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Research Article

Evaluation of Covid-19 Vaccine Sentiment on TikTok from 2020 to 2022

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Abstract

Purpose: The unprecedented spread of misinformation during the COVID-19 pandemic was largely driven by social media platforms. Public understanding of masking, viral transmission, treatment options for COVID, and vaccination were distorted by the influence of social media platforms. The pandemic saw a rise of TikTok, another social media platform, whose role in the dissemination of misinformation has been far less studied. The relatively new social medial platform boasts millions of monthly U.S. users, with a large portion of those users being impressionable children, teens, and young adults. Given its popularity, its role in the spread of misinformation is likely substantial. The purpose of this study is to assess the quantity of COVID misinformation on TikTok in the period of 2020 to 2022, looking specifically at the number of anti- and pro-vaccine videos appearing on the platform. By assessing the impact severity of the anti-vaccine content on TikTok, this study will be able to inform future public health efforts of these effects, with the goal of curtailing the spread of medical misinformation.

Methods: Videos were collected from the app by the research team retrospectively using four sets of search terms that appear frequently in pro and anti-vaccine related content. Researchers judged the videos as anti- or pro-vaccine while recording metrics on the videos such as likes and bookmarks. A total of 284 videos were selected for analysis. Comparisons were made between likes and the other metrics using p-values for significance.

Results: 109 anti- and 175 pro-vaccine videos were identified. A larger share of the data set was pro vaccine. There was no significant difference between the number of likes between anti- and pro-vaccine content.

Conclusion: This study took a novel approach to TikTok by examining videos using multiple search terms over the course of a three-year period. The lack of statistical significance in number of likes between anti- and pro-vaccine content, despite there being more pro-vaccine videos is indicative of pervasive misinformation is on TikTok. Ambivalence over medical facts is not reassuring for any public health effort. Our analysis found a larger share of misinformation than previous studies, providing further evidence that a supra-dominant positive narrative on social media platforms is difficult to achieve, even though this is critical for health care initiatives.

***Keywords:** COVID-19, Social Media, TikTok, Vaccine, Misinformation*

Introduction

SARS CoV-2 (severe acute respiratory syndrome coronavirus 2), the cause of COVID-19 (Coronavirus disease 2019), caused a worldwide pandemic with significant mortality and morbidity consequences. [1] The rapid spread of this novel disease prompted the World Health Organization (WHO) to declare a pandemic, and “stay at home” orders were seen around the world in attempts to decrease spread until there were treatments and prevention methods such as vaccination.[2,3]

This pandemic novel disease was accompanied by intense public desire for more information. This desire for knowledge combined with potential exposure to false or misleading information led to an "infodemic", which the WHO defines as "too much information, including false or misleading information" during a disease outbreak.[4] This false, biased, or misleading information is often referred to as misinformation.[5] One of the classic examples of misinformation was the study linking the MMR (measles mumps rubella) vaccine to autism. Even though the study has since been retracted, the effects of widespread vaccine hesitancy are still being felt today.[5,6] In this way, information overload and misinformation can prompt individuals to distrust health authorities further prolonging and worsening disease outbreaks by reducing the effectiveness of a public health response.[4]

Public health officials must initiate information campaigns in addition to understanding other sources of information that the public is exposed to. While many other researchers have studied Facebook, YouTube, Instagram, and Twitter, there is less available research on TikTok, a relatively new social media video sharing app.[7–11]

As of January 2023, TikTok has more than 1 billion active monthly users, with more than 130 million of those located within the United States.[12,13] Within the U.S., one third of TikTok users report regularly getting their news through the app. Roughly 67% of all teenagers use TikTok.[14,15] Although exact metrics on TikTok demographics are neither easily accessible nor completely verifiable, Influencer Marketing Hub reports that 32.5% of TikTok users are 10 to 19 years old.[16] These facts indicate that TikTok disproportionately affects the pediatric population. Adolescents are a vulnerable population at risk of believing misinformation so it is important from a public health perspective to understand the general sentiment of information disseminated on social media.

Efforts to inform the public on COVID-19 vaccination can utilize traditional mass media such as newsprint, television, and their internet counterpart extensions. Social media is now recognized as a significant source of information; so much so that many social media users do not watch television or read a newspaper. This applies mostly to children, adolescents, and young adults. Any public information campaign that fails to use all elements of information dissemination is missing substantial portions of the population. Within the social media world, there are the established platforms such as Facebook, YouTube, X (formerly known as Twitter), and Instagram, plus the emerging (and potentially booming) platforms such as TikTok that cater to children, teens, and young adults.[16] The vaccination rate for teens and young adults is low compared to that of older adults.[17] The purpose of this study is to assess the quantity of anti and pro COVID-19 vaccination information on TikTok.

Methods

Videos were collected retrospectively to examine the changes in COVID-19 vaccine sentiment over the course of January 2020 thru August 2022. The methodology in this study differs from similar studies due to the goal of sampling videos retrospectively from three different years. The TikTok app does not allow searching for videos from a specific time frame, such as videos posted only in the year 2020. Searches were performed, videos were identified in aggregate (from all three years), and then sorted into their respective years 2020, 2021, and 2022 for further analysis.

Within TikTok, users can find videos from the people that they follow, videos that are recommended by the TikTok algorithm, or they can search for content using hashtags.[18] In TikTok, hashtags are used by users to find related content on the app and by video creators to get more engagement with the content they produce. Video creators making a video about getting a vaccine might add hashtags to the descriptions of their videos such as #vaccine or #covid. Hashtags were the means by which videos were identified and viewed using the TikTok app in this study. Searching four sets of multi or single word search terms allowed videos with hashtags that related to these search terms to be viewed. These search terms were chosen based on the word cloud terms published by Southwick, et al., that documented hashtags that appeared most frequently in the descriptions for covid related videos.[19] We performed a preliminary trial of hashtags to assess the volume of videos. For example, some of the largest words in the Southwick word cloud resulted in very few videos. We then settled on 4 hashtags to perform the final video survey.

Under the sort by setting, "most liked" was selected, and for the date posted setting, "all time" was selected. Use of "all time" for date posted allowed videos from the desired time frame as opposed to only the most recent content to be found. Use of "most liked" allowed us to find videos that were seen by the most people. Exposure is likely proportional to influence and engagement resulting from the videos.

We finalized four hashtags which were: 1) Coronavirus vaccinated funny, 2) Facts vaccine coronavirus, 3) Pandemic vaccine health, 4) Unvaccinated. Our goal was to view 100 consecutive videos from each hashtag; however, some videos in the sequence were unrelated or had such a small number of likes (in the tens or hundreds) that inclusion in the study would not be significant. As a result, there were less than 100 videos for the pandemic vaccine health hashtag. In total, 342 videos were viewed and coded by two study investigators.

From the original 342 videos, 58 of the videos were removed due to being unrelated to COVID-19 vaccines. The remaining 284 TikTok videos were coded as either anti or pro-vaccine. Anti-vaccine was defined as any video that mocked vaccination, criticized the nature of COVID-19 vaccines, provided misinformation, or contained any material that would discourage people from getting a COVID vaccine. Pro-vaccine was defined as any video that contained material that would encourage people to get a COVID-19 vaccine, helped to dissuade people of vaccine misinformation, or promoted vaccine information. For each video, the date of video publication, number of likes, comments, and bookmarks were recorded. The total number of views or video viewings is not an available metric.

Results

The results of this study are summarized in Table 1, which tabulates the four different search terms "coronavirus vaccinated funny", "facts vaccine coronavirus ", "pandemic vaccine health", and "unvaccinated"; and within each of these search terms, the number of videos, the mean "likes" (a viewer has indicated that they "like" this video) per video, the total aggregate "likes", the mean number of comments per video, the total aggregate number of comments, the mean bookmarks per video, and the total aggregate bookmarks were calculated. Likes, comments, and bookmarks are markers of additional interest in a particular video by liking it, commenting on it, or bookmarking it. Within these rows, these numbers are stratified by the year of the video (2020, 2021, or 2022) and within each year, each video was classified as anti or pro-vaccine.

Table 1: Summary of COVID-19 vaccine TikToks for 2020 to 2022.

	2020			2021			2022			All Years		
	Anti	Pro	p-value	Anti	Pro	p-value	Anti	Pro	p-value	Anti	Pro	p-value
Coronavirus vaccinated funny												
number of videos	13	5		28	27		5	3		46	35	
mean likes	64,055	87,120	NS	37,474	83,511	NS	21,860	76,021	<0.001	43,289	83,385	NS
aggregate likes	832,719	435,600		1,049,263	2,254,804		109,302	228,064		1,991,284	2,918,468	
mean comments	1,002	1,218	NS	578	1,113	NS	512	1,353	<0.001	691	1,148	NS
aggregate comments	13,024	6,090		16,180	30,047		2,562	4,059		31,766	40,196	
mean bookmarks	2,856	1,374	NS	775	1,653	NS	698	1,675	<0.001	1,355	1,615	NS
aggregate bookmarks	37,132	6,868		21,706	44,628		3,489	5,026		62,327	56,522	
Facts vaccine coronavirus												
number of videos	0	1		5	68		0	18		5	87	
mean likes		13,600		7,194	18,191	<0.05		11,412		7,194	16,736	0.04
aggregate likes		13,600		35,969	1,236,996			205,415		35,969	1,456,011	
mean comments		761		352	957	0.006		933		352	950	0.005
aggregate comments		761		1,760	65,105			16,794		1,760	82,660	
mean bookmarks		301		215	521	NS		183		215	449	NS
aggregate bookmarks		301		1,076	35,441			3,287		1,076	39,029	
Pandemic vaccine health												
number of videos	0	3		3	23		1	5		4	31	
mean likes		12,079		16,089	8,932	NS	4,168	46,503		13,109	15,296	NS
aggregate likes		36,236		48,268	205,433		4,168	232,517		52,436	474,186	
mean comments		349		199	330	NS	897	809		374	409	NS
aggregate comments		1,047		598	7,582		897	4,045		1,495	12,674	
mean bookmarks		300		191	116	NS	136	1,905		178	422	NS
aggregate bookmarks		900		574	2,668		136	9,523		710	13,091	
Unvaccinated												
number of videos	0	0		37	19		17	3		54	22	
mean likes				90,446	158,753	NS	74,435	101,067	NS	85,406	150,886	0.03
aggregate likes				3,346,500	3,016,300		1,265,400	303,200		4,611,900	3,319,500	
mean comments				4,432	13,045	NS	2,744	3,542	NS	3,900	11,749	NS
aggregate comments				163,975	247,851		46,645	10,627		210,620	258,478	
mean bookmarks				1,250	2,844	NS	1,938	1,554	NS	1,466	2,668	NS
aggregate bookmarks				46,246	54,034		32,942	4,663		79,188	58,697	
Total												
number of videos	13	9		73	137		23	29		109	175	
mean likes	64,055	53,937	NS	61,370	49,004	NS	59,951	33,421	NS	61,391	46,675	NS
aggregate likes	832,719	485,436		4,480,000	6,713,533		1,378,870	969,196		6,691,589	8,168,165	
mean comments	1,002	878	NS	2,500	2,559	NS	2,178	1,225	NS	2,254	2,251	NS
aggregate comments	13,024	7,898		182,513	350,585		50,104	35,525		245,641	394,008	
mean bookmarks	2,856	897	NS	953	998	NS	1,590	776	NS	1,315	956	NS
aggregate bookmarks	37,132	8,069		69,602	136,771		36,567	22,499		143,301	167,339	

("Anti"=anti-vaccine, "Pro"=pro-vaccine) Rows with grey headers represent the videos that correspond to that set of hashtag search term(s). For example, the first 7 rows represent video data that was found using the hashtag search term "Coronavirus vaccinated funny." The columns labeled 2020, 2021, 2022 indicate the time frame that videos were posted. For example, the first 7 rows in the 2020 column are all data from videos found with the hashtag search terms "Coronavirus vaccinated funny," posted in the year 2020. The "All Years" column shows totals for videos under one hashtag search term set but across a three year period. The "Total" rows look at the sums of the data in each column.

For the "funny" and "unvaccinated" hashtags, the anti-vaccine videos outnumbered the pro-vaccine videos. This suggests that children and adolescents looking for entertaining funny videos are more likely to be exposed to anti-vaccine videos. For the "facts" and "pandemic vaccine health" hashtags, the pro-vaccine videos outnumbered the anti-vaccine videos.

When all three years are summed, there are no clear differences between the pro and anti-vaccine videos. There are more anti-vaccine videos for some of the years, but pro-vaccine videos receive more likes sometimes. This combined with a lack of significance for most of the inferential statistics on the mean values suggest that acceptance of pro and anti -vaccine videos is similar, suggesting that the influence of pro and anti-vaccination is of a similar magnitude.

Discussion

The anti vs pro videos and their respective number of likes, comments, and bookmarks are roughly consistent with most previous studies of COVID-19 related TikTok videos. If a majority of people support vaccination and/or are willing to get vaccinated, it might be expected that the overall pro-vaccine content would get more engagement in the form of likes, comments, and bookmarks, which occurred most of the time. As of May 2023, 74% of the US population older than 5 years of age has completed their primary vaccine series; however, age specific vaccine rates are very high in older adults (83% to 94% in those 50 to 64 years, and 65 years of age and above, respectively), but very low in children (6% in 2 to 4 year olds, 33% in 5 to 11 year olds) and teens (62%).[17]

Our study at best, shows only a modest pro-vaccine preponderance. In other words, the pro-vaccine and anti-vaccine content are similar which really means that the magnitude of anti-vaccine sentiment is substantial. In examining the total number of likes, comments, and bookmarks for anti-vaccine videos, these total numbers are substantial. Likes, comments, and bookmarks represent extraordinary interest, and they thus represent the tip of the iceberg. Many more viewers likely view the video without liking, commenting, or bookmarking. While gaining a slim majority works in an election; for a public health measure to achieve a public health success such as herd immunity or disease eradication, there must overwhelming public support of the measure.

Compared to previous publications, summarized in Table 2, our study found a far larger proportion of anti-vaccine or misinformation content. Southwick, et al., analyzed 750 videos posted on TikTok from January to March of 2020 with the hashtag "coronavirus" finding that while the majority of videos were "humorous", 27% of videos contained misinformation about topics dealing with COVID-19 in general such as transmission, vaccines, and deaths.[19] This is in contrast to the findings of Ostrovsky and Chen, who found that less than 1% of the 100 most popular videos with the hashtags "covid-19", "covid19", or "coronavirus" contained misinformation in July of 2020.[20] Using different hashtags, Baumel et al., analyzed 150 of the most viewed videos with the hashtags "Mask " or "Masks" in December 2020 and found that only 17% of these videos contained misinformation.[21] Misinformation rates on TikTok examined by studies show large discrepancies.

Table 2: Summary of reference studies examining COVID-19 information on TikTok.

Author(s), reference citation	Number of videos viewed in study	Summary statements
Southwick, et al[19]	750	27% contained misinformation
Ostrovsky and Chen[20]	100	1% contained misinformation
Baumel, et al[21]	150	17% contained misinformation about masks
Basch, et al[24]	100	36% encouraged and 38% discouraged covid vaccination
van Kampen, et al[25]	250	81% supported covid vaccination

Despite this, the overall popularity of pro-vaccine or informative information is consistent with other studies. Other studies have found similar evidence, analyzing the impact of TikTok as a positive factor for public health.[7,17,22,23] Basch, et al., analyzed the top 100 trending videos with the hashtag "covidvaccine" in December 2020 and found that only 36% of videos encouraged vaccination while 38% discouraged a vaccine.[24] van Kampen, et al., found that 81% of the most viewed TikToks with the hashtag "covidvaccine" in July 2021, supported vaccine use.[25] However, the variability in these results both by hashtag and temporally suggest that there remains a deeper understanding to be gained through a greater time period of review and through the combination of multiple hashtags.

It should be noted that TikTok has removed videos from their app in an effort to limit the amount of content that spreads false or misleading information surrounding COVID.[26] According to their website they have removed more than 250,000 videos for COVID-19 misinformation since July 2020.[26] Many of the hashtags identified in the Southwick study as very popular such as #Wuhan, are no longer available for viewing on TikTok. It is likely that these hashtags were associated with such a large amount of misinformation or deemed to be too controversial that videos associated with the hashtag were removed. Thus, there is likely to be a large amount of previously viewed anti-vaccine content that is no longer accessible, and hence has been missed by our study, thus underestimating the magnitude of the anti-vaccine content.

Over the video collection process for our study, finding anti-vaccine content was challenging. The removal of content from TikTok and other social media platforms such as Facebook and X poses a challenge to retrospective studies such as this one and future studies trying to recreate the course of the COVID-19 pandemic or future health crises. This is a recognized study limitation that clearly underestimates the magnitude of the anti-vaccine videos.

The main limitation of the study and all other studies that have taken a similar approach is the use of hashtags to find videos. Although this is the easiest method for researchers, it does not accurately replicate the experience of TikTok users. When people use TikTok, the app presents them with series of videos (video after video) rather than a menu of options, while tailoring the content they see based on their interests. Most people do not search topics as they would on Google. For example, videos on covid vaccines would just be presented to users at the home screen, as opposed to the user searching coronavirus and then clicking and viewing videos on COVID-19. For these reasons it is difficult to accurately examine what users of the app are exposed to regarding covid misinformation. Future studies should attempt to track a user over a longer period of many months to truly examine the frequency and nature of content that they are exposed to.

Past studies have used an approach where only a single search term is used such as "coronavirus" to find videos. In our study, four different sets of search terms were used which offered a far more varied group of videos. Despite having a smaller sample, the coverage of content is an improvement from other studies that relied on a single search term. With the removal of videos from TikTok, the use of multiple search terms is even more important. Search terms such as unvaccinated are necessary to access anti-vaccine content as many of the hashtags produce largely homogeneous content.

This study along with other published research confirms the importance of social media as a platform for controlling the narrative around vaccines and future health crises. Pro-vaccine content is received very positively, as shown in this study, and thus organizations such as the U.S. Centers For Disease Control (CDC) would be able to expect a largely positive response on a platform such as TikTok. This study also confirms that the anti-vaccine content is substantial and not easily curtailed in a free speech society. Simply posting more pro-vaccine content might not be sufficient because it can be easily diluted by anti-vaccine content.

In the era preceding social media, most people received information from paper media (newspapers and magazine), and media over the public airwaves (radio and television). A pro-vaccine position could easily dominate this environment since newspapers, magazines, radio, and television would carefully evaluate the veracity of the "story" that it chose to publish. In this pre-social media era, the media outlets formed an effective restriction against misinformation. If an authority source published scientific evidence that a vaccination program was effective with minimal risk, the public would read, hear, or see only this particular view, since the opposing misinformation without scientific support would have great difficulty convincing the media to publish or broadcast such "fake" news. But in current times, where social media permits the views of anyone to be viewed by many, the authority source is no longer dominant. It thus, should not be surprising that anti-vaccine misinformation is so pervasive. As stated earlier, the younger end of the population (children, teens, young adults) gets most of their "news" information from social media, while the older end of the population is still using traditional media (newsprint, magazines, radio, television).

To gain a supra-dominant or nearly unanimous presence on a social media platform, the following might be useful to employ: 1) There must a substantially greater presence by pro-vaccine groups on these platforms by leveraging their resources to gain extreme superiority (i.e., producing content in large volumes and postings by an army of supporters or via automated means such that content viewed by an impressionable viewer is greater than 90% pro-vaccine). 2) There must an active search for misinformation that must be deleted before it can be viewed by others. In a free speech society, this can be nearly impossible to achieve since there could be consequences and/or litigation based on the right to freedom of speech. For example, comedy often employs the use of false information, and this is often funny, thus creating a blurred distinction in the use of false information. 3) Social media should accept some responsibility for their content and employ a board of established experts who can help to identify egregious and obviously false information that has no other useful purpose.

Conclusion

In conclusion, it should be recognized that there is a substantial anti-vaccine presence on TikTok. Having a simple preponderance of pro-vaccine content is insufficient if the goal is to achieve widespread vaccination to halt a pandemic. In the future, health authorities should monitor the popularity of social media and actively utilize it in a prioritized and leveraged fashion to create a supra-dominant presence to make positive progress toward public health success.

Conflict of Interest

The authors declare no conflict of interest.

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