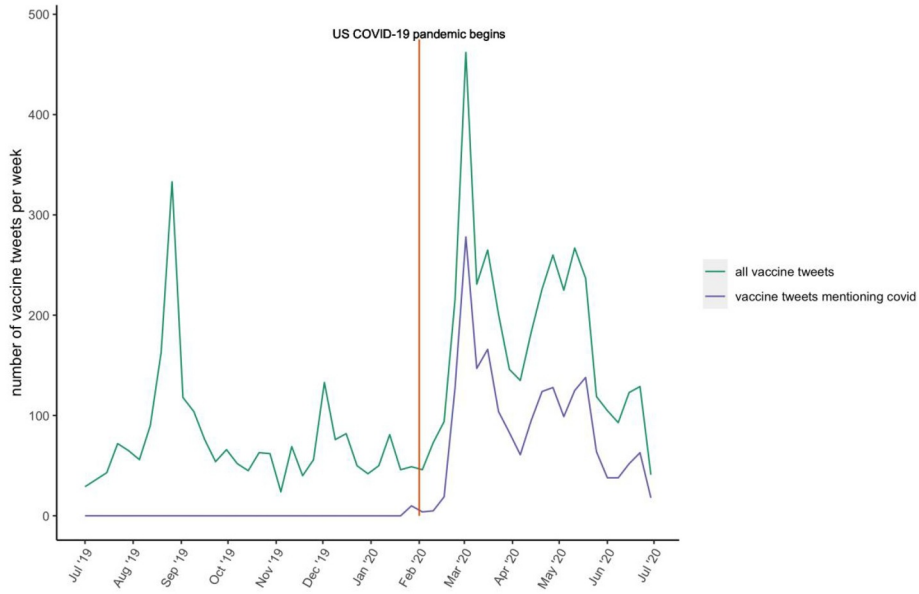

Figure 1. Vaccine-related tweets per week overall and that mention a COVID-related term. *The beginning of the COVID-19 pandemic in the United States was defined as February 1, 2020 based on a number of key events that occurred on or around that date including the World Health Organization's issuance of a Global Health Emergency (January 31, 2020) and the United States' declaration of a public health emergency (January 31, 2020) and restriction of global air travel (February 2, 2020).[14]

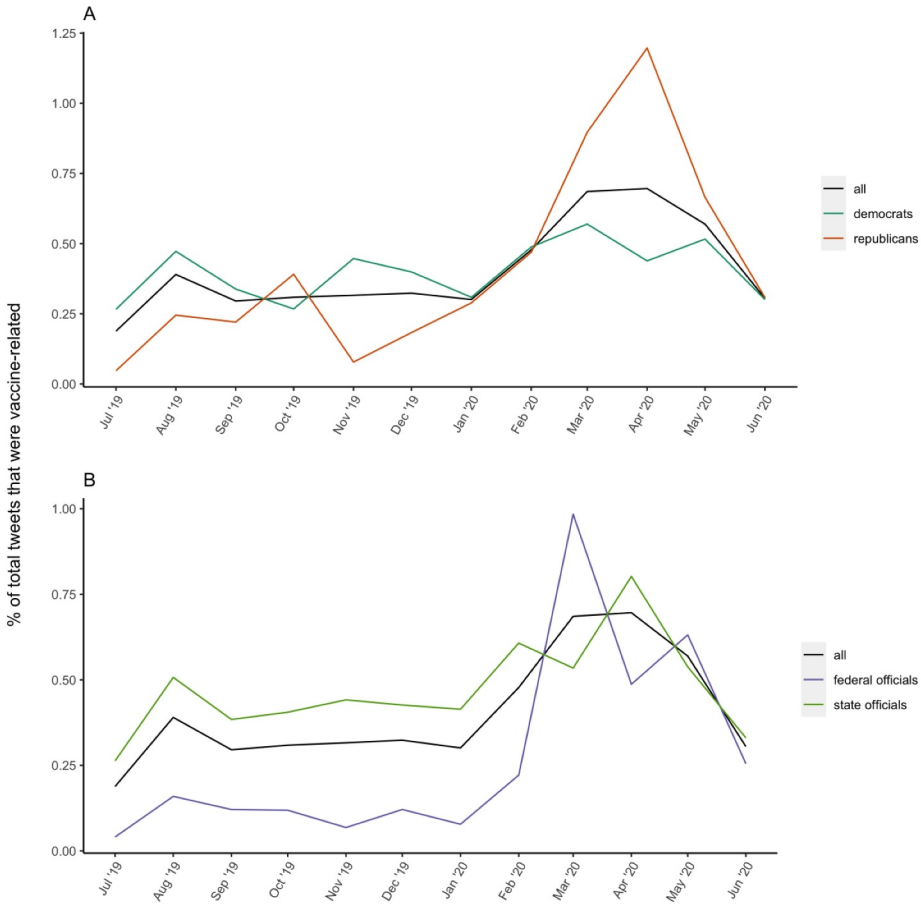

Figure 2. Vaccine-related tweet percentage per month by political party and legislator level.

engaged following the arrival of COVID-19 ($p < .001$). We also found a larger increase in legislator engagement among federal than state legislators (Figure 3b). Federal legislators (70.0%) were more likely than state legislators (57.4%) to go from non-vaccine-engaged to vaccine-engaged after the arrival of COVID-19 ($p < .001$). Conversely, only 2.3% of federal

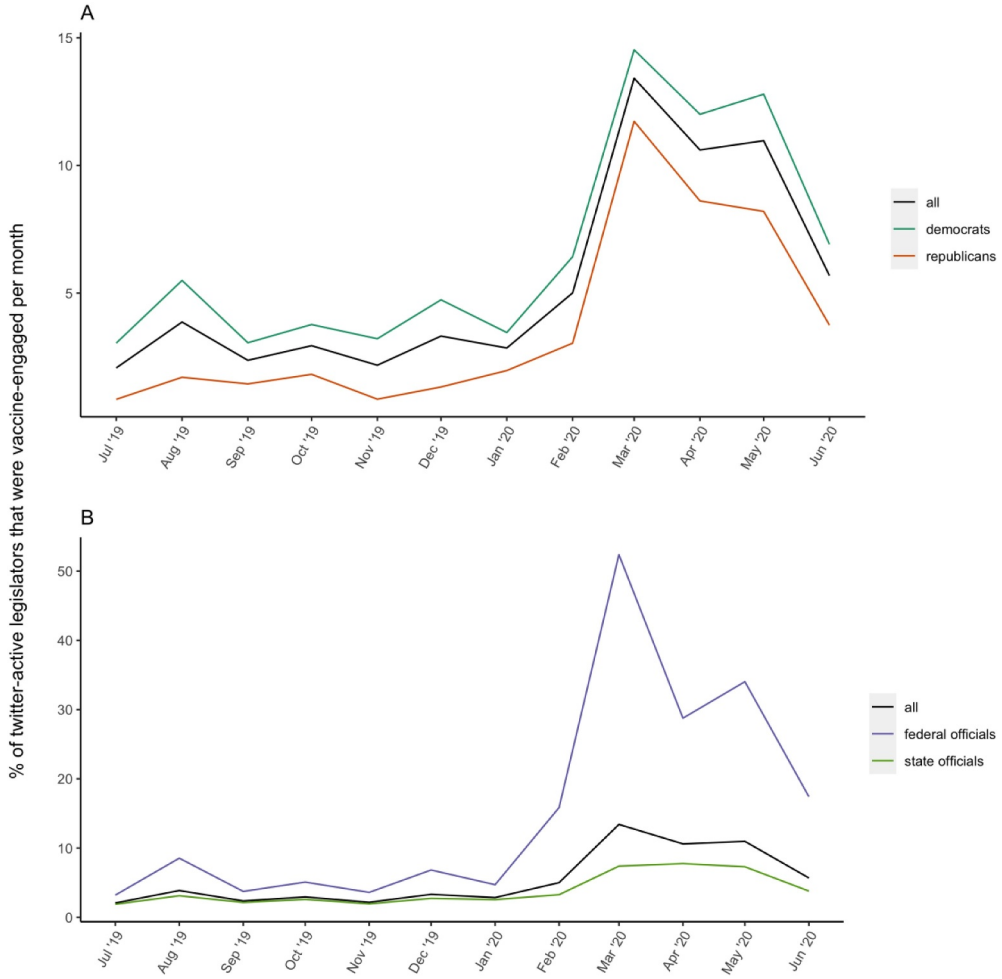

Figure 3. Percent of Twitter-active legislators that were vaccine-engaged per month by political party and legislator level.

legislators versus 18.9% of state legislators went from engaged pre-COVID-19 to non-engaged during the COVID-19 era.

The arrival of SARS-CoV-2 in the United States was associated with an increase in vaccine-related Twitter communication from state and federal legislators. When these differences were examined across subgroups, we found that the largest increases in vaccine engagement were among Republican legislators and federal legislators. This is, to our knowledge, the first study to examine legislator social media activity related to vaccination following the arrival of COVID-19.

Given that the majority of COVID-era tweets also contained a COVID-related word, the arrival of the SARS-CoV-2 pandemic likely contributed to the increase in Twitter activity about vaccination seen in the spring of 2020. Previous studies have shown that vaccine discussion by political figures can increase willingness to vaccinate, so it is possible that the increase in Twitter activity seen in this study will lead to increased public acceptance about and uptake of vaccination.[8] Alternatively, it may be that the increase in vaccine-related tweets was the result of increasingly politicized and polarized discussion of vaccination. Politicization of vaccine discourse has been associated with increased public skepticism, which could result in decreased uptake of the SARS-CoV-2 vaccine.[15,16]

Our findings suggest that the arrival of COVID-19 was associated with a shift in vaccination from being a primarily local issue of concern to Democrats, to a more bipartisan (although still primarily Democratic) issue of interest to federal legislators. These findings may mean that new segments of the public were exposed to vaccination discussion from public figures. For example, the expansion of vaccination discussion to include Republican legislators, who are more likely to be followed by fellow Republicans, may have introduced a new cohort of Republican social media consumers to vaccine-related content.[17] Similarly, the particularly large increase in vaccine-engagement among federal legislators, who may have larger Twitter followings than state legislators, may have exposed Twitter users to new vaccine-related content.

Republican legislators increased their vaccine-engagement to a greater degree than Democrats after the arrival of the COVID-19 pandemic. This may have occurred because the development of a SARS-CoV-2 vaccine during the Trump administration would reflect a Republican political victory and one that President Trump has repeatedly promised to the public.[18,19] Alternatively, the increase may have been driven by greater anti-vaccination sentiment among Republican than Democratic lawmakers, as political conservatism has historically been associated with vaccine hesitancy.[20] This is less likely, however, given that on cursory manual review of the dataset, the majority of Tweets were found to be either neutral or vaccine-endorsing. We also found larger increases in vaccine-engagement among federal than state

legislators. One explanation for this finding is that, prior to COVID-19, vaccination was often discussed as it related to local outbreaks of infectious disease or local vaccine-related policies. The arrival of a global pandemic that affected all regions of the country and necessitated federal intervention may have shifted vaccination from an issue of local importance to an issue of national importance.

A limitation of this study is that, while we completed a cursory manual review of included tweets, we did not formally code tweet content or sentiment in the present analyses. While discussion of vaccination on Twitter may increase awareness about vaccination among the general public, the content of tweets is also important in impacting public sentiment. In subsequent projects we plan to examine changes in tweet valence, tweet content, and politicization of vaccine-related tweets produced by legislators prior to and during the COVID-19 era. Another limitation of this study is that it is possible that other non-COVID infectious diseases (for example the Measles outbreak that occurred in 2019) contributed to the patterns observed in our data. Lastly, it is unclear whether the increase in vaccine-related tweets seen here will be durable. Follow-up studies are needed to characterize the longevity of these changes in legislator vaccine-engagement.

Declaration of potential conflicts of interest

The authors have no relevant financial or non-financial competing interests to report.

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