Coronavirus misinformation: quantifying sources and themes in the COVID-19 'infodemic'

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Abstract

The COVID-19 pandemic has unfolded alongside what the World Health Organization has termed an "infodemic" of misinformation. This study identifies and analyzes the most prominent topics of COVID-related misinformation that emerged in traditional media between January 1 and May 26, 2020 based on a total sample of over 38 million articles published in English-language media around the world. To our knowledge, our analysis is the first comprehensive survey of the traditional and online media landscape on this issue. We found that media mentions of US President Donald Trump within the context of COVID-19 misinformation made up by far the largest share of the infodemic. Trump mentions comprised 37.9% of the overall misinformation conversation, well ahead of any other topics. We conclude that the President of the United States was likely the largest driver of the COVID-19 misinformation "infodemic". Only 16.4% of the misinformation conversation was "fact-checking" in nature, suggesting that the majority of COVID misinformation is conveyed by the media without question or correction.

Keywords: COVID-19, COVID, coronavirus, SARS-CoV-2, pandemic, misinformation, infodemic, conspiracy theories

Introduction

The COVID-19 pandemic has unfolded alongside what the Director-General of the World Health Organization has termed an "infodemic" of misinformation[1]. In their coverage of the pandemic, traditional media outlets have reported and sometimes amplified the voices of various actors across the political spectrum who have advocated unproven cures, denied what is known scientifically about the nature and origins of the novel SARS-CoV-2 coronavirus, and proposed conspiracy theories which purport to explain causation and often allege nefarious intent. These competing narratives and explanations have risen and fallen rapidly, behaving almost as viral phenomena themselves.

Misinformation about COVID-19 is a serious threat to global public health. If people are misled by unsubstantiated claims about the nature and treatment of the disease, they are less likely to observe official health advice and may thus contribute to the spread of the pandemic and pose a danger to themselves and others. Health protection strategies such as hygiene, sanitation, social distancing, mask wearing, lockdowns, and other measures will be less effective if distrust of public health authorities becomes sufficiently widespread to substantially affect public behavior. Specifically, misinformation about treatments for COVID disease can prompt people to attempt cures that might harm them, while fears and distrust about a possible vaccine could undermine the uptake of any vaccination campaign aiming to immunize the public at a later date.

Both misinformation and disinformation center on the dissemination of false information, with the difference being that the former is shared without malice while the latter is spread with the intent to deceive. Though we use the term misinformation in this study, it is clear that some of the nine main

topics that emerged do include elements of disinformation in that they appear to have been shared intentionally, primarily to advance political agendas, and others are a combination of misinformation and disinformation.

It is commonly assumed that misinformation is largely a phenomenon of social media, provoking calls for stricter regulation of the content on platforms such as Facebook and Twitter. However, misinformation also appears in traditional media. Here it typically takes two forms: amplification of false claims through widespread coverage of prominent persons whose views and comments are considered newsworthy; and to a lesser degree, active fact-checking and debunking of false claims and misinformation.

In this paper we aim to quantify the extent of the COVID infodemic within traditional media and examine it as a multi-dimensional informational phenomenon. While previous authors have investigated specific types of social media misinformation[2,3] including the role of "bots" in its dissemination[4], to our knowledge our analysis is the first comprehensive survey of the traditional and online media landscape regarding COVID-19 misinformation, encompassing millions of articles published globally within the five-month span that followed the outbreak of the pandemic in January 2020.

Ours is not the first media assessment: the Reuters Institute/Oxford Martin School published a factsheet in April 2020 looking at "Types, Sources and Claims of COVID-19 Misinformation," but this considered a sample of only 225 misinformation examples in the media[5]. By using a quantitative approach examining a comprehensive English-language global media database of tens of millions of articles, we aim to present empirical insights into the nature and impact of the entire infodemic that may better inform response measures taken by public health authorities, media institutions, governmental organizations, academia, and others.

Methods

We performed a comprehensive analysis of media coverage of the COVID-19 pandemic using Cision's Next Generation Communications Cloud platform. This commercial platform aggregates online news (including licensed print and traditional media news content via LexisNexis), blogs, podcasts, TV, and radio, sourced via webcrawlers and third-party content providers. In total, this database encompasses a network of 7 million-plus global sources of print, broadcast, and online news. Cision's comprehensive coverage and search capabilities make it a potentially powerful tool for the kind of content analysis we perform here.

This Next Generation Communications Cloud database aggregates global coverage, with the largest volume of English-language results coming in descending order from the United States, United Kingdom, India, Ireland, Australia, and New Zealand, with African and other Asian nations also represented in the sample. This database was queried using an English-language search string for misinformation topics in the context of COVID-19. The search string included variations on common thematic keywords ("COVID-19", "coronavirus", "2019-nCoV", etc.) and used Boolean operators such as AND, OR, NOT, and proximity terms to sift for relevant content. (For a full reproduction of Boolean operators see Supplementary Information 1.) Media coverage was examined from a sample of articles published between January 1 and May 26, 2020.

Misinformation terms were identified by an iterative cycle of reviewing coverage of COVID-19-related misinformation, creating an initial search string, further reviewing coverage, and adding additional terms to improve inclusiveness. Sites known to produce non-news content, such as wordpress.com and livejournal.com, were excluded. Keyword-based, pre-set content filters for press releases, job postings, earnings and stock news, and other irrelevant categories were applied in order to exclude them from results.

Specific misinformation topics were identified within media coverage via a similar iterative approach of reviewing sample coverage, search query adjustment, and further review of coverage until it was possible to determine that the leading misinformation narratives over the time period were represented since new topic searches failed to generate a substantial volume of results. Misinformation topics were then searched within the overarching misinformation search, operating as a layering set of context terms. When topic research identified new misinformation keywords, they were added to the master search to further improve comprehensiveness.

There is obviously a distinction to be made between misinformation per se (defined as information that is likely to mislead the audience) and information that discusses misinformation topics or the phenomenon of the infodemic with the explicit objective of debunking or correcting factual inaccuracies. We explicitly isolate this fact-checking coverage within the broader misinformation sample by identifying common terms used to identify misinformation as false, such as "fact-check" and "false claim", as well as the use of terms like "misinformation" and "conspiracy theory" which inherently imply that the narratives they reference are untrue.

Coverage falling into the misinformation search was also compared to coverage of COVID-19 generally, which was defined as the misinformation COVID-19 search *excluding* misinformation context terms. We quantify the extent of misinformation by volume, meaning the number of articles about a topic. To avoid excluding coverage that mentions more than one topic, topics within the report are not mutually exclusive. A notable amount of overlap between certain topics was observed, thus "frequency" is used to ensure accurate representation of each topic. In this report, "frequency" is defined as the volume of a specific topic divided by the total volume for the misinformation conversation.

Results

From January 1 to May 26, 2020, English-language traditional media outlets published over 1.1 million individual articles (total 1,116,952) mentioning COVID-19 misinformation. This represented just under 3% of the overall COVID-19 conversation (total 38,713,161 articles) during the same timeframe.

We identified five different sub-sections within the overall COVID misinformation conversation, summarized in Table 1. (See Supplementary Info for specific search strings that yielded these results.) Specifically:

- **Misinformation/conspiracies sub-topics**: We identified 11 key sub-topics within this conversation, which are shown in Table 2 and profiled in more detail in the discussion section below.
- **Trump mentions**: This topic comprises all mentions of US President Donald Trump within the total misinformation conversation, irrespective of whether other subjects were also referenced in the same news article. This topic is included as a way to quantify the prominence of Trump within the overall COVID "infodemic" without risking double-counting by combining Trump mentions from a number of topics that can be expected to overlap. Any and all mentions of Trump will appear in this category irrespective of whether they also appear elsewhere.
- **Infodemic coverage**: This topic includes articles that mentioned the general term "infodemic" (or related keywords such as "misinformation" or "hoax" combined with mentions of COVID-19) without mentioning a specific additional topic such as 5G or Dr Fauci.
- **Fact-checking**: This topic includes articles that explicitly mentioned conspiracies, misinformation, or factual inaccuracies in a way that aimed to correct misinformation with the

audience. Examples of this coverage include articles from established fact-checking sources, such as The Washington Post's Fact Checker, and coverage that mentioned the fact-checking of COVID-19 misinformation.

- **Trump-only mentions**: This topic represents the volume and frequency of articles that mentioned President Trump in the context of misinformation but did not mention a specific other topic at the same time. Examples were articles alleging in general terms that Trump has spread misinformation about COVID-19 or discussing his social media posts in this context. Note ALL articles appearing in this category will also be captured in the "Trump mentions" category.

Misinformation Topic	Volume	Frequency
Misinformation/conspiracies (11 sub-topics)	522,472	46.6%
Trump Mentions	423,921	37.9%
Infodemic Coverage	261,102	23.4%
Fact Checking	183,717	16.4%
Trump-Only	115,216	10.3%

Table 1: Major sub-topics identified within the misinformation conversation. Note: Total volume adds up to more than the total number of articles because of overlaps where individual articles may mention more than one topic. Similarly, frequency percentages total more than 100%.

The largest component of the misinformation conversation on COVID-19 is discussion about multiple different conspiracy theories and other sub-topics, which we categorized into eleven different sub-topics. These are broken out and discussed in further detail below. Coverage about the "infodemic" as a phenomenon has also been very significant, with nearly a quarter of the overall conversation including a mention of this. Fact-checking coverage, however, comprised only a minority of the conversation, just 16.4% of the total. Trump-only mentions within the misinformation conversation totalled 10.3%, while the entirety of Trump mentions within the misinformation conversation were 37.9%.
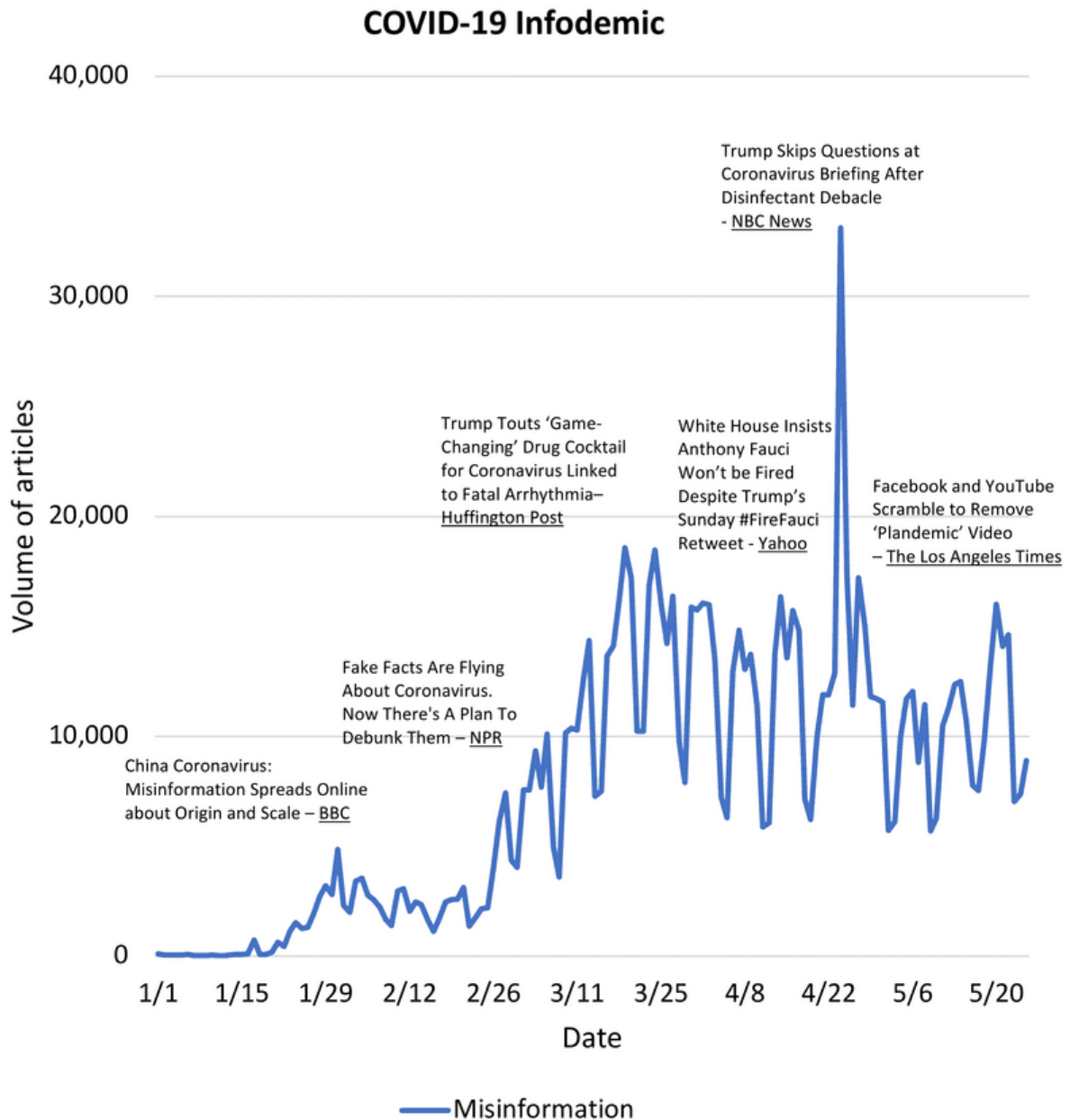
COVID-19 Infodemic

Trump Skips Questions at Coronavirus Briefing After Disinfectant Debacle - NBC News

Trump Touts 'Game-Changing' Drug Cocktail for Coronavirus Linked to Fatal Arrhythmia– Huffington Post

White House Insists Anthony Fauci Won't be Fired Despite Trump's Sunday #FireFauci Retweet - Yahoo

Facebook and YouTube Scramble to Remove 'Plandemic' Video – The Los Angeles Times

Fake Facts Are Flying About Coronavirus. Now There's A Plan To Debunk Them – NPR

China Coronavirus: Misinformation Spreads Online about Origin and Scale – BBC

Figure 2: The shape of the infodemic: Misinformation coverage of all combined topics over time during the COVID-19 pandemic. (Headlines are illustrative and not necessarily indicative of the most prominent articles or issues.)

Next we examine in more detail 11 specific misinformation/conspiracy sub-topics, ranked in order of volume in Table 2.

Table 2: The 11 most prevalent misinformation/conspiracy sub-topics in terms of frequency of appearance in traditional media coverage:

Rank	Misinformation Sub-Topic	Volume	Frequency
1	Miracle Cures	295,351	26.4%
2	New World Order / Deep State	49,162	4.4%
3	Democratic Party Hoax	40,456	3.6%
4	Wuhan Lab / Bioweapon	29,312	2.6%
5	Bill Gates	27,931	2.5%

6	5G	23,199	2.1%
7	Antisemitic Conspiracies	17,358	1.6%
8	Population Control	14,788	1.3%
9	Dr. Anthony Fauci	11,321	1.0%
10	Plandemic	7,431	0.7%
11	Bat Soup	6,163	0.6%

A graph representing the volume of different misinformation sub-topics in traditional and online media articles over time shows pronounced spikes (Figure 3).
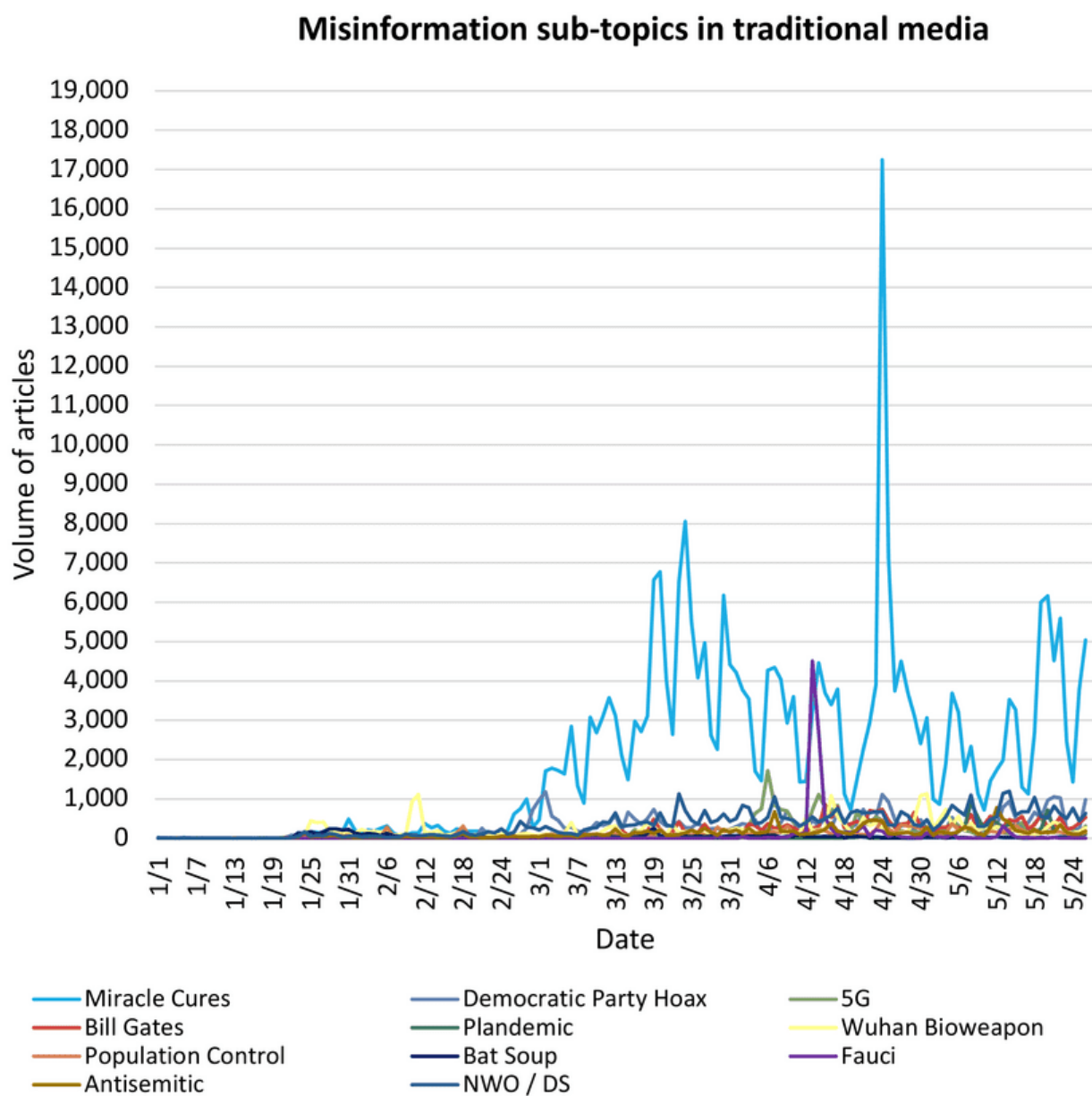

Figure 3: *Coverage volume of different misinformation sub-topics in traditional and online media during the pandemic*

This is particularly the case with the "miracle cures" misinformation sub-topic, which sees three separate prominent peaks in March, April, and May 2020. In contrast, the "Fauci" sub-topic sees only one clear peak (on April 13), as does the "5G technology" conspiracy theory, which sees a less prominent peak in the first week of April. "Bat soup" peaks early on in the infodemic (before the end of January) and then ebbs to a very low level thereafter. The "Bill Gates" misinformation sub-topic begins a slower build in March, reaches a plateau in April, and continues relatively unabated into May. Similarly, "Democratic Party hoax" began to build strongly in the second week of February, continuing with minor peaks and troughs up until the end of our data sample in May. "Wuhan bioweapon" emerged at the beginning of April, with "population control" rising somewhat in late April, but only to a relatively low level in contrast to the other misinformation topics. The "Plandemic" video rose quickly to a peak after its online release on May 4.

We discuss events in the COVID-19 news cycle that triggered the most prominent spikes in misinformation coverage in the discussion below.

Discussion

It is apparent from the data that mentions of President Trump within the context of COVID-19 misinformation comprise by far the largest single component of the infodemic. Trump mentions comprised 37.9% of the overall infodemic, well ahead of "miracle cures", which comprised 26.4%. However, a substantial proportion — possibly even the majority — of the "miracle cures" topic was also driven by the president's comments, so a substantial overlap can be expected between these topics. We conclude therefore that the President of the United States was likely the largest driver of the COVID-19 misinformation "infodemic". Only 16.4% of the misinformation conversation was "fact-checking" in nature, suggesting that the majority of COVID misinformation is conveyed by the media without question or correction.

Eleven separate sub-topics of misinformation emerged from our analysis of the COVID-19 infodemic, as ranked by the percentage of coverage they generated. In Figure 4, the misinformation topic "miracle cures" is displayed separately as this comprises a disproportionately large amount of conversation compared to other misinformation sub-topics.
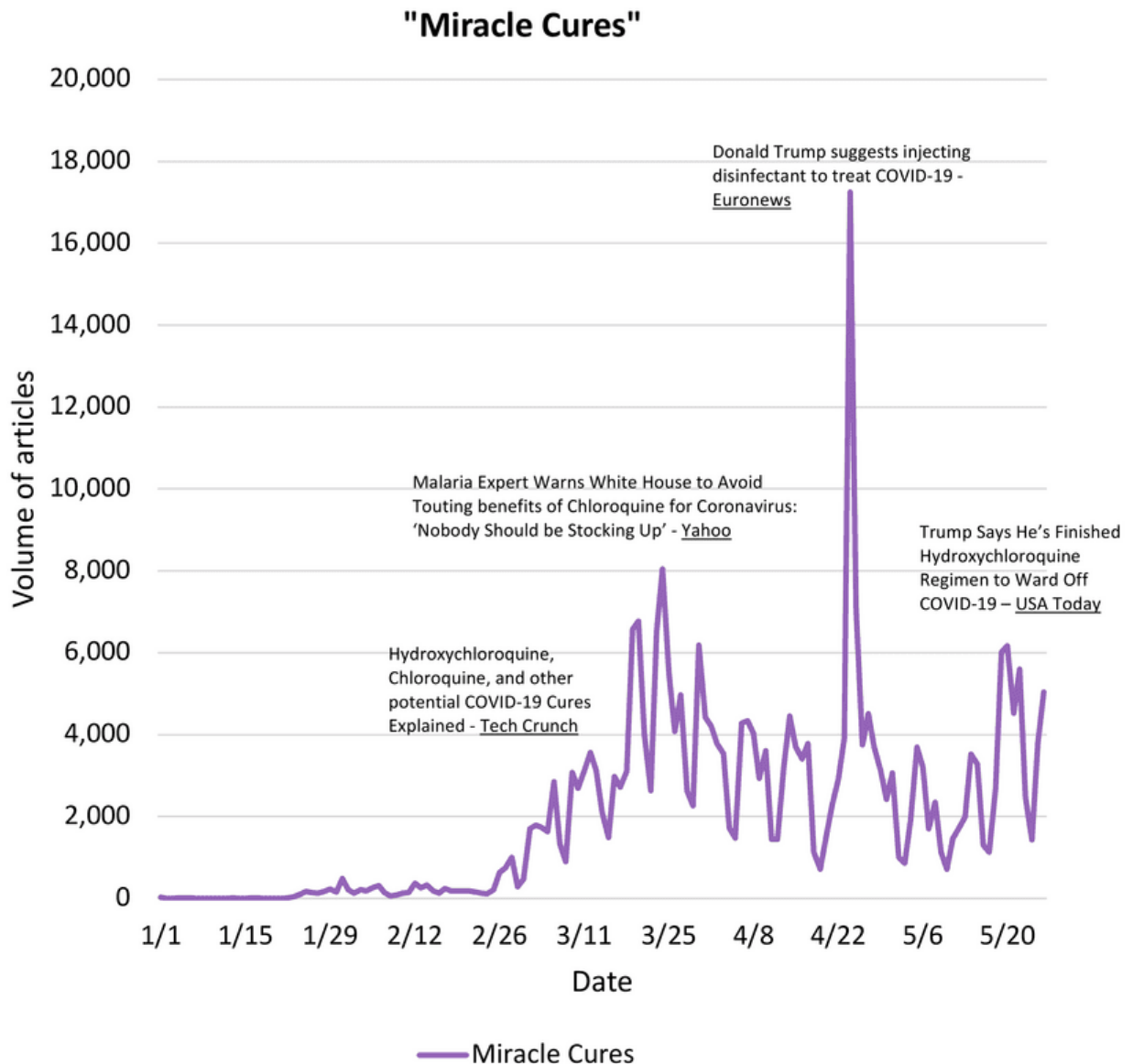
"Miracle Cures"

Figure 4: Misinformation media coverage of the "miracle cures" topic over time. (Note: headlines are illustrative to show topic peaks and are not necessarily the most prominent specific articles of the time.)

Miracle cures

Multiple different misinformation themes converged around the idea of a "miracle cure" for coronavirus. Most notably, President Trump began to advocate for the use of hydroxychloroquine and chloroquine (already in use as anti-malarial drugs) as treatments or cures for COVID-19 from March 19[6], though there was no peer-reviewed clinical data showing that these drugs had any efficacy for treating those suffering from the disease[7]. This sparked a substantial amount of media coverage regarding his announcement, the subsequent shortage of these drugs, and later the finding that they were not effective in treating COVID-19 and might indeed be harmful[8]. Coverage received another boost when President Trump claimed on May 20 to be taking hydroxychloroquine as a preventative, keeping this issue in the limelight longer[9].

The prominent April 24 peak for the "Miracle cures" topic dwarfs all other misinformation sub-topics throughout the entire period (see Figure 3) and therefore deserves particular consideration. This peak represents President Trump's press conference statements about the potential of using bleach or other disinfectants internally as a cure for coronavirus infection[10]. This peak, along with others in the "miracle cures" topic — in particular the president's promotion of hydroxychloroquine — makes this

sub-topic the second-largest contributor to the misinformation conversation after President Trump himself. Additionally, the "miracle cures" sub-topic accounts for more misinformation coverage than the other ten sub-topics combined. Though substantial overlap can be expected between these sub-topics given the prominence of President Trump within the "miracle cures" theme, these results strengthen our conclusion that the US President was likely the largest driver of misinformation during the COVID-19 pandemic, particularly given that trendline spikes in coverage of Trump's comments closely resemble those in more than one sub-topic.

Other sub-topics:

Figure 5 shows the rises and falls in the other ten misinformation sub-topics over time (i.e. not including "miracle cures"), which are discussed in turn below.

Other COVID-19 misinformation sub-topics
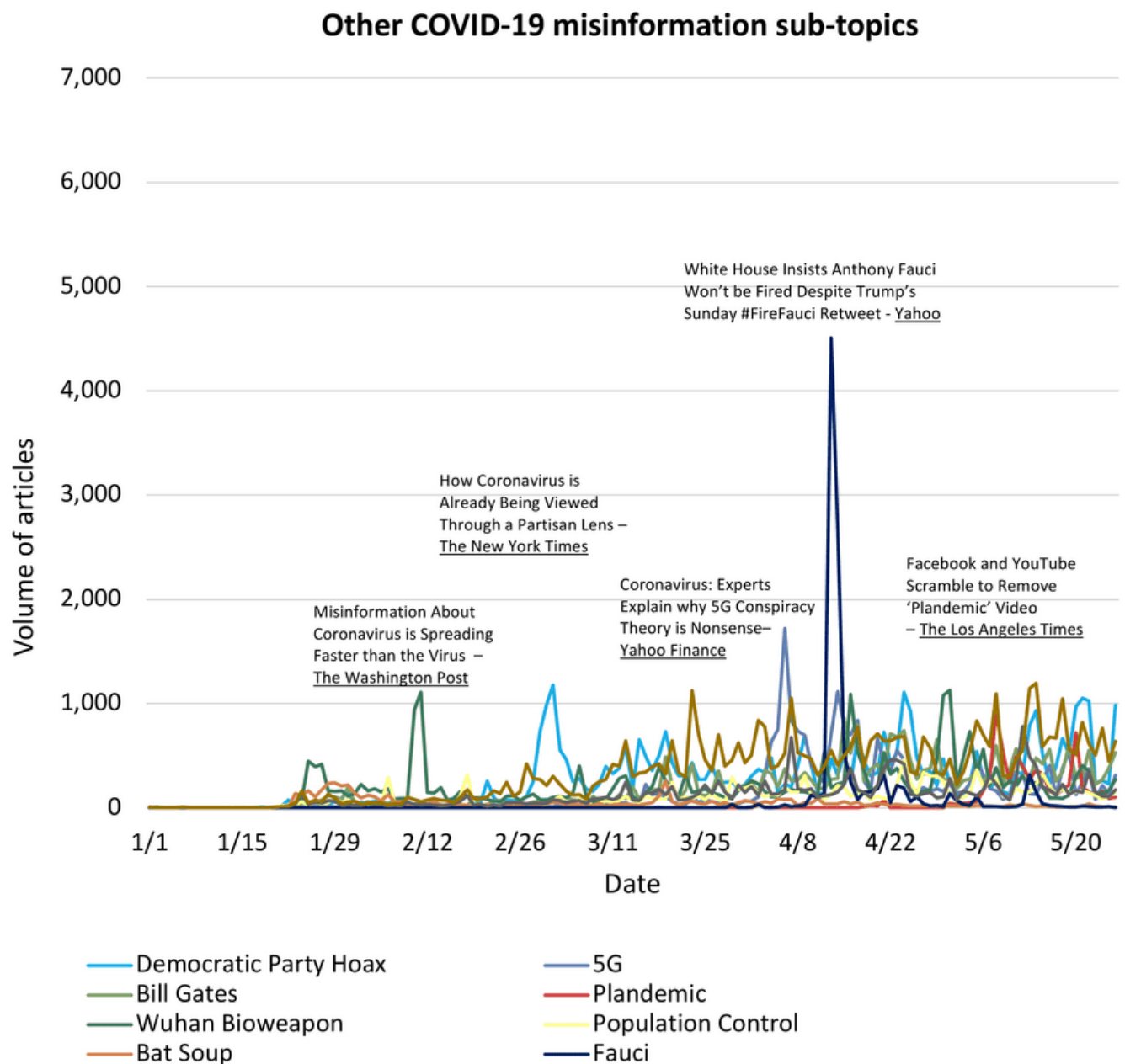
Democratic Party hoax
A conspiracy theory emerged in January that suggested the COVID-19 pandemic was intentional and manufactured to coincide with President Trump's impeachment trial. The most prominent public

advocate of this idea has been Eric Trump, President Trump's son, with Fox News reporting on May 17 Eric Trump's comments that the coronavirus will "magically all of a sudden go away and disappear and everybody will be able to reopen"[11] after the November 3, 2020 presidential election. This misinformation topic fed into the politicization of the coronavirus response and appeared to energize protests demanding that states end their lockdowns early and "open up" their economies before they had met the criteria for safe opening established by the US Coronavirus Task Force.

5G technology
The conspiracy theory that 5G technology has negative health impacts predates the pandemic. For example, in January 2019 the Russian government's English-language channel RT featured a correspondent warning that 5G "might kill you"[12]. In January 2020 this existing conspiracy narrative was picked up by a French conspiracy website called *Les moutons enragés*, which suggested a correlation between the emergence of the novel coronavirus and the installation of 5G towers in Wuhan, China[13]. The 5G/COVID-19 conspiracy theory broke into mainstream media coverage on April 5 with widespread reporting of vandalism of 5G towers in the United Kingdom and later other countries. While 5G technology was the sixth most prevalent misinformation topic in traditional media, much of the coverage was fact-checking. This included reportage of how celebrities may have influenced the reach of the conspiracy theory via their own social media channels, and issues regarding the banning of prominent conspiracists from online media for spreading 5G-related misinformation that could incite further criminal damage of cell phone towers.

Bill Gates
Conspiracies connecting Bill Gates to COVID-19 emerged early on in the pandemic, often referring to and inflating pre-existing conspiracy narratives surrounding Gates. Ironically, Gates' prescience in predicting a pandemic such as COVID-19 was used against him by conspiracy theorists, who cited a 2015 TED talk Gates gave about the danger of pandemics as evidence that he had foreknowledge of or even directly contributed to causing the SARS-CoV-2 outbreak[14]. Gates' long-standing interest in vaccinations as a public health measure — and the boost given to COVID vaccine efforts by the Bill & Melinda Gates Foundation — were further taken as evidence of nefarious intent by those spreading misinformation, with an oft-made claim being that Gates planned to equip COVID-19 vaccines with microchips to track and control peoples' actions[15]. The anti-vaccination movement has been both a major source and amplifier of conspiracy theories about Gates due to his long-standing advocacy for and financial support of vaccines. This topic of misinformation received a secondary peak when an Italian politician (who had previously compared vaccines to "genocide") called for Gates' arrest for "crimes against humanity", sparking a number of media headlines[16].

Dr. Anthony Fauci
Mentions of US National Institute of Allergy and Infectious Diseases Director Dr. Anthony Fauci appeared as a misinformation topic early in April, with conspiracists accusing him of exaggerating deaths or being a beneficiary of pharmaceutical efforts to find treatments and a vaccine. Social media shares of these reports were often combined with popular hashtags such as #FireFauci and #FauciFraud. Mainstream media often defended Fauci with fact-checking articles, with outlets such as The New York Times, Business Insider, and Forbes all publishing pieces debunking these claims. Compared with longer-running conspiracy and misinformation topics, the Fauci conspiracy was confined to a brief several-week period in April. A prominent spike in this topic is visible on April 13, which corresponds to a major upsurge in coverage after President Trump retweeted a Twitter post by a prominent conservative that stated "Time to #FireFauci"[17]. This single spike is big enough to be comparable in volume to those in the "miracle cures" category.

Plandemic
The 24-minute Plandemic pseudo-documentary became a major topic of conspiracy conversations shortly after being posted to YouTube on May 4 by a film producer called Mikki Willis[18]. After gaining millions of views through platforms such as YouTube, Twitter, and Facebook, the video was widely debunked for making numerous false claims and removed from most video-streaming

platforms. The video's main interviewee, a disgraced former virologist named Judy Mikovits[19], became well enough known however to merit a profile piece on May 9 by The New York Times[20].

Wuhan bioweapon

Conspiracy theories surrounding the Wuhan Institute of Virology emerged early in COVID-19 misinformation coverage, including theories that it was a secret bioweapons facility and that it was the origin point for a deliberate or accidental release of SARS-CoV-2[21]. Numerous fact-checking articles examined the actual likely zoonotic origin of the coronavirus, as well as a rise in anti-Asian sentiment and hate crimes early on in the pandemic. This misinformation topic also had a geopolitical component in the US government's struggle with China for blame over the origins of the pandemic and subsequent response to it[22].

Population control

Generic conspiracy theories mentioning COVID-19 as an intentional population control scheme were often combined with other issue areas such as assertions by anti-vaccination activists that a COVID vaccine might be a population control effort. This narrative is popular in some countries in Africa, where Western philanthropic organizations, particularly those concerned with public health, are seen to have a nefarious intent of reducing or controlling fertility and population numbers. "Human population planning" and "population control" mentions linked to the ongoing pandemic peaked March 15 and declined through the next several months.

Bat soup

Early conspiracy theories surrounding COVID-19 focused on the claim that the coronavirus was initially caught by humans consuming bats in Wuhan, China. These ideas were spread by a mislabeled viral video showing human consumption of bats in Micronesia, which actually dated from 2016. Outlets such as The Guardian reported early that this conspiracy theory was rooted in racism and likely contributed to an increase in anti-Asian sentiment, including death threats to a Chinese celebrity[23]. As a misinformation topic "bat soup" was an early starter, peaking on January 25 and spiking again in the week of March 15, followed by a swift decline in mentions.

Antisemitic conspiracies

Misinformation coverage included conversations around how the pandemic and its associated conspiracies were driving anti-Jewish sentiment in the US and Europe. The Anti-Defamation League has claimed for example that extremists are seeding anti-Jewish COVID conspiracy theories online[24]. Most media coverage was not supportive of antisemitic conspiracies; however, we observed some conspiracy blogs promoting longstanding antisemitic conspiracies, such as those associated with George Soros.

New world order / deep state

Mentions of conspiracies linked to alleged secret "new world orders" or "deep state" government bodies existed throughout the time period and were referenced in passing in conversations that mentioned or listed widespread conspiracies. Indeed, President Trump joked about the US State Department being a "Deep State" Department during a White House COVID press conference, triggering a much-commented-upon "facepalm" by NIAID director Dr. Anthony Fauci, who was standing behind the president at the time[25]. These conspiracies included allegations that specific figures associated with the COVID-19 response (most prominently, Fauci and Gates) were "paid" by "deep state actors" or secret global governments.

Conclusion

To our knowledge, this study is the first to attempt a fully comprehensive analysis of media-generated misinformation during the COVID-19 pandemic. While the misinformation portion comprised only 2.9% of the whole COVID-19 conversation, the 1.1 million articles identified as covering, fact-checking, or repeating misinformation represent a large volume of information that is likely to have

significantly affected public perceptions of the pandemic. It is especially notable that while misinformation and conspiracy theories promulgated by ostensibly grassroots sources, such as anti-vaccination groups, 5G opponents, and political extremists, do appear in our analysis in several of the topics, they contributed far less to the overall volume of misinformation than more powerful actors, in particular the US President.

This underscores the outsized role that media professionals play in disseminating misinformation through choices made in who and what to cover. By choosing to uncritically report statements and remarks made by influential persons, without necessarily verifying or discounting the accuracy of those claims, they risk unwittingly facilitating the dissemination of misinformation. Though media professionals do publish fact checks and other reports that clarify or correct statements, that type of reportage comprised just 16.4% of the misinformation conversation. Furthermore, fact-check pieces almost always appear later in time, which suggests that a great deal of misinformation is going out to the public uncorrected. When misinformation is repeated in mainstream media outlets it is likely to gain credibility and credence in the eyes of the audience, who might view social media misinformation more skeptically. To avoid this scenario, genuine experts and the representatives of scientific institutions should in our view be given greater prominence in media coverage in order to avoid the inadvertent spreading of misinformation. Alternatively, misinformation presented by public figures should be corrected by media within the same report, rather than after the fact.

In previous pandemics, such as the HIV/AIDS outbreak, misinformation and its effect on policy was estimated to have led to an additional 300,000 deaths in South Africa alone[26]. If similar or worse outcomes are to be avoided in the present COVID-19 pandemic, greater efforts will need to be made to combat the infodemic that is already substantially polluting the wider media discourse.

Competing interest statement

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