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# Is focusing on a single strategy effective during health crises? How the hydroxychloroquine discourse became counterproductive during the COVID-19 pandemic

Monique Oliveira, Sylvia Maria Affonso da Silva, Diogo Lopes de Oliveira, Roberto Mitsuo Takata

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MARCO AKERMAN (ORCID: <https://orcid.org/0000-0003-1522-8000>)

# Is focusing on a single strategy effective during health crises? How the hydroxychloroquine discourse became counterproductive during the COVID-19 pandemic

Monique Batista de Oliveira

Faculty of Public Health, University of São Paulo

✉ [info@moniqueoliveira.org](mailto:info@moniqueoliveira.org), <https://orcid.org/0000-0002-7642-0971>

Sylvia Maria Affonso da Silva

Federal University of São Paulo, Department of Psychobiology and Morphology and Genetics

- ✉ [sylvia.maria@unifesp.br](mailto:sylvia.maria@unifesp.br), <https://orcid.org/0000-0002-9645-0879>

Diogo Lopes de Oliveira

Federal University of Campina Grande, Department of Art and Media

- ✉ [diogo.lopes@professor.ufcg.edu.br](mailto:diogo.lopes@professor.ufcg.edu.br), <https://orcid.org/0000-0002-8486-9824>

Roberto Mitsuo Takata

Federal University of Minas Gerais, Department of Scientific Dissemination

- ✉ [rmtakata@gmail.com](mailto:rmtakata@gmail.com), <https://orcid.org/0000-0002-1322-9651>

*ABSTRACT:* The COVID-19 pandemic provides a compelling case study of the intersection between political rhetoric and scientific discourse during crisis situations. This study examines the controversy surrounding hydroxychloroquine (HCQ) and chloroquine (CQ) as potential therapeutic agents for SARS-CoV-2, demonstrating how these pharmaceuticals dominated public discourse at the expense of other mitigation strategies. Using Google Trends data analysis and network mapping methodology, we identify a diverse network of actors, including political leaders and "counterpublics," where these drugs evolved beyond their scientific context to become political symbols. The communication model that emerged can be described as "confrontational," with different positions attempting to establish vertical models of communication. We propose an alternative framework that embraces pluralistic approaches to scientific understanding and strategy, incorporating interdisciplinary and inter-editorial perspectives. This approach may help mitigate the tendency to dismiss scientific expertise when addressing issues beyond traditional scientific boundaries. We conclude that traditional communication models risk reinforcing confrontational discourse patterns, which may be counterproductive given the inevitable controversies arising from competing interests in a public health crisis of this magnitude.

**Keywords:** COVID-19, Hydroxychloroquine (HCQ), Scientific Communication, Public Discourse, Crisis Communication, Social Studies of Science and Technology Counterpublics, Network Analysis, Science controversies, Public Health Crises

## 1. Context: Scientific controversies in the age of disinformation

During the early stages of the Covid-19 pandemic (2020-2021), the intersection between science and politics became evident in the search for SARS-CoV-2 mitigation strategies. Political leaders systematically minimized the pandemic's severity (Bermúdez, 2020; Perrigo, 2020), utilizing social media platforms as communication channels (Walker et al., 2020). A significant manifestation of this phenomenon emerged in the discourse surrounding

chloroquine and hydroxychloroquine (HCQ/CQ)<sup>1</sup>. Following his positive SARS-CoV-2 test in 2020, Brazilian President Jair Bolsonaro shared an image on Twitter (currently X) displaying hydroxychloroquine medication, accompanied by the statement: "RT-PCR for SARS-CoV-2: negative. Good morning everyone"<sup>2</sup>. Subsequently, he claimed that the drug, "even without scientific evidence", had saved his life<sup>3</sup>. Similarly, Donald Trump, in a tweet about the same compound, defended the immediate use of the substance because "people are dying"<sup>4</sup>. One proposed explanation for the emphasis on this therapeutic approach is its potentially reduced political and economic implications compared to alternatives such as quarantine measures and social distancing protocols. The focus on hydroxychloroquine and chloroquine resulted in medication shortages in Brazil and documented fatalities associated with their use in France (Agência Brasil, 2020; Cabut, 2020).

At the time of these tweets, the scientific community did consider chloroquine and hydroxychloroquine as potential Covid-19 treatments, albeit based on limited *in vitro* studies and small-scale observational research<sup>5</sup>. Subsequent analysis revealed methodological limitations, including insufficient sample sizes and accelerated peer review processes, leading to article retractions and ongoing narrative disputes. Notable examples include a study published in the *Journal of Antimicrobial Agents*, which was accepted merely four days post-submission with only 36 participants. This publication was ultimately retracted in 2024 at the authors' request (Honorato, 2024). Furthermore, a comprehensive clinical trial published in the *New England Journal of Medicine*, comprising 1561 treatment subjects and 3151 controls, demonstrated no therapeutic benefit from hydroxychloroquine administration (The RECOVERY Collaborative Group, 2020)

This evidence illustrates a significant disparity between scientific methodology and political rhetoric. While researchers approached these compounds as experimental therapeutic candidates, certain political leaders presented them as validated treatments — exemplifying a cognitive bias that poses substantial challenges to modern democratic systems (Bennett & Livingston, 2020). This divergence represents a manifestation of "post-truth" dynamics (Bennett & Livingston, 2020; Jaiswal et al., 2020), characterized by three distinct elements: disinformation (intentionally false content), misinformation (unintentionally false content), and mistrust (erosion of confidence). Also, the communication of scientific uncertainty — encompassing imprecision, ambiguity, and indeterminism — may inadvertently contribute to perceived disinformation (Smith & Stern, 2011).

Within the healthcare domain, the proliferation of misinformation during the SARS-CoV-2 pandemic has been the subject of concern in scientific literature, with claims that the phenomenon threatens medical practice (Moran, 2020). Drawing from the etymological roots of "pandemic," the World Health Organization introduced the term "infodemic" to describe the public health implications of widespread unverified information dissemination (World Health Organization, 2021).

Although the digital age has dramatically amplified disinformation impact through rapid and widespread dissemination channels, these campaigns have long existed throughout history. Edwards (2021) identifies marketing and public relations practices as precursors in the "normalization" of disinformation. Hannah Arendt (2017) also demonstrated that the systematic and intentional dissemination of false information has been an established political

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<sup>1</sup> The compounds are drugs against malaria and autoimmune diseases considered for the treatment of Covid-19, as we will show in the analysis. As hydroxychloroquine and chloroquine are similar compounds for the purposes of this article, the authors will use the abbreviation (HCQ/CQ).

<sup>2</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1286994557440348160>

<sup>3</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1292523257288167425>

<sup>4</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/realDonaldTrump/status/1241367239900778501>

<sup>5</sup> Bolsonaro's tweets were published in July and August respectively. Trump's, in March. As we will show, we consider that a certain consensus on the compounds was reached in July, when the World Health Organization definitively suspended tests with the drug. However, although there is some consensus on the non-indication of hydroxychloroquine for the treatment of Covid-19, we do not consider that the controversy has completely ended in November 2020.

strategy, with well-documented techniques of public opinion manipulation. Contemporary manifestations often exhibit hybrid characteristics, as evidenced by Donald Trump's social media presidential campaign, which integrated traditional manipulation tactics with algorithmic amplification (Empoli, 2019).

### 1.1.Theoretical framework

The investigation of societal debates is fundamental to democratic processes, and Jürgen Habermas (2014) provided critical insights into this matter. He argued that in democratic societies, restricting consultation to experts or representatives risks creating bureaucratic, elitist, and formalistic governance. The strengthening of the public sphere—where collective decision-making debates occur—serves as a mechanism to maintain the connection between society and the state. Public sphere functions as a mediating structure between the modern state and civil society, helping to constrain top-down decisions (Habermas, 2014).

The challenge within a complex public sphere is to maintain a qualified debate while accommodating diverse perspectives. A primary critique of Habermas's public sphere concept centers on its presumption of a homogeneous public discourse with few divergent positions. In multicultural contexts, the public sphere manifests greater complexity, featuring multiple hegemonic and non-hegemonic discussion arenas (Fraser, 1990). This observation led to the development of the "counterpublics" concept—social groups within the public sphere who recognize their subordinate status relative to dominant cultural groups (Warner, 2010; Rocha, 2019). The counterpublics framework has expanded public sphere theory by identifying diverse deliberative spaces, including "**subaltern counterpublics**" such as anti-racist and feminist movements, but also conservative groups. These groups have established alternative venues for socialization and deliberation, thereby exerting pressure on hegemonic public sphere practices (Fraser, 1990; Mello, 2021).

In this arena is science, which exists as a non-homogeneous entity comprising diverse groups with majority and minority perspectives. One disciplinary area that has focused on studying this scientific diversity is the Social Studies of Science and Technology (STS). Drawing from the Strong Programme and Actor-Network Theory (ANT), scholars in this field maintain that scientific consensus emerges through processes beyond empirical validation alone (Bloor, 1991; Law, 2004; Latour, 2012). Facts represent stabilized controversies, often emerging from complex networks of human and non-human actors. From this theoretical perspective, consensus—or its absence—regarding COVID-19 pandemic mitigation strategies involves interplay among narratives, algorithms, SARS-CoV-2, individuals, institutions, *bots*, and emotional factors such as fear (Jasanoff, 2004; Latour, 2005; Stein et al., 2014; Lemieux, 2015). This heterogeneity in scientific fact stabilization, while not unprecedented, might suggest that all arguments hold equal validity. However, acknowledging the constructed nature of knowledge through heterogeneous elements does not imply the impossibility of truth (Latour, 2012). Rather, truth manifests as non-homogeneous and non-absolute, contingent upon various validation spheres in complex societies.

In such contexts, controversy mapping has emerged as a productive methodology in social sciences and STS. These situations represent moments when society requires consensus for action, yet the public sphere remains "in suspension," with key actors disagreeing on facts and actions while facing urgent deliberative needs (Venturini, 2010). This methodological approach has facilitated analysis of pivotal historical moments, including controversies surrounding embryo research (Mulkay, 1994), genetically modified organisms (Klintman, 2002), and the human genome program (Reardon, 2001).

Initial evidence collected during the pandemic pointed that the HCQ/CQ debate transcended laboratory boundaries and expanded beyond traditional scientific discourse in mainstream media. The discourse featured diverse stakeholders, utilized social media

platforms, and exhibited heterogeneous narratives integrating scientific and socio-political considerations. Therefore, an actor-following methodology would be appropriated to understand narrative formation and the consideration of these substances alongside other strategies. The identification of a controversial network with polarized positions regarding these compounds establishes this episode as a significant case study for examining public sphere dynamics and the social circulation of scientific knowledge in times of crisis.

### 1.3. Objectives and research questions

Based on evidence suggesting that HCQ/CQ sparked controversy during the Covid-19 pandemic, we investigated the following research questions:

1. Which sectors and actors participated in the HCQ/CQ debate within the public sphere?
2. Did the focus on these substances overshadow other potential pandemic mitigation strategies?
3. What does this case point out about how scientific knowledge circulates in society?

## 2. Methods

Drawing upon the theoretical framework of Science and Technology Studies (STS) and established methodologies for mapping controversies, we analyzed the trajectory of hydroxychloroquine and chloroquine (HCQ/CQ) compounds during the COVID-19 pandemic. Our methodological approach comprised three distinct phases: first, identifying and delineating the controversy; second, mapping key actors within public discourse; and third, examining the interrelationships among these actors, with particular attention to elements of adherence and rupture (Latour, 2005; Venturini, 2010; Chateauraynaud, 2017). Elements of adherence encompass shared social, political, or economic positions that unite actors, while elements of rupture represent divergent positions or ideological frameworks that create distance between them.

Our initial investigation employed search engines and social media platforms, focusing on the terms "chloroquine" and "hydroxychloroquine" between January 1 and November 30, 2020—the period marking the emergence of the COVID-19 pandemic. The search yielded 164 English-language and 216 Portuguese-language results, deemed relevant by the search algorithm<sup>6</sup>. We conducted a systematic review of media coverage, academic literature, and official documentation. This exploratory analysis centered on materials primarily addressing HCQ/CQ in relation to COVID-19, with the objective of understanding the broader context, public discourse, and the dynamic roles of various actors within the controversy.

To complement our textual analysis, we examined the social media presence—specifically Twitter (now X) accounts—of key figures identified in our primary research. Additionally, we utilized Google Trends to quantify public interest in these substances, as measured by search volume. These digital tools have proven invaluable in controversy mapping: Twitter has emerged as a crucial platform for tracking misinformation networks (Gruzd & Mai, 2020), while Google Trends has demonstrated utility in predicting epidemic patterns in regions with limited official data (Strauss et al., 2020). Our analysis included comparative examination of search patterns for other contemporaneous therapeutic interventions and public health measures, including social distancing protocols, convalescent plasma therapy, and ivermectin.

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<sup>6</sup> The search engine considers the main results to be relevant and omits similar pages, thus reducing the number of sources. In general, the tool shows no more than 40 pages of results per search. Available at: <https://support.google.com/websearch/answer/9603785>. Accessed: March 2025

Through this multi-modal methodological approach, it was possible to establish a comprehensive framework for identifying principal actors and their interconnections within the debate. To visualize these relationships, we employed concept mapping methodology, which illustrates actor relationships through verbal linkages. We utilized CmapTools software<sup>7</sup> for this visualization, which enables the representation of specific knowledge domains or research questions at the map's center (Cañas et al., 2005). Within this framework, knowledge is conceptualized as the interconnection between concepts, which themselves emerge from observed patterns in events or phenomena (Novak, J. D. & Cañas, 2008).

This methodological toolkit facilitates the identification of key actors and their interrelationships, supported by empirical evidence drawn from textual sources, scientific literature, and social media discourse. We acknowledge that controversy mapping, by its nature, is exploratory—the complete documentation of all network traces often proves impossible—yet it effectively exposes the multifaceted nature of public discourse.

### 3. Results

#### *3.1. An overview of the controversy*

Based on our exploratory analysis of various tools and documents, we identified five key actors in the HCQ/CQ controversy: 1) political leaders, particularly Jair Bolsonaro (Brazil) and Donald Trump (USA); 2) the scientific community; 3) pharmaceutical companies; 4) the press; 5) SARS-CoV-2, HCQ/CQ itself; and the structure of social networks. Medical and professional associations in Brazil were also significant participants. As shown in Figure 1, most actors were interconnected—except for the pharmaceutical industry, where the connections visible from the material collected were limited.

The conceptual map illustrates relationships of adhesion and rupture between these actors (Fig. 1). The map's first level uses colors to represent network movements and actor similarities. Green denotes actors who predominantly supported using HCQ/CQ during the pandemic. Yellow identifies "non-humans" who also have agency (in the sense of moving the network), although lacking the same visible intentionality as humans. Orange indicates institutions and scientists who followed scientific studies and, primarily in the latter half of 2020, opposed using these compounds. Blue represents the pharmaceutical industry, with relations mainly with the green and yellow areas.

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<sup>7</sup> The software is available for download from the Florida Institute for Human & Machine Cognition (IHMC) at: <https://cmap.ihmc.us/cmptools/>. Accessed on: March 2025.

At the second level, the connectors—expressions linking the nodes (actors)—indicate the relationships between elements. This exploratory map synthesizes these discovered relationships. While it doesn't exhaust all the connections, it offers a clear overview of the network's dynamics and key connections. The pharmaceutical industry, for instance, shows a connection to Donald Trump. Jair Bolsonaro, then president of Brazil, heavily utilized social media. At the pandemic's onset, both the World Health Organization and segments of the scientific community considered hydroxychloroquine as a potential treatment. The debate proved controversial, with the green side advocating for the drug's use and the orange side distancing itself from the initial hypothesis—forming distinct publics and counter-publics, where the green side established an alternative space to legitimize their (Fraser, 1990; Mello, 2021).

In the following sections, we examine specific actors and their connections to the focus of this mapping: chloroquine and hydroxychloroquine.

### *3.2. Non-humans: the link between HCQ/CQ and SARS-CoV-2*

Early reports from our investigation began with the documentation of an emerging virus in Hubei (China), inducing cases of pneumonia with unknown causes, characterized by low or normal leukocyte counts and resistance to conventional treatments (Li et al., 2020). According to reports, these cases demanded an urgent reorganization of healthcare systems, given Asia's previous experience with severe acute respiratory syndrome (SARS) since 2002 (Senger et al., 2020).

Following the identification of this novel pneumonia, researchers conducted epidemiological investigations, isolated the virus, and assessed its transmission rate. The Hubei report, published in March 2020, revealed a virus that demanded both extensive research and swift containment measures. "The development of the epidemic follows an exponential growth in cases" researchers noted in the *New England Journal of Medicine* (Li et al., 2020).

Figure 1: Conceptual map showing the actors in the HCQ/CQ controversy



Research at the time highlighted the challenges in controlling this pathogen. Studies demonstrated that SARS-CoV-2, like other viruses, commandeers the host cell's machinery to replicate. Within hours, one infected cell can generate thousands of new virus particles, each capable of infecting healthy cells (Senger et al., 2020). Scientists recognized that, similar to other viruses such as HIV—where antiviral cocktails only reduce infection potency—no single drug would likely eliminate SARS-CoV-2 completely. They predicted that treatments for this emerging disease would likely follow a similar pattern (Hargreaves et al., 2020).

The urgent need to address SARS-CoV-2 transmission, coupled with the challenges of controlling the infection, led to the consideration of HCQ/CQ for preventing and treating Covid-19. These substances were theorized to prevent the virus from entering cells by blocking fusion with cell membranes. Without this intervention, SARS-CoV-2 would continue its infectious cycle (Huang, 2004). Researchers tested both compounds as drug substitutes<sup>8</sup>, combining them with antivirals and anti-inflammatories. Their low cost and availability, plus proximity to a large market near Covid-19's epicenter<sup>9</sup>, made them attractive options. Ultimately, the agency<sup>10</sup> of SARS-CoV-2, combined with economic, political, and social factors—along with scientific hypotheses about these compounds' effectiveness—sparked the HCQ/CQ controversy.

### 3.3. *The Scientific Community's Response*

Our analysis reveals that hydroxychloroquine/chloroquine (HCQ/CQ) as a potential Covid-19 treatment initially emerged in scientific discourse through a letter published in *Cell Research*, documenting possible *in vitro* effects of these compounds (Fantini et al., 2020). A temporal analysis using *Google Trends* data (Figs. 2, 3) demonstrates that public interest in HCQ/CQ increased significantly in March, correlating with French microbiologist Raoult Didier's inaugural Twitter<sup>11</sup> (now X) announcement. Didier reported that his research group had observed a "significant reduction in viral load" in 20 SARS-CoV-2 patients treated with a combination of hydroxychloroquine and azithromycin. This announcement, accompanied by a preprint on MedRxiv (Gautret et al., 2020), generated considerable social media engagement<sup>12</sup>. Although the study was subsequently published in the *International Journal of Antimicrobial Agents* in July 2020, it underwent extensive scholarly debate (O'Grady, 2024) before its ultimate retraction in January 2025 (Gautret et al., 2025). The extended timeline between publication and retraction exemplifies both the persistence of scientific controversies and the limitations inherent in drawing conclusions from isolated studies.

The discourse surrounding HCQ/CQ became increasingly polarized by May 2020, with pro-chloroquine advocates adopting more assertive positions, while segments of the scientific community advocated for rigorous clinical trials and methodologically sound research (illustrated in Figure 1 through green and orange color coding, respectively). The World Health Organization (WHO) issued a critical report in May, acknowledging the compounds' media prominence while highlighting methodological concerns in existing studies (Paho, 2020). Although the institution initially considered including HCQ/CQ in its treatment guidelines, this consideration was suspended as empirical evidence failed to demonstrate efficacy (BBC News, 2020). The FDA's definitive stance against HCQ/CQ as a Covid-19

<sup>8</sup> Drug substitution is the evaluation of existing drugs for new therapeutic purposes. It is a common practice in medicine to prevent and avoid public health problems [cited 2020 Oct 30]. Available from: <https://www.sciencedirect.com/topics/medicine-and-dentistry/drug-substitution>.

<sup>9</sup> India biggest producer of "game-changer" hydroxychloroquine drug; has enough capacity India Business News - Times of India [Internet]. The Times of India. 2020 [cited 2020 Oct 30]. Available from: <https://timesofindia.indiatimes.com/business/india-business/enough-capacity-in-country-to-meet-hydroxychloroquine-demand-industry/articleshow/75029934.cms>

<sup>10</sup> We use the concept of agency to characterize the actions of humans and non-humans. The term is relational. It evokes what happens in the encounter between different actors; in this case, the encounter between the virus and the organism [Latour, 2005].

<sup>11</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: [https://twitter.com/raoult\\_didier](https://twitter.com/raoult_didier)

<sup>12</sup> As well as being widely quoted in the press, the microbiologist is the subject of a Facebook page with 490,000 members. Available at: Chonchon Dieudonne [Internet]. Facebook.com. Facebook Groups; 2020 [cited 2020 Nov 20]. Available from: <https://www.facebook.com/groups/DidierRaoultVsCoronavirus/permalink/299938541301962/>

treatment in July 2020 marked a significant turning point in the scientific consensus (FDA, 2020).

### 3.4. *Pharmaceutical companies*

The pharmaceutical industry's role in this controversy manifests through subtle yet significant patterns of influence and economic interests. Notable examples include the disclosure of Donald Trump's shareholding in Sanofi, an HCQ manufacturer<sup>13</sup>, and documented evidence from CNN revealing the Brazilian army's procurement of chloroquine at triple the market price<sup>14</sup>. The intersection of political and commercial interests is further exemplified by documented meetings between President Bolsonaro and industry executives, and the notable political alignment of a prominent Brazilian HCQ manufacturer with the administration<sup>15</sup>.

### 3.5. *Political leaders: Donald Trump (USA) and Jair Bolsonaro (Brazil) and social networks*

This section examines how two prominent political figures, Donald Trump, then-president of the United States, and Jair Bolsonaro, former president of Brazil, engaged with hydroxychloroquine and chloroquine discourse during the COVID-19 pandemic. Our analysis reveals that these politically aligned leaders employed analogous communication strategies: extensive social media utilization, provocative rhetoric, and systematic delegitimization of mainstream media (Bennett & Livingston, 2020). We conducted a systematic analysis of their official Twitter accounts (now X) to track HCQ/CQ mentions between February and November 10, 2020.

To evaluate their engagement with hydroxychloroquine within broader COVID-19 discourse, we examined references to alternative treatments: azithromycin, dexamethasone, REGN-COV2, tocilizumab, and convalescent plasma therapy<sup>16</sup>. Additionally, we tracked mentions of ivermectin, an antiparasitic allegedly capable of inhibiting SARS-CoV-2 replication *in vitro* (Caly et al., 2020). The drug has been the subject of controversy in Brazil.<sup>17</sup>

The quantitative investigation revealed that Trump referenced hydroxychloroquine 13 times and chloroquine once, with two instances coupling hydroxychloroquine with azithromycin. His initial HCQ/CQ reference appeared on March 21<sup>18</sup>. Besides these mentions, his only other treatment-related communication concerned plasma therapy. Bolsonaro initiated his discourse on March 26<sup>19</sup>, ultimately accumulating 39 references to hydroxychloroquine or chloroquine, three incorporating azithromycin. No other investigated treatments appeared in his communications. Both leaders prioritized HCQ/CQ promotion over

<sup>13</sup> Baker P, Rogers K, Enrich D, Haberman M. Trump's Aggressive Advocacy of Malaria Drug for Treating Coronavirus Divides Medical Community. The New York Times [Internet]. Apr 6, 2020 [cited Nov 6, 2020]. Available from:

<https://www.nytimes.com/2020/04/06/us/politics/coronavirus-trump-malaria-drug.html>

<sup>14</sup> CNN Brasil. 2020 [cited 2020 Nov 6]. Available from: <https://www.cnnbrasil.com.br/nacional/2020/09/15/exclusivo-sem-contestar-exercito-paga-quase-triplo-por-insumo-da-cloroquina>

<sup>15</sup> [Internet]. 2020 [cited 2020 Nov 6]. Available from: <https://br.financas.yahoo.com/noticias/bilionario-bolsonarista-estao-entre-empresarios-lucram-cloroquina-191224668.html>

<sup>16</sup> We used as a reference the Recovery Clinical Study, which tests the therapeutic possibilities for Sars-CoV-2. Welcome - RECOVERY Trial [Internet]. Recoverytrial.net. 2020 [cited 2020 Nov 20]. Available from: <https://www.recoverytrial.net/>

<sup>17</sup> Ivermectin has also been the target of misinformation in Brazil, to the point where the press has come to classify it as the "new chloroquine". BBC News Brasil [Internet]. BBC News Brasil. BBC News Brasil; 2020 [cited 2020 Nov 20]. Available from: <https://www.bbc.com/portuguese/brasil-53494836>

<sup>18</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/realDonaldTrump/status/1241367239900778501>

<sup>19</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1243169243589476353>

other COVID-19 interventions, suggesting that chloroquine's "agency" served as an instrument for amplifying domestic political tensions<sup>20</sup>.

Regarding public health measures, our analysis of "social distancing" and "isolation" references yielded notable findings. While Trump's discourse omitted these terms entirely, Bolsonaro employed "isolation" five times, demonstrating ambivalent positioning—alternating between critique<sup>21</sup> and suggesting that the measure should not be radical<sup>22</sup>. This result, together with data from *Google Trends*, suggests that the chloroquine narrative intensified parallel to the emergence of social distancing as an effective viral control measure, reflecting leaders' economic concerns<sup>23</sup>.

Our analysis identified four key rhetorical strategies employed by Trump and Bolsonaro to amplify HCQ/CQ discourse: 1) strategic decontextualization of media information (taking information from the press and drawing conclusions from different contexts); 2) epistemological simplification exploiting limited scientific literacy; 3) promotion of epistemic individualism and institutional distrust through emotional appeals (claiming that individuals know more than the press and science; we also observed emotional appeals); 4) ideological framing and political polarization of scientific discourse (chloroquine is not being used because the mainstream press lies or is left-wing).

Despite these parallels, significant divergences emerged, particularly regarding interactions with national health regulatory bodies—the FDA (Food and Drug Administration) in the United States and Anvisa (National Health Surveillance Agency) in Brazil. While Trump's Twitter communications demonstrated antagonism toward the FDA<sup>24</sup>, Bolsonaro expressed alignment with Anvisa's hydroxychloroquine-related policies<sup>25</sup>, suggesting contrasting dynamics in regulatory relationships.

Though both leaders initiated their HCQ/CQ narrative campaigns in March, their temporal engagement patterns differed. Bolsonaro maintained his advocacy until the conclusion of our analysis period on November 10, 2020<sup>26</sup>, while Trump's final related communication occurred on August 23<sup>27</sup>. Our findings position these political actors as central nodes in the HCQ/CQ narrative network, demonstrating significant capacity to mobilize other actors and establish extensive network connections (Fig. 1).

### 3.6. Press

Media coverage emerged as a significant actor in the controversy surrounding these substances. Extensive press coverage documented the intersection between hydroxychloroquine advocacy and political interests (Goodman & Giles, 2020; Rogers, 2020; Stone, 2020). News organizations conducted systematic fact-checking of HCQ/CQ claims and reported on scientific research outcomes (Facher, 2020; Projeto Comprova, 2020). A significant Brazilian clinical trial investigating these compounds' efficacy against Covid-19 received substantial media attention when researchers documented severe cardiac arrhythmias in participants receiving high-dose hydroxychloroquine (Glenza, 2020; Howard, 2020).

*Wired* magazine characterized hydroxychloroquine as a "much-hyped drug that sparked a battle between power and knowledge"<sup>28</sup> (Rogers, 2020). The BBC's analysis centered on

<sup>20</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/realdonaldtrump/status/1247268841845141504>, Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1247455251013214209>

<sup>21</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1242786257354309632>

<sup>22</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1280849019892314117>

<sup>23</sup> ISTOÉ DINHEIRO. 2020 [cited 2020 Nov 10]. Available from: <https://www.istoedinheiro.com.br/custo-de-isolamento-social-para-a-economia-e-de-r-20-bi-por-semana-diz-spe/>

<sup>24</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/realDonaldTrump/status/1297148038385991680>

<sup>25</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1243502405779628033>

<sup>26</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/131739236595538949>

<sup>27</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/realDonaldTrump/status/1297715098795094017>

<sup>28</sup> In free translation, "a vaunted drug that sparked a battle between power and science"

political figures' advocacy—specifically Trump and Bolsonaro—for these substances (Goodman & Giles, 2020), corroborating our findings. An in-depth Brazilian investigation revealed the extensive societal penetration of hydroxychloroquine discourse, leading to Brazil's characterization as a "chloroquine country." Municipal administrations implemented Covid kit distribution programs (Oliveira, 2020), which one interviewee characterized as "bags of illusion (...) deployed for electoral and demagogic purposes."

Certain media entities demonstrated alignment with political leaders' promotion of the compounds. In Brazil, "Terça Livre" was a primary properponent of pro-HCQ/CQ coverage and Bolsonaro's position (Roveran, 2020). Analogously, in the United States, Fox News maintained support for both the compounds and Donald Trump's stance (Re, 2020a, 2020b).

### 3.7. Public interest

We conducted an analysis of public interest in the compounds utilizing *Google Trends*<sup>29</sup> for the period spanning January 1 to November 30, 2020. The analysis quantified the relative attention directed toward HCQ/CQ in comparison with alternative COVID-19 therapeutic interventions<sup>30</sup> and social distancing measures<sup>31</sup>.

Analysis of Brazilian search patterns revealed that queries for hydroxychloroquine and chloroquine remained below the frequency of searches related to social distancing measures throughout the study period (Figure 2). In the comparison of HC/HCQ with other SARS-CoV-2 mitigation strategies, search activity exhibited peaks in March and May, with ivermectin—another controversially discussed therapeutic agent—surpassing HC/HCQ in search frequency by mid-July (Figure 3).

Global search trends demonstrated similar patterns, with HC/HCQ searches reaching peak volumes in March, May, and mid-August when compared to searches for social distancing measures (Figure 4). Identical temporal patterns were observed when comparing HC/HCQ searches with those for other therapeutic agents (Figure 5).

The data demonstrate the significant impact of the discourse and controversy surrounding these compounds, evidenced by search volumes that temporarily exceeded those of other early pandemic intervention strategies in 2020. Both global and Brazilian search patterns exhibited a decline in frequency in HC/HCQ searches toward the end of 2020.

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<sup>29</sup> Google Trends. 2020. Google Trends. [online] Available at: <<https://www.google.com/trends/>> [Accessed November 13, 2020]. Searches were carried out in Portuguese for the Brazilian context and in English for the global context.

<sup>30</sup> We carried out searches for azithromycin, dexamethasone, REGN-COV2, tocilizumab, chloroquine, hydroxychloroquine, ivermectin and plasma from recovered patients, following the same procedure adopted for Twitter searches, according to the Recovery Trial. REGN-COV2 and tocilizumab showed no results, considering the normalization of data for relative popularity (Available at: <https://support.google.com/trends/answer/4365533?hl=pt-BR>). Google Trends results consider searches for the exact terms, not their contexts. We also merged the data for hydroxychloroquine with that for chloroquine, since we believe there is no significant difference between the compounds in the context of this analysis.

<sup>31</sup> The mapping showed that the terms "social distancing", "quarantine" and "social isolation" were often used synonymously. For this reason, the searches included findings with all three expressions.

Figure 2: Comparison of HC/HCQ searches with terms related to social distancing during the Covid-19 pandemic in Brazil from January to November 2020.

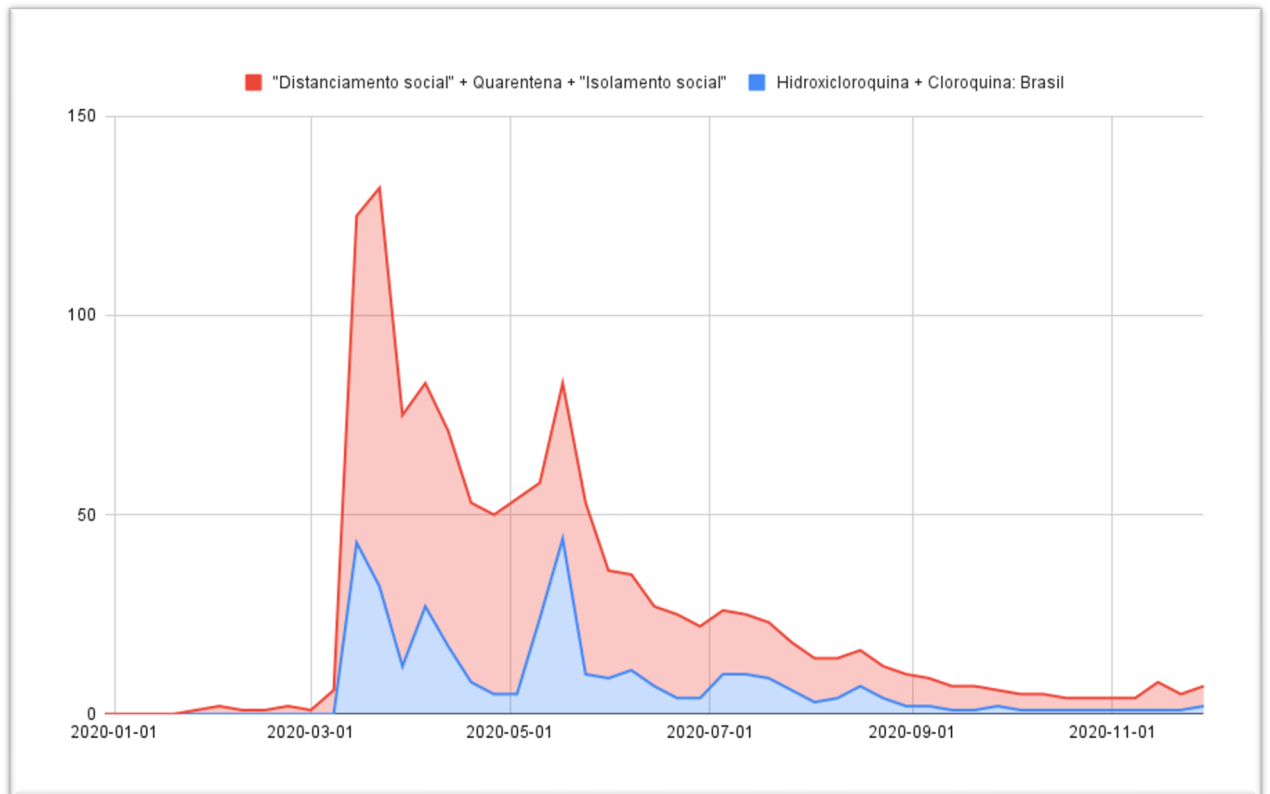


Figure 3: Comparison of HC/HCQ searches with other compounds considered during the Covid-19 pandemic in Brazil from January to November 2020

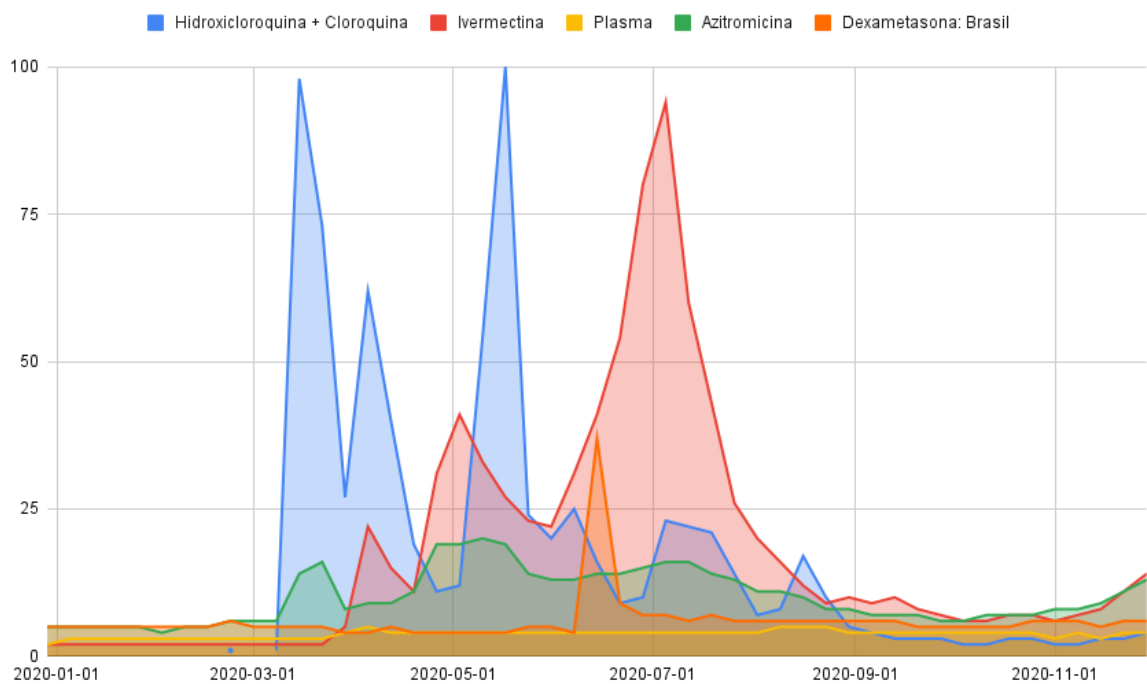


Figure 4: Comparison of worldwide HC/HCQ searches with terms related to social distancing during the Covid-19 pandemic from January to November 2020

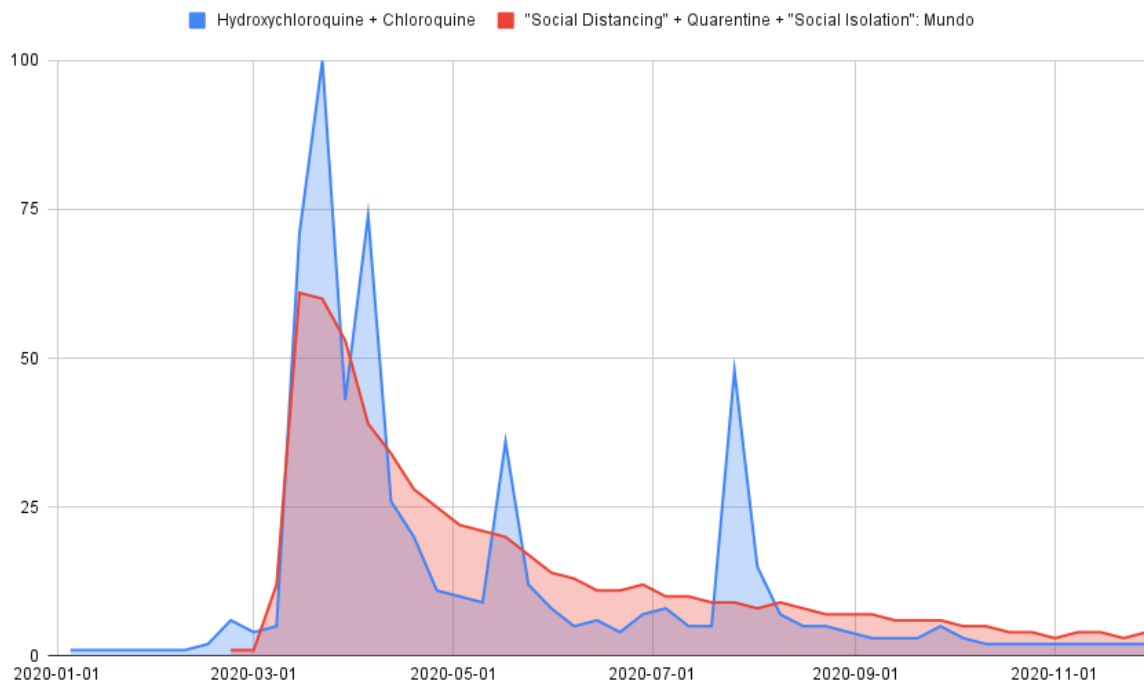
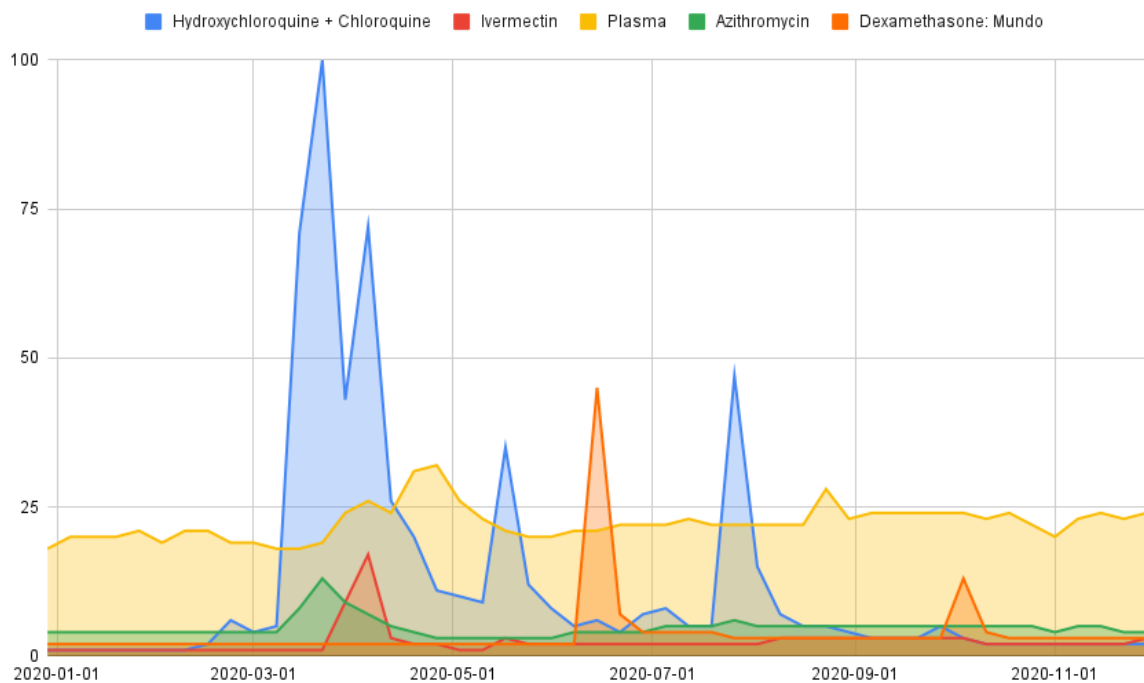


Figure 5: Comparison of worldwide searches for HC/HCQ with other compounds considered during the Covid-19 pandemic from January to November 2020



### 3.8. The controversy in Brazil

The network analysis in Brazil demonstrated distinct characteristics, particularly regarding the involvement of political figures and medical associations advocating for the

compounds' use. As mentioned, while the Brazilian president continued referencing these substances through November 2020<sup>32</sup>. Donald Trump ceased mentioning them in the latter half of that year<sup>33</sup>.

The stance on drug recommendation among professional medical associations in Brazil showed significant division<sup>34</sup>. Notable institutions, including the Brazilian Medical Association (AMB) and the Federal Council of Medicine (CFM), endorsed physicians' discretion to prescribe hydroxychloroquine for Covid-19 in specific (AMB, 2020; CFM, 2020). AMB's official statement addressed the politicization of the matter, particularly noting instances where negative efficacy results were met with celebration.

When, on May 22, The Lancet journal published the results of a study proving the apparent absence of effects of hydroxychloroquine in the fight against Covid-19, the reaction of some people and organizations was astonishing: they were celebrating!!!

(...)

It was clear there that the discussion had been politicized. After all, what could justify such euphoria in the face of such frustrating news for the health of the population? And precisely at a time when there were no effective treatments... (AMB, 2020)

The HCQ/CQ narrative extended beyond medical associations to encompass healthcare institutions and political figures. Notably, a private Brazilian hospital conducted a controversial study that received partial support from the Brazilian scientific community<sup>35</sup>. While our analysis focused primarily on HCQ/CQ, it is worth noting that ivermectin, another proposed Covid-19 treatment that generated substantial discourse in Brazil, was not documented in our findings<sup>36</sup>.

Documentation shows that approximately ten Brazilian municipalities implemented the distribution of "chloroquine kits" for Covid-19 prevention and treatment, which sometimes included ivermectin and azithromycin (Oliveira, 2020). The controversy surrounding HCQ/CQ in Brazil contributed to the resignation of two health ministers during the pandemic (G1, 2020). Subsequently, Bolsonaro appointed a military official as Minister of Health, who aligned with the previously established protocol (Farfan, 2020).

#### 4. Discussion

Debates in the scientific literature usually revolve around two primary models of communication: vertical/deficit (following a classic sender-receiver paradigm) and dialogic ones, where the message emerges through interaction between participants (Brossard & Lewenstein, 2009). These models traditionally presuppose that there are conditions for

<sup>32</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/jairbolsonaro/status/1317392365955538949>

<sup>33</sup> Twitter. 2020 [cited 2020 Nov 20]. Available from: <https://twitter.com/realDonaldTrump/status/1297715098795094017>

<sup>34</sup> Many institutions, such as the Brazilian Society of Infectious Diseases (SBI), the Brazilian Society of Clinical Oncology (SBOC), the Brazilian Association of Intensive Care Medicine (AMIB) and the Brazilian Society of Pulmonology and Phthisiology (SBPT), have published independent technical notes arguing against the use of HCQ/CQ due to the lack of reliable data. A few associations, such as the Brazilian Cancer Society (SBC), have taken a stand in favor of its use.

<sup>35</sup> This episode was the subject of intense controversy. The study was published in April on public platforms such as Dropbox (Available at: <https://bit.ly/3evHz28>). A YouTube video features a scientist from the University of São Paulo together with a doctor from the hospital showing the benefits of the hydroxychloroquine protocol. Available at: <https://youtu.be/3RY5d-0kZjc>. In the mainstream press, the study was treated with caution, but had wide repercussions, with articles that garnered a lot of comment. Available at: <https://bit.ly/3l9>. We also found intense discussions on Twitter and other platforms such as Reddit. All content was accessed in November 2020.

<sup>36</sup> See note 15.

choosing *a priori* which communication model will be used. However, the hydroxychloroquine (HCQ) case study reveals communication patterns that defy such predetermined frameworks, demonstrating characteristics that can only be analyzed *ex post*. No single actor can maintain a position that can determine the communication dynamics across the network.

Our analysis reveals that the HCQ/CQ narrative exhibited remarkable heterogeneity, transcending the boundaries of scientific discourse to encompass diverse spheres of power and institutional influence, including a network of world leaders. This finding addresses our first research question regarding the scope of stakeholder involvement in the public discourse surrounding HCQ/CQ. The result has implications for communication models: as the number of actors increases, the feasibility of predetermined communication strategies diminishes. This effect is particularly pronounced when certain actors possess significant "capture capacity" — (the ability to bring others to their "side" of the narrative — as exemplified by Jair Bolsonaro and Donald Trump positions (Chateauraynaud, 2017).

The emergence of political leaders who challenged established scientific expertise facilitated the development of "counter-publics," wherein previously marginalized perspectives find their own field of legitimacy in the public sphere (Fraser, 1990; Habermas, 2014). The pro-HCQ/CQ narrative contested hegemonic spaces, at times moving from the periphery to the center of public discourse. *Google Trends* data demonstrates HCQ/CQ's significant influence on Covid-19 mitigation strategies, persisting even as evidence mounted against its efficacy in treating and preventing SARS-CoV-2.

The role of non-human actors requires particular attention in this analysis. The viral dynamics of Covid-19 — where a single infected cell can generate thousands of virions within hours (Senger et al., 2020) — leads to exponential case growth (Li et al., 2020), turning single-drug interventions largely ineffective (Hargreaves et al., 2020). Communication strategies that acknowledge viral agency and materiality must therefore embrace multiple containment approaches rather than focusing on a single strategy. Therefore, the expectation of a unified narrative from the scientific community becomes untenable given the virus's agency, pandemic conditions, high uncertainty levels, and many interests involved.

The disproportionate attention given to hydroxychloroquine in public discourse (evidenced by the range of actors involved and *Google Trends* data) was incongruent with both the preliminary nature of clinical trials during the pandemic's early stages and the demonstrated viral dynamics requiring multi-strategic interventions. This hyper-focus on HCQ/CQ addresses our second research question, and emerged from a network that reframed the compounds within political polarization — a finding corroborated by other studies. Research indicates that the HCQ/CQ controversy were more centered on political implications than on health considerations, with a greater concentration of messages in a few users, while the rest mainly contributed to their viralization on Twitter (Araujo & Oliveira, 2020).

Within certain network segments, HCQ advocacy became synonymous with political alignment with Donald Trump or Jair Bolsonaro, while opposition signified political resistance to these leaders. This dynamic manifested notably in Brazilian medical associations, as evidenced by a note from the Brazilian Medical Association's (AMB) that addresses celebrations of studies demonstrating the compounds' inefficacy. The AMB's surprise at such reactions highlighted how these substances had transformed from potential therapeutic agents into hybrid actors whose identity transcended scientific parameters.

The hydroxychloroquine debate extends questions of efficacy, having evolved beyond scientific method. One key lesson from this analysis is that society and science will inevitably deal with controversies, with scientists having limited control over how discourse circulates. These debates are shaped by the impact of what is being at stake, network complexity, and the

agency of both human and non-human elements. Nevertheless, it does not change the fact that hydroxychloroquine was indeed ineffective to treat and prevent COVID-19. And this raises a critical question: is it possible to promote effective interventions when the discourse moves beyond scientific authority?

While it is not possible to predict which communication model will predominate across networks, this case study indicates that effective science communication during a pandemic must account for multiple factors including viral agency and political polarization. Rather than promoting or discrediting single interventions, communication strategies could acknowledge diverse approaches. Furthermore, interdisciplinary scientific approaches - manifested in journalism through inter-editorial collaborations - should holistically address societal concerns, potentially reducing the tendency to reject scientific expertise when dealing with issues outside science's traditional scope, such as viral agency.

It is worth noting that such strategies may face limitations, as traditional scientific education, with its emphasis on certainty and homogeneous representations of science, often creates barriers to public acceptance of multiple valid approaches and the provisional nature of scientific knowledge (Santos, 2007). The hydroxychloroquine/chloroquine narrative demonstrates the necessity for both communication and scientific education to better engage with inherently controversial objects and situations. An authoritative presentation of science risks perpetuating "confrontational communication" models that may prove counterproductive and exacerbate polarization.

## 5. Conclusion

The chloroquine and hydroxychloroquine narrative dominated public discourse around COVID-19 mitigation strategies, overshadowing alternative approaches. The discussion network exhibited heterogeneity, including participation from global leaders. Our analysis demonstrates that substances acquire meanings beyond their scientific properties, becoming embedded in sociopolitical frameworks. The communication model that emerged can be described as "confrontational," with different positions attempting to establish vertical models of communication. Within contemporary technoscientific controversies, the persistence of conflicting stakeholders ("counterpublics") with their own sources of legitimacy and interests in generating such debates is practically inevitable. We argue for an approach that recognizes and fosters communication practices grounded in pluralistic understandings of science and strategy. Such an orientation may facilitate a shift from adversarial discourse toward collaborative problem-solving for addressing collective challenges.

### Author Contributions

MO: Conceptualization, Writing –original draft, Writing –review & editing. SA: Writing–original draft, Writing –review & editing. DL: Writing–original draft, Writing –review & editing. RT: Writing –review & editing.

### Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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