

Analysis of government agencies and stakeholders' twitter communications during the first surge of COVID-19 in Brazil

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Received 30 September 2021

Accepted 2 September 2022

Abstract.

BACKGROUND: Official authorities are in charge of communicating with the public in a consistent and coherent manner. The impact of social media on managing the coronavirus 2019 (COVID-19) pandemic potentially influenced social behavior in Brazil.

OBJECTIVE: Using Twitter, this study analyzes communications about the COVID-19 pandemic from official agencies of the Brazilian government and key public sector decision-makers.

METHOD: We captured public Twitter messages about COVID-19 exchanged between authorities at the federal, state, and municipal levels of government. These messages were further classified into guidance and information messages or disinformation messages. Finally, through analysis of tweets and their frequency, we evidenced the level of information generated by the three levels of government.

RESULTS: Our analyses show an underestimation of the magnitude of the pandemic by Brazilian government authorities. None of the spheres of government anticipated the imminent health crisis, did not issue good recommendations and guidelines, and did not take preventive actions.

CONCLUSION: The lack of governmental actions and adequate guidance in Brazil has led to an explosive increase in infected people and deaths. Surprisingly, this was not due to technical or structural reasons. It resulted from conflicting communication strategies implemented by the federal, state, and municipal governments in attempts to minimize the effects of COVID-19 on their local health structures.

Keywords: Coronavirus, public health, social media, infodemic, human behavior

1. Introduction

Around the world, societal action measures were implemented in response to the coronavirus 2019 (COVID-19) pandemic [1]. The scenario imposed by SARS-CoV-2 at the start of the pandemic was quite

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hazy [2, 3]. Research, studies, and observation of events shed light on what needs to be done to treat infected people and to reduce the spread COVID-19 and death rates. This knowledge guided pandemic response measures [4, 5].

To help coordinate actions, various international agencies (such as the World Health Organization) disclosed what was being discovered about the new coronavirus and suggested actions that countries could take [6, 7]. Each country was responsible for coordinating actions and directing the population under its sovereignty [8–10]; therefore, it was necessary to communicate with citizens in a straightforward and accurate manner [11].

When it came to communicating with the general public, social media played an important role as a communication channel [12]. People may now stay connected practically all the time because of advancements in networks and mobile devices [13]. Social media platforms have evolved into formidable content dissemination platforms as a result of their widespread use. Users can utilize various media to educate themselves, as well as produce and affect how information is distributed [11, 14].

The way information reaches citizens has been altered as a result of social media [15]. In a many-to-many strategy, information had previously gone from a few (major media) to many (citizens), but now information flows between users [16]. The available amount of information has grown to the point where it is frequently more than users can consume [17].

Despite this improvement in the ability to rapidly disseminate information, the information on social media can sometimes be of dubious validity. What is made public could be inaccurate (or incomplete), might be released with the goal to confuse, and often comes from an unknown source [15, 18]. Since the start of the pandemic, a rush of low-quality content has culminated in an infodemic [11].

The information that a user receives will have an impact on comprehension of a subject and, as a result, behavior. The user's information diet is related to the information users consume [19, 20]. A number of factors can affect what information a social media user receives. The users' actions (for example, who they follow, what they view, like, comment on, or share) are used by social media to determine what appears relevant (or popular) in order to make recommendations based on algorithms of user interests [14].

Instead of a good information diet [19], people have faced an infodemic. The relationship issues of

human interaction and communication supported by social media are connected to the concept of Big Social Data [21], where technology and society interfere with each other. This paper fits into this context by assuming that social media communication has had an impact on pandemic response outcomes.

Official authorities are in charge of communicating with the public in a consistent and coherent manner [20, 22]. We can observe social media's impact on managing the COVID-19 pandemic [23], potentially influencing social behavior in Brazil [24], by analyzing the social media messages from governments (federal, state, and municipality) and agencies. Decision-making [25] about adoption of certain risk-taking or risk-mitigating measures is partly influenced by the messages communicated by experts, and the characteristics of these leaders play an important role in shaping health beliefs and risk perceptions. Public health officials, for instance, are very important in leading communication efforts during a pandemic; and they are responsible for meeting the public's need for expert information because they are often perceived as trusted and credible leaders [26].

Twitter is one of the most popular social media platforms in Brazil. This media has verified profiles of many Brazilian officials, including the president, the public health minister, and some ministries and mayors. This social media platform also provides formal access to data. For these reasons, we chose Twitter as a platform for investigating social media messages from the Brazilian government and its agencies.

There was a lack of policy and strategy for dealing with the pandemic resulting in a lack of coordination among the various levels of government. The unclear criteria for transferring resources to lower government levels, administrative structure problems, and lack of transparency [27] reflect evidence of this situation. Adding to this problem, there was a generation of conflicting and inconsistent official information by official agencies and the federal government demonstrated a negationist behavior [28].

Depending on content, communication actions could either contribute to better management of the epidemic or create a context for confusion and misinformation. Therefore, forming the context of confusion and misinformation made it difficult to fight the pandemic, because combatting the pandemic depended on strategies that involved raising awareness to get community engagement [29]. Uncertainty about the most effective measures to deal with the pandemic and the non-existence of pharmacological

solutions, such as effective drugs or vaccines, allowed the possibility of ambiguous communication or even misinformation from governmental and social stakeholders. Understanding how managers at all levels of government communicated policies and actions can provide indications of their impact on tackling the outbreak and how this crisis has reached catastrophic dimensions in Brazil.

1.1. Related works

Online social networks (the network of people on social media) use digital technology with increasing reach and velocity for sharing a large amount of information among users. The capacity of spreading information about epidemics through social media allows members of a population and health professionals or agencies to collaborate [30]. In their review article, De Araújo [30] identified papers about use of social media to achieve health goals in the H1N1 epidemic, the Zika epidemic, and the Dengue epidemic. These described characteristics can be used to spread information about non-pharmacological measures, such as is necessary to deal with SARS syndromes. Conversely, [31] a qualitative analysis of content posted on Reddit shows that a conspiracy theory emerged as people tried to understand a public health crisis, reflecting their emerging information needs and their widespread mistrust in official sources of Zika information.

However, even with the emergence of conspiracy theories and fake news, the use of social media to deal with healthcare emergencies cannot be underestimated. Chan and colleagues [32] claim that “in the current COVID-19 pandemic, social media has the potential, if responsibly and appropriately used, to provide rapid and effective dissemination routes for key information”. However, they define several criteria for responsible use of social media like source trust, professional forums, identified methods to verify sources, transparent methods for peer review and feedback, and acknowledging and documenting collaborations with identified professional experts [32].

Wang et al. [33] analyzed almost 14k tweets from several US federal and state agencies and stakeholders. They identified inconsistencies and incongruencies of message types in communicating COVID-19 in the US on critical topics such as spatial disparities, timeliness, and sufficiency across actors. They pointed out that network analysis shows that communication coordination improves over time.

1.2. The Brazilian scenario

National authorities in China informed the World Health Organization (WHO) of the presence of cases of pneumonia of unknown cause in Wuhan City, Hubei Province, on December 31, 2019. Despite the spread of COVID-19 in many countries in Asia and Europe, in February 2020, the Carnival was authorized in Brazil. Meanwhile, many cities received domestic and foreign tourists without adopting sanitary measures and, on February 26, the local public health authorities confirmed the first case of COVID-19 in Brazil. On March 11, WHO declared COVID-19 a Pandemic, and six days later, Brazil confirmed the first death caused by COVID-19. Just three months after the first death, Brazil registered 50,000 deaths from COVID-19. At the end of April 2021, the most lethal month of the pandemic in Brazil, there were 400,000 deaths from COVID-19 recorded. On September 1, the number of deaths in Brazil had reached 581,150 persons.

Brazil faced political and strategic problems in combating the pandemic caused by SARS-CoV-2. Agencies and elected politicians were in opposition. These public actors produced information with controversial communications about the fight against the pandemic. The various levels of government (federal, state, and municipal) adopted different strategies and guided the population according to a variety of convictions and beliefs. The different positions among the levels of government resulted in presenting a variety of strategies for the population, producing confusion and misalignment in collective actions.

A timeline based on the project “Rights in The Pandemic” [34] documents research about public data by federal normative, administrative acts and federal speech response to the pandemic. The study presents evidence of incompetence and negligence on the part of the federal government in managing the pandemic. Among the conclusions listed by the authors of the study are observations on the following concerns:

1. Defense of the theory of herd immunity;
2. Constant encouragement to exposure of the population to the virus and non-compliance with preventive health measures;
3. Trivialization of deaths and damage caused by the disease;
4. Systematic obstruction of containment measures promoted by governors and mayors;
5. Focus on assistance measures and abstention from disease prevention measures, often adopt-

ing measures only when prompted by other institutions, especially the National Congress and the Judiciary Branch;

6. Attacks on critics of the federal response, the press and professional journalism; and
7. Awareness of the irregularity of specific conduct.

In this situation, social media was one of the main communication channels used by official stakeholders and agencies to proclaim their conflicting positions with the creation of doubt and the denial of information about the seriousness of the pandemic. Within this context, communications reflect health emergency response actions; therefore, we have adopted the premise that communications (message content) are related to the high number of victims of COVID-19 in Brazil, deaths and people with sequelae.

1.3. The research question

This research focuses on analyzing the information content broadcast in social media from the three levels of government (federal, state and state capitals, municipal and city halls) during the first months of the COVID-19 pandemic in Brazil. This study approaches the research question as follows: How did key government agencies and stakeholders communicate information on Twitter about COVID-19?

2. Method

For this research study, we developed a set of steps to analyze communications from the multiple levels of Brazilian government. These steps comprise the analysis methodology for extracting the results. Figure 1 presents the methodology as a set of activities that start with identifying stakeholders and government agencies.

The first task was to identify the official social media profiles of public agencies and politicians who were directly involved in the pandemic response. These agencies and politicians were considered the stakeholders. After identifying the stakeholders, the next task was to find their social media accounts. We made an observation that some actors did not have a social media profile to be monitored. The task of Stakeholder Message Collection aimed at extracting the data itself. In other words, it was the task of collecting publications from the accounts. These

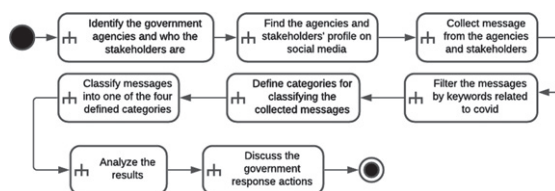


Fig. 1. The methodology flow as a set of activities.

publications comprised the dataset that would be analyzed. The Filter Messages activity was extracting messages from the dataset that directly cited the subject addressed; therefore, it was necessary to identify which words could be used to index and retrieve only the posts about the theme of COVID-19.

To answer the research question, classes were defined in order to categorize the messages. The definition of the classes must produce objective options to answer the research question. The defined classes have labels (identifiers), and each class must have a meaning.

The categories serve to point out the subject covered in the message. In this way, messages written with different vocabularies could be analyzed and marked concerning the communicated content. Following the classification, the messages were assigned to a group based on their content. For example, three classes would suffice if a question sought to understand whether a stakeholder was for or against using social isolation measures: one category to classify messages in favor of isolation (with the label “positive”), another category to classify messages against social isolation (with the label “negative”), and a third category to classify all messages that did not present a position on isolation (with the label “neutral”).

The classification activity consisted of the researchers reading the message and assigning it to one of the created classes. The result of this activity was the dataset that allows for answering how stakeholder communication took place.

This process enabled the visualization of how communication took place under the analyzed perspective. The analysis of results activity consists of extracting information after classification based on observation of the three levels of government, and relating the analyses of secondary results to provide a better understanding of the whole of the analyzed scenario. That is, an analysis of what happened in social media, how and who published the messages, and extracted information to understand the influence on citizens.

This last activity consisted of observing the analysis results, understanding what happened on social media, and analyzing the scenario presented to the world. The vision of the virtual world allowed a better understanding of what happened in the real world, or more specifically, an understanding of the relationships of what happened in social media with the positions of stakeholders and the impact (positive or negative) in the real world. Based on this understanding, it was then possible to discuss the communications from the three levels of government during the pandemic, including analysis of how they agreed or diverged, and how they confused or guided the population.

3. Implementation: Analysis of stakeholder Twitter communication in Brazil

The implementation and processes developed to analyze the government and stakeholder communication in social media during the pandemic are described in the next subsections. Twitter was chosen due to the greater facility provided for data collection because the prominent stakeholders widely use it. The methodology was applied to the pandemic scenario in Brazil, the period of study was the first half of the year 2020.

3.1. Implementation: Analysis of stakeholder Twitter communication in Brazil

Public health authorities have a unique position to lead communication efforts and to address the public's needs because they are often seen as credible experts during a pandemic [26]. Individuals might mishandle risk when government officials fail to produce a sense of trust with the public [35].

In determining stakeholders, our initial focus turned to the personal profiles of the executive parts of the Brazilian government (the federal government, state governments, and state capitals). Additional profiles gained prominence by publishing on social media or in the mainstream media about topics related to COVID-19. Ministries' profiles (such as the ministry of health) and profiles of leaders of the armed forces appear in this set. Also, profiles of other power holders in the legislative or judiciary arms of government were observed if they had outstanding performance and high visibility among the population.

The decision of which stakeholders should be monitored was a joint decision of the authors because of a degree of subjectivity when evaluating all the suggestions made by their peers.

3.2. Finding the stakeholder profiles on Twitter

Identification of the profiles on Twitter was aimed at finding the stakeholders' accounts. Accounts could be personal (a profile of a person), an institution (a profile of an institution), or an individual profile of a person working in an institution. Among the profiles monitored are: the president of the republic, ministers of state, governors, secretaries, and mayors of state capitals. We monitored the three powers of the republic: Executive, Legislative, and Judiciary (see Table 1).

3.3. Getting the tweets and collecting data

We collected the data from Twitter using its Application Programming Interface (API) on the Web (<https://developer.twitter.com/en/docs/twitter-api>). In the context of software, an API is a method of connecting computer programs to provide services via interfaces (functions with input and output). The Twitter API provides JavaScript Object Notation (JSON, <https://www.json.org/>) content with metadata related to the tweet, including the message, data, authors, and other fields. JSON is a standard textual data-interchange format to represent data using attribute-value pairs and arrays. So, we refer to a tweet as a set of metadata related to a message posted on Twitter. We have the collected tweets on a document-oriented program (<https://www.mongodb.com/>).

The API allows us to collect up to the last 3600 tweets posted on Twitter by each stakeholder. To retrieve the messages, we need Twitter credentials, which we have obtained by subscribing to specific Twitter functions (<https://developer.twitter.com/en/docs/twitter-api/getting-started/getting-access-to-the-twitter-api>). Afterward, we created a script (<https://github.com/labinovacao/stakeholdersCommunicationBrazil.git>) to retrieve the data via Twitter's API. Our script extracted all the messages from each stakeholder's profile in an iterable way. In other words, we went to a Twitter profile and got its messages. Then we proceeded to the next profile in our list of stakeholders until we reached the end.

The period that we analyzed was from 12/31/2019 to 06/30/2020. We use the data of tweet creation

Table 1
Government agencies and stakeholders

Government level	Power	Authority	Twitter account
Federal	Executive	Presidency	1
		Minister of State	22
		Health Agency	3
	Legislative	President of legislative house	2
	Judiciary	Minister of Supreme Court	11
State + Federal district	Executive	Governor	27
		Health Secretary	27
		Mayor of State Capitals	27
Municipal	Executive	Mayor of State Capitals	27

– metadata “created_at” – to filter all tweets into this time period. After utilizing that filter, we had 65,858 raw tweets (tweets without any treatment) in the dataset. This dataset was named “raw dataset” to differentiate it from others.

3.4. Filtering tweets about the COVID-19 pandemic

The raw dataset has all stakeholders’ posts in the analyzed period. Therefore, we needed to differentiate messages related to COVID-19 and messages unrelated to the pandemic. To do this, we created a set of terms to index tweet messages (texts from tweets). The terms were “corona”, “covid”, “epidemic”, “pandemic”, and “sars”. All messages containing such tokens were retrieved. For instance, if a message has the word “sars-cov-2” or “covid-19”, it would be retrieved because those words have “sars” and “covid,” respectively. Therefore, the messages containing at least one of these specified terms were retrieved.

The Elastic Stack (<https://www.elastic.co/>) was used to index and retrieve information by word filters. The tool deals with lowercase and uppercase and other natural language processing:

1. We have indexed all datasets in MongoDB to do this task;
2. We have retrieved the messages using the keyword filters;
3. We had a new dataset after filtering tweets by keywords in the tweet messages, which we named “main dataset.”

Table 2 gives the result of this filter. We collected 10,967 messages out of 67,027 tweets posted by the selected accounts during the analyzed period for the study.

Table 2
Tweets filtered to restrict COVID-19 related messages

Type of tweet	Tweets collected between 12/31/2019 and 06/30/2020	%
COVID-19 related	10,958	16.3%
Other issues	56,069	83.7%
Total	67,027	100.0%

3.5. Defining classes to analyze messages

To meet the objective of analyzing communications of the three levels of government in Brazil, four classes were identified to evaluate the content communicated in the messages during the first half of 2020.

1. Strategies and guidance: The tweets describing strategies or guidance recommended by health agencies to individuals, households, and other stakeholders towards minimizing the risk of infection or containing the spread. Examples of strategies can be “wash hands”, “wear masks”, and “disinfect the house”.
2. Situational information: The messages describing the influence or associated risks of the pandemic towards supporting situational awareness of the general public. Examples can be the number of infection cases, the number of deaths, or the assessed risks by an authoritative agency.
3. Misinformation: Wrong orientations to prevent the effects of the pandemic. Examples can be encouraging the use of medicines without scientific evidence of efficacy (hydroxychloroquine, etc.).
4. Negationism and downplaying: Downplaying the pandemic or scientific negationism about COVID-19 outbreak preventive measures.

The categories “strategies and guidance” and “situational information” are the same as used by other published studies [33, 36]. The categories “misinformation” and “scientific negationism [37] and

Table 3
Tweets filtered to restrict COVID-19 related messages

Categories	Tweets frequency	%
Strategies and guidance	5,999	64.3%
Situational information	3,155	33.8%
Misinformation	111	1.2%
Negationism and downplaying	62	0.7%
Total	9,327	100%

downplaying,” were developed by the authors of this study.

3.6. Assigning tweets classification

A classification process to facilitate collaboration of authors was necessary due to the number of messages to be manually classified. The classification process started with a calibration among all involved to reduce problems with divergent interpretations of the messages. The authors classified 200 messages during the initial calibration process by assigning a label to each message after discussing which class the message belonged. In the event of divergences, the authors discussed until reaching a consensus on how to classify the message.

After calibration, a rule for blind assessment of the messages during the classification task was established. Human classifiers should see only the message fields that do not show the message author. Only the text and time of publication should be considered. This was done to avoid bias in classification due to the identification of the message author.

The tweet's publication date and not just the text was considered to be of importance. The publication date allowed us to properly classify the messages as related to the evolution of the COVID-19 pandemic in Brazil. This consideration is important because the scientific knowledge about the pandemic has changed since the first case of COVID-19. Furthermore, a recommendation could be poorly assessed at first glance if the temporal dimension was not considered.

4. Results and discussion

After the classification of tweets, 1,631 messages were discarded for not meeting one of the categories of the four classes identified to evaluate the content communicated in the messages (defined in section 4.5), and 9,327 tweets remained in the dataset (see Table 3).

The data analysis pointed to an underestimation of the pandemic magnitude by the main stakeholders during the analyzed period. A Brazilian authority posted the first COVID-19-related tweet message in the fourth week of 2020 (Fig. 2). The first federal official to publish a message about COVID-19 was the minister of health on January 23. The ANVISA, an agency equivalent to the EMA and the FDA, published its first tweet one day later. The Department of Health posted its first message on February 7. The 120 official accounts considered for this study posted an average of 2.5 COVID-19-related tweets in the first eight weeks of 2020.

The authors wish to draw attention to the permanent denialism of Brazilian key authorities (see Fig. 2). By the time the coronavirus had already spread in many Western Europe countries and despite the knowledge that mass gatherings are always expected during the Carnival which is Brazil's biggest festival with events in all regions of the country during February, no authority (the president, the state governors, or mayors) anticipated the health emergency and promoted recommendations. Below is an example of a message from the Minas Gerais State Health Department underestimating the risk in maintaining the crowded parties for Carnival:

@SaudeMG - “Is it necessary to cancel the carnival because of the coronavirus cases? #carnaval2020 #coronavirus #oms #china <https://t.co/vbu9hwi8nq>” (02/18/2020)

The official account of the Minas Gerais State Health Department informed the public that it would not be necessary to suspend Carnival with the justification that Brazil had no confirmed cases at that time. This is an example of negationism and downplaying.

We have verified that the main government agencies of some states and cities published messages to inform and sensitize the population about prevention and care measures. There are many strategic orientation messages and situational information (see Table 3) examples of messages classified as strategies and guidance:

@lhmandetta: learn how home isolation should be like in confirmed cases of#coronavirus! Share! <https://t.co/mij0ghhha9>

@lhmandetta: The ministry of public health/SUS has a new service to prevent and fight #coronavirus. Download the app now and stay informed. Help us spread the word.

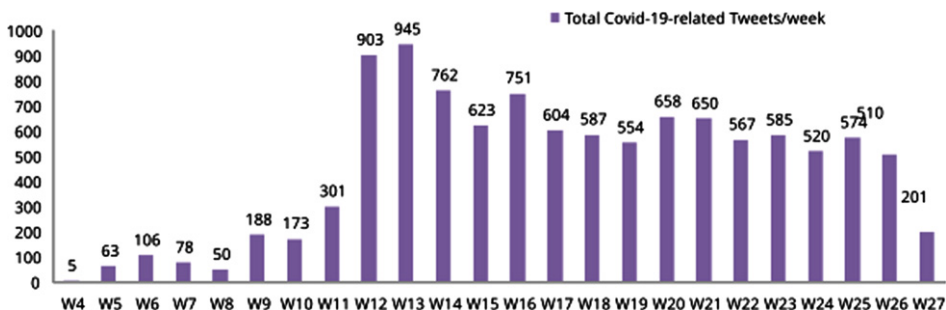


Fig. 2. Frequency of COVID-19-related tweet messages per week.

The Brazilian Unified Health System (SUS) operates as a decentralized health system, mainly operated by states and municipalities and financed by the central government. Therefore, for the system to function in adequate conditions, coordination of actions among stakeholders at different government levels is paramount, even in normal situations. However, the qualitative analysis of the messages pointed to inconsistent, incongruous, conflicting information and scientific negationism during COVID-19. It was possible to verify the contradiction in government communication in some tweets. The president of the republic shared a video of the then minister of the republic health praising the fact that the vaccine was tested for the first time in humans. The president claimed to be on a conference call with the governors of the northeast to align measures to combat the pandemic. However, the president declared that, after the decisions of the Federal Supreme Court, the fight against the pandemic would be the responsibility of states and municipalities. The contradiction in the president's manifestations in communication against the COVID-19 vaccine is notorious. The federal government boycott measures to combat the pandemic are documented, especially in opposition to measures adopted in states and municipalities [34]:

@jairbolsonaro – the vaccine against covid19 was tested in humans for the first time. The tests took place in the USA. @tvbrasilmgov <https://t.co/yfirwhkm3p> (03/18/2020)

@jairbolsonaro – We continue in a teleconference with governors of the northern region, to align actions in the face of coronavirus <https://t.co/8mbjzfeqqo> (03/23/2020)

@jairbolsonaro – the stf determined that direct actions in relation to covid-19 are the

responsibility of states and municipalities. even <https://t.co/uiwefvj7az> (06/19/2020)

In the next message example, the president of the republic expresses his adherence to a “vertical” social distance. In this measure, only the elderly and individuals in risk groups should be isolated from the rest of society. By this strategy, those not included in the isolation groups should not participate in social isolation in order to maintain the country's economic activity:

@jairbolsonaro – “We don't want to neglect the issue of Covid-19. We only seek the appropriate dose to combat this evil without causing an even greater one. If everyone collaborates, we will be able to care for and protect the elderly and other risk groups, keep daily preventive care and the country running.” (03/25/2020)

Brazilian federal government officials, including the president of the republic and ministers of state, posted messages mentioning the supposed efficacy of hydroxychloroquine in the treatment of COVID-19 even though there is no scientific evidence on the efficacy of the drug in the treatment of COVID-19. These types of messages are examples of misinformation. Due to this policy, the sale of drugs such as hydroxychloroquine doubled in Brazil. According to a Federal Council of Pharmacy report, the sales rate increased from 963,000 units in 2019 to 2 million units in 2020 [38]:

@minsaude – “The @govbr advances in the treatment for #coronavirus. Serious hospitalized patients will be able to make use of #chloroquine and #hydroxychloroquine, with medical indication. Understand the new @minsaude protocol for hospitalized patients only:

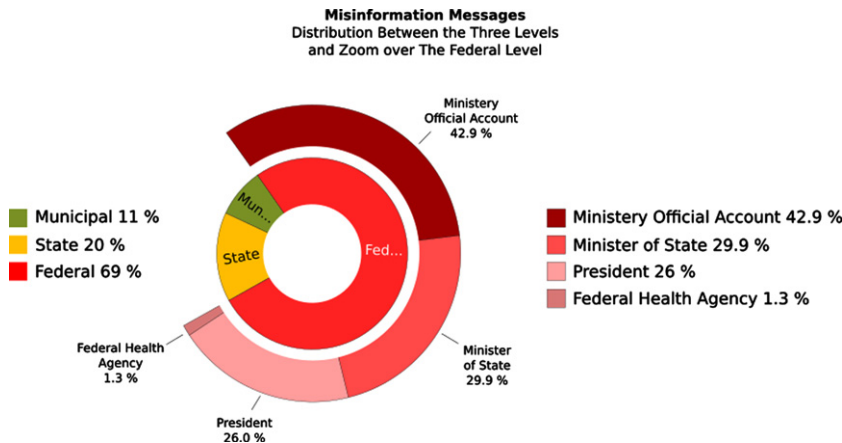


Fig. 3. The distribution of misinformation messages between the three government levels and zoom over the federal level.

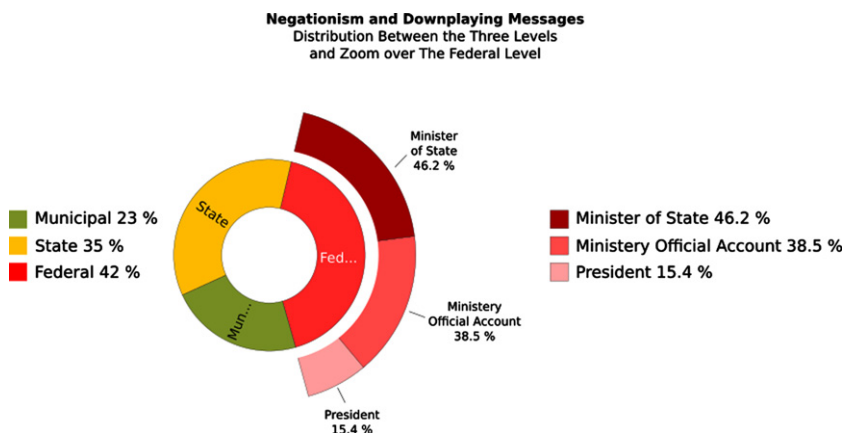


Fig. 4. The distribution of scientific negationism and downplaying messages between the three government levels and zoom over the federal level.

<https://bit.ly/2UCk5yO><https://t.co/8nf1euybyw>.” (03/26/2020)

@jairbolsonaro – “hydroxychloroquine increasingly demonstrates its effectiveness in patients with covid-19. <https://t.co/ymwnj5hyti>” (03/27/2020)

@jairbolsonaro – “Hydroxychloroquine increasingly demonstrates its effectiveness in patients with COVID-19. – I have received reports from all over Brazil in this regard. – Preserve lives and jobs. - <https://youtu.be/vYLIRzhJIoY>” (03/29/2020)

@jairbolsonaro – “- @rudgiuliani interviewed doctor dr. zelenko who has treated about 500 patients with covid-19. - watch: <https://t.co/d6tkyge5uy>” (04/05/2020)

@jairbolsonaro – “I- for 40 days I have been talking about the use of hydroxychloroquine in the treatment of covid-19. I always tried to deal with the life of <https://t.co/treidmpgx8>” (04/08/2020)

@jairbolsonaro – “- Dr. Kalil Filho: “I used it...it’s worth the use of hydroxychloroquine in patients infected by the coronavirus.” <https://t.co/wh4z8xblb0>” (04/08/2020)

During the time period the next tweet example was posted, COVID-19 started to spread in Brazil and countries to the north, especially in Europe, were in the peak of the first pandemic wave. The message clearly reflects a misunderstanding of the pandemic risk among the population and did not represent the reality of the situation:

@casacivil – “brazil has the lowest lethality rates of #covid19, in relation to higher economies. <https://t.co/ywu69z0kcc>.” (04/23/2020)

An analysis of the data shown in Fig. 3 indicates that the central government was responsible for 69% of messages classified as misinformation. An analysis focused on the federal government has the following results for misinformation messages: ministry official accounts 42.9%, the accounts of the ministers of state 29.9%, the president of the republic 26%, and the Health Department 1.3%. An analysis of the data shown in Fig. 4 represents the frequency of the messages classified as negationism and downplaying. The federal government posted 42% of these tweets. Considering only the central government, the frequency of negationism and downplaying messages was the following results: the ministers of state 46.2%, ministry official accounts 38.5%, and the president of the republic 15.4%. Despite a comparatively low frequency, messages classified as misinformation and messages classified as negationism and downplaying must be seen as a concerning issue when propagated by government authorities. They have the potential to sow distrust, misinformation, and anti-scientific rhetoric.

Below, we show some non-exhaustive examples of “strategies and guidance” and “situational information” messages that are signs of positive communication at certain levels of the Brazilian government. However, due to the lack of coordination and conflicting communications from the central government, “strategies and guidance” and “situational information” messages have a limited effect on the population’s behavior.

Strategies and guidance:

@joaoazevedolins – “rt @govparaiba: the government of paraíba, together with the northeast consortium, launched the app monitors covid-19, developed by private institutions in partnership with the region’s governments. The platform is a tool to support the fight against the new coronavirus pandemic and allows monitoring,” (05/15/2020)

@wdiaspi – “Brazil needs integrated actions at the moment. The Northeast remains united in the fight against the coronavirus. We created a technical chamber that will operate in the 9 states, respecting the particularities of each one.” (03/27/2020)

@jdoriajr – “Stop minimizing the pandemic. The whole world is suffering the consequences of this virus, and the countries that did not take it seriously today are paying with their lives. These are not fake deaths. This is not flu. Coronavirus kills. Stay at home!” (03/28/2020)

@costa_rui – “The war against #covid19 is not over. Those who have already been contaminated, especially those who are contaminated, must stay home. The disease sees no age, no class. To save lives and our economy to return to normal, we need to reduce the infection rate. #Stayathome” (06/29/2020)

Situational information:

@minsaude – “@lhmandetta @spsaude_ epidemiological situation of the coronavirus in Brazil on 02/26:20 suspected cases 1 confirmed case discarded <https://t.co/si5fzppjv>” (02/26/2020)

@minsaude – “#transparency | epidemiological situation of #coronavirus in Brazil, until 06/03:13 confirmed cases 768 case <https://t.co/uthztzkuyy>” (03/06/2022)

@carloselula – “Attention so far, #no confirmed cases of #coronavirus in the state. We continue to monitor 72 suspected cases <https://t.co/wfd9btriao>” (03/19/2022)

5. Conclusions

This study analyzed the official communication about the COVID-19 pandemic on Twitter made by agencies of the Brazilian government and key public sector decision-makers. Our results showed that the federal, states, and municipalities had conflicting messages. The lack of coordination on communications among the different agencies and the various levels of government that included even messages against scientific orientations or misinformation may have contributed to the population’s engagement to follow the measures to reduce the spread of COVID-19.

As a contribution, this work enables a discussion about the importance and impact of adequate government communications strategies and objectives in social networks (with a focus on Twitter). Such communications are especially important to cope with the health crisis [25, 30] when the population’s awareness

and trust are needed to embrace strategies to prevent the spread of diseases, as happened with SARS-Cov-2 [11].

The communication network that spreads fake news appears to hope to normalize the crisis, with no need for social distancing, no mask use, early treatment with untested drugs, no trust in vaccines, and an underlying strategy for implementing herd immunity.

5.1. Limitations

The volume of data made us divide the dataset into five subsets to be analyzed by the authors. To avoid bias in classifications, the authors calibrated the responses using small sets of data before classifying the entire dataset. However, the messages were not classified per pair in order to verify the classifications' accuracy.

5.2. Suggestions for future research

Communications for community engagement to follow non-pharmacological measures at the beginning of the pandemic and for vaccination when available are very important. Additional research could supplement understanding of the real impact of official communications on the Brazilian second-ranked position in the number of deaths from COVID-19 [29]. This study was based on analyzing communications from official agencies of the Brazilian government and key public sector decision-makers on Twitter in the first six months of 2020. We analyzed the content and frequency of these messages in just one type of social network platform.

Further studies are needed to analyze the behavior of Brazilian authorities in different communication media, such as interviews and statements given through the social networks of Facebook and YouTube, and how this communication was disseminated and enhanced by the WhatsApp and Telegram groups. Other studies could be carried out to analyze the interviews and testimonies of authority figures in other forms of communication channels.

More studies should be done on how conflicting communication objectives have influenced populations' behavior and trust and how this has contributed to the overall impact of COVID-19. It is important to extend the collection and analysis of messages to the entire pandemic period to understand how communications influence people's engagement during the different pandemic moments. Another necessary approach is expansion of the analysis with a consid-

eration of the impact and the reach of messages with the followers of specified accounts.

Ethical approval

Not applicable.

Informed consent

Not applicable.

Conflict of interest

The authors have no conflicts of interest to declare.

Acknowledgments

Not applicable.

Funding

Not applicable.

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