

Infodemic insights: Mapping COVID-19's digital discourse in Romania

Research Article

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Received 12 December 2024; Accepted 17 March 2025

Abstract: The coronavirus disease 2019 (COVID-19) pandemic, while primarily a global health crisis, also triggered an infodemic – a surge of information ranging from accurate to misleading, significantly shaping public perceptions and behaviors through social networks. This study analyzes the COVID-19 infodemic in Romania using social media datasets from CrowdTangle, integrating text analysis, sentiment analysis, and social network analysis to examine pandemic-related discourse, identify key themes, and trace the spread of various types of information. The findings provide insights into how the infodemic influenced collective responses, offering strategies for managing information flow during health crises. This study highlights the crucial role of social media in shaping public awareness and underscores the need for effective communication strategies to counter misinformation and improve public understanding in future emergencies.

Keywords: COVID-19 • Infodemic • Social media analysis • Machine learning • Romania • CrowdTangle

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has been accompanied by an “infodemic,” a term describing the overwhelming spread of both accurate and misleading information that has complicated public health responses globally (Cinnelli et al., 2020; Zielinski, 2021). The World Health Organization (WHO) has highlighted the challenges posed by misinformation, disinformation, and the rapid dissemination of unverified claims, particularly on social media platforms (Chen et al., 2022; Hu et al., 2020; Hua & Shaw, 2020; Kaul & Guaba, 2022; World Health Organization (2020); Ying & Cheng, 2021). Despite the availability of reputable sources, distinguishing credible updates from misinformation remains difficult (Naeem & Bhatti, 2020). The infodemic has eroded trust in health authorities, fueled vaccine hesitancy, and distorted public perceptions of risk (Adekoya & Fasae, 2021; Chen et al., 2022; Freire, 2023; Gupta et al., 2021). Several factors influence its impact, including message framing, risk perception, and

the amplification of misleading content through social media engagement (Priest & Myrick, 2020).

Social media platforms – including Facebook, Twitter, and WhatsApp – have played a critical role in amplifying both accurate and false information, often worsening public uncertainty and anxiety (Freire, 2023; Kaul & Guaba, 2022; Koltay, 2022; Kundhalini, 2023). Research indicates that misinformation about COVID-19 treatments, vaccines, and restrictions often spreads faster than factual corrections (Koltay, 2022; Ying & Cheng, 2021). Emotional and politically charged content tends to generate higher engagement, leading to its broader circulation (Lohiniva et al., 2022; Ying & Cheng, 2021). Additionally, automated bots have contributed to the amplification of false narratives, reinforcing the need for platform-based moderation and improved digital literacy (Yang et al., 2020). A growing body of research links the infodemic to vaccine hesitancy, with individuals frequently exposed to vaccine-related misinformation being significantly less inclined to accept vaccination (Adekoya & Fasae, 2021; Chen et al., 2022; Freire, 2023). Misleading narratives regarding vaccine safety and efficacy have altered public perceptions and

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willingness to vaccinate, reinforcing skepticism toward public health interventions (Adekoya & Fasae, 2021; Chen et al., 2022). These findings highlight the urgent need for infodemic management strategies that counter misinformation and promote reliable health information (Chen et al., 2022; Gupta et al., 2021; Mourad et al., 2024; Susanti et al. (2021); White et al., 2023).

Efforts to manage the infodemic have focused on strategic communication, community engagement, and digital monitoring (Chen et al., 2022; Ghouschi et al., 2023; Gisondi et al., 2022; Hua & Shaw, 2020; Naeem & Bhatti, 2020; White et al., 2023). The WHO has introduced frameworks to enhance health literacy, equipping communities with the tools to critically evaluate sources (Chen et al., 2022; Luo et al., 2023; White et al., 2022; Zarocostas, 2020). Real-time public sentiment analysis aids health authorities in identifying and responding to viral misinformation, while curated COVID-19 datasets support the development of automated misinformation detection methods (Abdeen et al., 2021; Luo et al., 2021; Mourad et al., 2024). Beyond its effects on public health, the infodemic also has significant psychological and societal consequences. Exposure to contradictory and misleading information increases stress, anxiety, and confusion, leading to increased mental health burdens (Chen et al., 2022; Hu et al., 2020; Lee et al., 2023; Su et al., 2021). In some cases, unverified medical claims have resulted in harmful behaviors, such as the ingestion of toxic substances and reliance on unproven treatments (Gavvani, 2020; Rovetta & Bhagavathula, 2020).

The degree to which misinformation affects public behavior varies across regions, shaped by political structures, institutional trust, and cultural dynamics. In Brazil and the United States, political polarization deepened skepticism toward public health measures, while in Indonesia, misinformation weakened trust in government strategies (Chen et al., 2022; Kundhalini, 2023; Rovetta & Castaldo, 2021). In Italy, the severity of the pandemic and inconsistent policy shifts influenced public sentiment and media narratives, requiring targeted communication strategies (Fernandez et al., 2022; Guarino et al., 2021). Meanwhile, in West Africa, low vaccination rates have been linked to deep-rooted distrust in local health institutions rather than misinformation alone (Seytre, 2022). These variations underscore the need for region-specific responses to infodemic challenges (Chen et al., 2022; Williams et al., 2020).

Despite significant research on COVID-19 misinformation, country-specific studies remain limited, particularly in post-communist contexts where institutional trust is fragile. Romania presents a unique case study, given its history of political distrust, media fragmentation, and the

influence of both mainstream and alternative information sources on public discourse. The interaction between political figures, media outlets, and public health institutions in shaping pandemic narratives warrants closer investigation.

In this study, we examine how COVID-19-related misinformation and official communications evolved on Facebook within the Romanian context, focusing on which narratives gained traction over time, how public sentiment toward health measures and pandemic policies fluctuated based on social media discourse, and who the most influential actors in shaping pandemic discussions were, including political figures, media organizations, and health authorities in Romania.

To analyze the dissemination of pandemic-related narratives, we use Facebook data collected via CrowdTangle, a public insights tool that tracks engagement metrics such as shares, reactions, and comments. By examining interactions with posts from political figures, media organizations, and government agencies, we systematically assess which actors were most influential in shaping Romania's COVID-19 discourse. This approach allows us to measure the impact of misinformation, the role of mainstream versus alternative media, and the evolution of public sentiment during the pandemic.

This study addresses three central research questions:

- RQ1: How did the COVID-19 infodemic evolve in Romania, and what major themes and narratives shaped public discourse on social media?
- RQ2: How did the emotional and cognitive responses of the Romanian public shift during the pandemic, as revealed by sentiment analysis?
- RQ3: Who were the key influencers and networks driving information flow, and how did political figures and media outlets shape pandemic-related content on social media?

From a theoretical standpoint, this study broadens the current literature by examining infodemics through the lens of narrative economics (Roos & Reccius, 2024; Shiller, 2017), illustrating how widely circulated stories – particularly about financial repercussions and policy decisions – can reshape collective attitudes and behaviors. Unlike studies focusing solely on misinformation patterns, our approach integrates how economic narratives intertwine with health communications, creating compound effects on public behavior. In post-communist Romania, where trust in institutions remains fragile, pandemic narratives may carry additional weight, as they interact with pre-existing skepticism toward official sources. By simultaneously tracking sentiment patterns and network influences, we can better understand how “narrative entrepreneurs” – such as politicians and media outlets – amplify certain storylines while suppressing

others, ultimately shaping both health behaviors and economic decisions during the crisis. Finally, we offer practical recommendations to improve health communication and mitigate misinformation's economic and social effects, bridging theoretical perspectives with actionable strategies.

This article is organized as follows: Section 2 describes the pandemic context in Romania; Section 3 outlines the data and methods; Section 4 discusses the results from the data analysis; Section 5 presents the conclusions, limitations, and policy implications. The data and codes used to obtain the results in this article are available via <https://github.com/QuantLet/Covid-RO/tree/main>.

2. Pandemic context in Romania

The COVID-19 pandemic posed unprecedented global challenges, with Romania experiencing significant disruptions across public health, economic, and social domains. The country's first confirmed case, involving a resident returning from Italy – one of the early epicenters of the outbreak – was reported on February 26, 2020, in Gorj County. In response, the Romanian government swiftly declared a state of emergency on March 16, 2020, implementing stringent public health measures, including travel restrictions, school closures, and flight suspensions to regions severely affected by the virus.

By early April 2020, Romania, in alignment with many other nations, enforced a nationwide lockdown, which included a nightly curfew and mandatory quarantines for individuals exposed to the virus. Official sources provided daily updates on infection rates, hospitalizations, and fatalities, often framing these statistics to highlight both the public health crisis and its economic ramifications. Social media, particularly Facebook, played a crucial role in disseminating urgent information; however, as observed globally, it also became a primary channel for misinformation, exacerbating public uncertainty and distrust (e.g., Mărcău *et al.*, 2022).

Misinformation during the COVID-19 pandemic has significantly impacted public health efforts in Romania. Studies have shown that false information disseminated through social media has led to increased anxiety and confusion among the population, undermining trust in health measures and contributing to vaccine hesitancy. For instance, research indicates that many Romanian citizens refuse vaccination due to fears generated by uncertainties based on information obtained from fake news (Mărcău *et al.*, 2022). The spread of misinformation has also had psychological consequences for healthcare professionals. Frontline workers have reported elevated

levels of stress, anxiety, and insomnia, exacerbated by the overwhelming influx of false information during the pandemic. This infodemic has added to the burden on already overwhelmed medical staff, highlighting the need for effective communication strategies to combat misinformation (Secosan *et al.*, 2020).

Efforts to counteract misinformation in Romania have included government-led social media campaigns aimed at promoting accurate information about COVID-19 and vaccination. However, public engagement with these campaigns has been limited, and negative emotions such as frustration and anger have been prevalent in responses to official messages. This suggests that simply disseminating information may not be sufficient; addressing underlying public sentiments and building trust are crucial components of effective communication strategies.

As the pandemic progressed, Romania's healthcare system came under considerable strain. Hospitals struggled with an influx of patients, exacerbated by shortages of medical personnel, protective equipment, and critical care resources. While the government expanded hospital capacity and procured additional medical supplies, long-standing concerns over systemic underfunding and understaffing fueled public skepticism regarding the effectiveness of official interventions. This aligns with broader research on public trust during crises, which suggests that institutional credibility plays a crucial role in shaping public compliance with health directives (e.g., Dascalu *et al.*, 2021).

The economic fallout from the pandemic was severe, mirroring global trends. Lockdowns, supply-chain disruptions, and declining business confidence significantly influenced consumer sentiment and policy debates. Romania experienced rising unemployment, particularly in key sectors such as retail, tourism, and manufacturing, triggering a broader economic downturn. Although the government introduced relief measures, including business subsidies and extended social benefits, public discourse frequently characterized these interventions as either insufficient or politically motivated. This aligns with research on the politicization of pandemics, which underscores how economic and health-related measures often become entangled in political narratives, shaping public perceptions of government credibility (Altıparmak *et al.*, 2021).

Romania launched its vaccination campaign in December 2020, prioritizing healthcare workers, older adults, and individuals with pre-existing conditions. However, vaccine hesitancy – driven by economic anxieties, misinformation, and institutional mistrust – hindered efforts to control the virus and delayed economic recovery. This trend mirrored global patterns, with widespread concerns about vaccine safety, efficacy, and long-

term effects often amplified by online misinformation campaigns (Choi & Fox, 2022).

A comparative analysis of Romania's infodemic – the overabundance of information, including false or misleading content – with other Eastern European countries offers valuable insights into how misinformation influenced pandemic outcomes across the region. Studies have indicated that countries with lower levels of trust in government and media tended to experience higher vaccine hesitancy and lower adherence to public health measures (Popa et al., 2022). As case numbers stabilized, the Romanian government modified its communication strategy. By mid-2022, daily pandemic updates were replaced by periodic summaries, reflecting a broader global shift toward sustainable pandemic management centered on vaccination campaigns, booster doses, and measures to prevent healthcare system overload. Nevertheless, public discourse continued to emphasize the long-term economic repercussions, from growing public debt to the precarious situation of small businesses, illustrating the enduring financial impact of the crisis.

According to the WHO, between February 28, 2020, and November 6, 2023, Romania reported 3,499,607 confirmed COVID-19 cases and 68,568 deaths. However, a more telling indicator of pandemic severity is excess mortality, which measures the difference between observed and expected deaths. Recent estimates place Romania's excess mortality rate at over 200 deaths per 100,000 people (Kontis et al., 2022), ranking it among the highest in Europe, alongside Bulgaria, Lithuania, Poland, and Portugal. These figures encompass not only COVID-19-related fatalities but also deaths resulting from disruptions in healthcare services for other conditions, a phenomenon observed in several countries with underfunded and overstretched healthcare systems (Andrei, 2022).

Comparatively, Romania's high excess mortality rate underscores profound structural vulnerabilities within its healthcare infrastructure and broader crisis management capabilities. From a narrative economics perspective (Shiller, 2017), the pandemic not only exposed these underlying weaknesses but also shaped public debate and policy discussions, ultimately influencing the nation's broader response to health crises.

Romania's experience during the COVID-19 pandemic reflects both global and region-specific challenges. The country faced significant healthcare strain, economic disruptions, and a widespread infodemic, all of which contributed to public skepticism and policy complexities. High excess mortality rates and vaccine hesitancy further highlight the need for more resilient health infrastructure, transparent communication strategies, and stronger public

trust in institutions. Moving forward, addressing these systemic issues will be critical for improving Romania's preparedness for future public health crises.

3. Data and methodology

This study employs a mixed-method approach to examine the COVID-19 infodemic in Romania, utilizing data collected from Facebook. The methodology consists of four key phases: data extraction, sentiment analysis, topic modeling, and social network analysis (SNA).

3.1 Data extraction

The research data were systematically extracted using CrowdTangle, a platform that enables the collection of key engagement indicators for public Facebook posts (CrowdTangle Team (2023)). To ensure comprehensive coverage of the infodemic in Romania, we analyzed Facebook posts spanning from March 2020 to June 2022. This timeframe was selected because it not only captures the early outbreak phase but also extends to the point where detailed COVID-19 case reporting declined and public discourse around the topic began to subside.

To identify relevant posts, we employed the Romanian-language keyword "Covid" within CrowdTangle's search function. This approach ensured that all selected content pertained to discussions surrounding the pandemic. The extracted posts include content from a diverse range of sources, including news outlets, government agencies, public figures, and individual users (Table 1).

The dataset used in this study consists of approximately 950,000 entries, each with 47 variables. These variables include the author's name, post content, and metadata related to the user or page initiating the post. Additionally, the dataset captures various forms of engagement, such as the number and type of likes, shares, and comments, providing insights into interaction patterns.

The dataset focuses exclusively on Romania, with Facebook as the primary social media platform. This selection is based on Facebook's dominant role in news dissemination and public communication, particularly by government authorities. As of 2024, Facebook maintained a 91% usage rate among Romanian social media users, with a potential advertising reach of 9.05 million users (Statista, 2024). Furthermore, Facebook dominates public news-sharing practices in Romania, serving as a significant platform for information distribution (Media Ownership Monitor Romania, 2024).

Variable name	Explanation
Post Created Date	Date the post was created (used as an index for the database)
Page Name	Name of the page that posted
Page Category	Page category by industry
Page Description	Short description of the page
Type	Post type (video, status, Photo, Link)
Total Interactions	Total number of interactions
Likes	Number of likes of the post
Comments	Post comment count
Shares	Number of shares of the post
Post Views	Number of views
URL	The link present in the post
Message	Post text

Table 1. Main variables extracted from Facebook posts using the CrowdTangle platform, covering the period from March 2020 to June 2022, with posts selected by choosing “Covid” as a keyword. Source: CrowdTangle data.

3.2 Sentiment analysis

The second phase of this study involved sentiment analysis, which aimed to capture the emotional tone conveyed in Romanian Facebook posts related to COVID-19. By examining how different emotions were expressed in online discussions, this analysis helped identify fluctuations in public sentiment throughout the pandemic. To ensure accurate sentiment classification, we first applied several preprocessing steps to clean and standardize the text data. Since the posts were written in Romanian, we began by removing diacritics using the *Unicodedata* library in Python, converting special Romanian characters such as “ș” and “ț” into standard Latin script to ensure consistency.

Next, we performed tokenization using the Natural Language Toolkit (NLTK), breaking down posts into individual words to facilitate text analysis. All text was then converted to lowercase to maintain uniformity, and a custom vocabulary was created, ensuring the retention of pandemic-related terms while filtering out words that were unrelated to COVID-19.

To further refine the dataset, we applied stopword removal using NLTK’s Romanian language stopword list, eliminating common words such as conjunctions and pronouns that do not contribute meaningful sentiment. We also removed URLs, email addresses, and special characters (e.g., exclamation marks, question marks), as they lack semantic value. Additionally, emojis and hashtags were either removed or mapped to their text-based equivalents

(e.g., 😊 → “happy”) to preserve their sentiment meaning. Further manual cleaning was conducted to eliminate incomplete words or anomalies that automated processes may have missed.

Once the text was preprocessed, sentiment analysis was conducted using the SpaCy library, which includes pre-trained Romanian language models capable of assigning sentiment scores to words based on their emotional value. Each term received a score ranging from -1 to 1, where -1 represents strong negativity, 1 represents positivity, and 0 indicates neutrality. The final sentiment score for each post was calculated by aggregating individual word scores, enabling classification into three primary sentiment categories: negative (-1 to -0.1), neutral (-0.1 to 0.1), and positive (0.1 to 1). Posts classified as negative often expressed frustration, fear, anger, or pessimism, while neutral posts presented factual content without emotional undertones. Positive posts, in contrast, conveyed optimism, relief, or encouragement.

Despite the rigorous methodology, one limitation of this approach is that some contextual nuances in Romanian language sentiment may not be fully captured by automated models, particularly in cases of sarcasm or implicit emotional expression. Additionally, because sentiment analysis relies on individual word scoring, longer posts containing mixed sentiment may not always be accurately classified, as positive and negative expressions may cancel each other out in the final sentiment score.

3.3 Topic modelling

In the context of analyzing the COVID-19 infodemic in Romania, social media platforms, especially Facebook, provide a rich source of unstructured data. These data, when properly analyzed, can offer valuable insights into public sentiment, misinformation spread, and the role of influencers in shaping narratives. Given the volume of content generated during the pandemic, manual analysis is impractical. Researchers have thus turned to text mining techniques like Latent Dirichlet Allocation (LDA) to extract patterns and identify key themes related to COVID-19 (Thakur, 2022).

LDA, an unsupervised machine learning model, is particularly effective for analyzing unstructured text. It identifies hidden topics within large datasets by assuming that topics generate documents. LDA’s ability to recognize the multi-topic nature of social media posts makes it ideal for this study, allowing us to uncover themes related to public concerns, misinformation, and influencers’ roles in the COVID-19 discourse in Romania. The LDA model was used to analyze preprocessed Facebook posts, with five

distinct topics emerging, including pandemic severity and vaccine discussions.

3.4 SNA

The final phase of this study applies SNA to examine how COVID-19-related information was disseminated on Facebook in Romania and to identify key influencers shaping public discourse. Given Facebook's role as a primary platform for both public discussions and official announcements, understanding how information flows, who the most influential actors are, and how different communities interact is essential. To conduct this analysis, we used NetworkX, a Python library designed for analyzing the structure and properties of complex networks.

In this study, each Facebook page or user that posted COVID-19-related content is represented as a node, while interactions such as comments, shares, and mentions form the edges connecting them. The goal is to identify the most central nodes – those with the greatest influence on the network – since these actors play a critical role in shaping public opinion and determining how information spreads during the pandemic.

To quantify influence and network position, we calculated several key centrality metrics, which provide insight into the relative importance of different nodes in the network.

Degree centrality measures how many direct connections a node has to other nodes in the network, indicating its immediate influence based on its number of connections. It is calculated using the following formula:

$$C_D(v) = \frac{\deg(v)}{n - 1}, \quad (1)$$

where $C_D(v)$ is the degree centrality of node v , $\deg(v)$ represents the number of edges (connections) connected to node v , and n is the total number of nodes in the network.

A high degree centrality suggests that a node has numerous direct connections, making it a key player in disseminating information quickly across the network. In this study, Facebook pages or users with the highest degree centrality were identified as the most active hubs, distributing information broadly within the network.

Betweenness centrality measures how often a node acts as a bridge along the shortest path between two other nodes. This metric is crucial for identifying nodes that control the flow of information, as they serve as intermediaries between different clusters or groups within the network. It is calculated as:

$$C_B(v) = \sum_{s \neq v \neq t} \frac{\sigma_{st}(v)}{\sigma_{st}}, \quad (2)$$

where σ_{st} is the total number of shortest paths from node s to node t , and $\sigma_{st}(v)$ is the number of those paths that pass through node v .

Nodes with high betweenness centrality are often gatekeepers or brokers of information, connecting different groups that may not be directly connected. These nodes are critical in the overall network structure, as they can influence the reach and spread of information by connecting otherwise disconnected parts of the network. In the COVID-19 discourse, these individuals or pages may have acted as conduits for information between various public and private organizations, news outlets, and general users.

Eigenvector centrality goes beyond simple connection counts by measuring not only the number of connections a node has but also the importance of the nodes to which it is connected. A node is considered influential if it is connected to other influential nodes. This is computed using the following formula:

$$x_i = \frac{1}{\lambda} \sum_{j=1}^N A_{ij} x_j, \quad (3)$$

where x_i is the eigenvector centrality of node i , A_{ij} is the adjacency matrix representing the connection between nodes i and j , and λ is the largest eigenvalue of the matrix.

Eigenvector centrality identifies nodes that, despite not having the highest number of direct connections, wield significant influence due to their links with other highly connected and influential nodes. In the context of the COVID-19 infodemic, this metric highlights pages or individuals who, while not the most frequent posters, are closely linked to key influencers and therefore have a broader reach within the network.

Beyond pinpointing influential actors, community detection algorithms were applied to uncover distinct clusters within the network. These clusters represent groups that interact more frequently with each other than with external sources, offering insight into how information was disseminated within specific communities. Mapping these interactions helps reveal which groups were most engaged with COVID-19 content and how different segments of the population processed and shared information. Certain political or medical figures may have held greater sway within specific communities, influencing the way information spreads and shaping public perceptions accordingly.

By examining degree, betweenness, and eigenvector centrality alongside community detection, we can better understand how COVID-19 information spread on Facebook in Romania. Identifying the most influential nodes in the network helps reveal who played a key role in amplifying or countering misinformation.

4. Empirical results

4.1 Exploratory data analysis (EDA)

Before applying advanced analytical techniques, an initial EDA was conducted to uncover patterns, trends, and anomalies within the dataset. This process provides valuable insights and informs subsequent hypotheses for deeper investigation.

Figure 1 categorizes Facebook pages from Romania that posted about COVID-19 between 2020 and 2022 based on their level of activity.

The data reveal that political parties and politicians were among the most active contributors, emphasizing the centrality of COVID-19 in Romanian political discourse

during the pandemic. This aligns with the broader trend of pandemic-related topics being leveraged for political narratives. Media organizations, including news sites, TV, and radio, also played a significant role, highlighting their function as key disseminators of COVID-19-related information. Additionally, community and non-profit organizations demonstrated considerable engagement, suggesting an effort to relay public health updates and resources to their respective communities.

Beyond these dominant categories, a variety of other page types – including educational institutions, entertainment pages, and personal blogs – actively participated in COVID-19 discussions, reflecting the pandemic's far-reaching societal impact. The involvement of public figures and influencers further underscores the widespread diffusion of COVID-19-related discourse across diverse public and private spheres.

Figure 2 expands on this analysis by illustrating the number of views received by posts across different Facebook page categories within the same timeframe.

The distribution of post views reveals that news sites were the primary source of COVID-19-related information for the Romanian public, followed by media news companies and government organizations. This indicates a

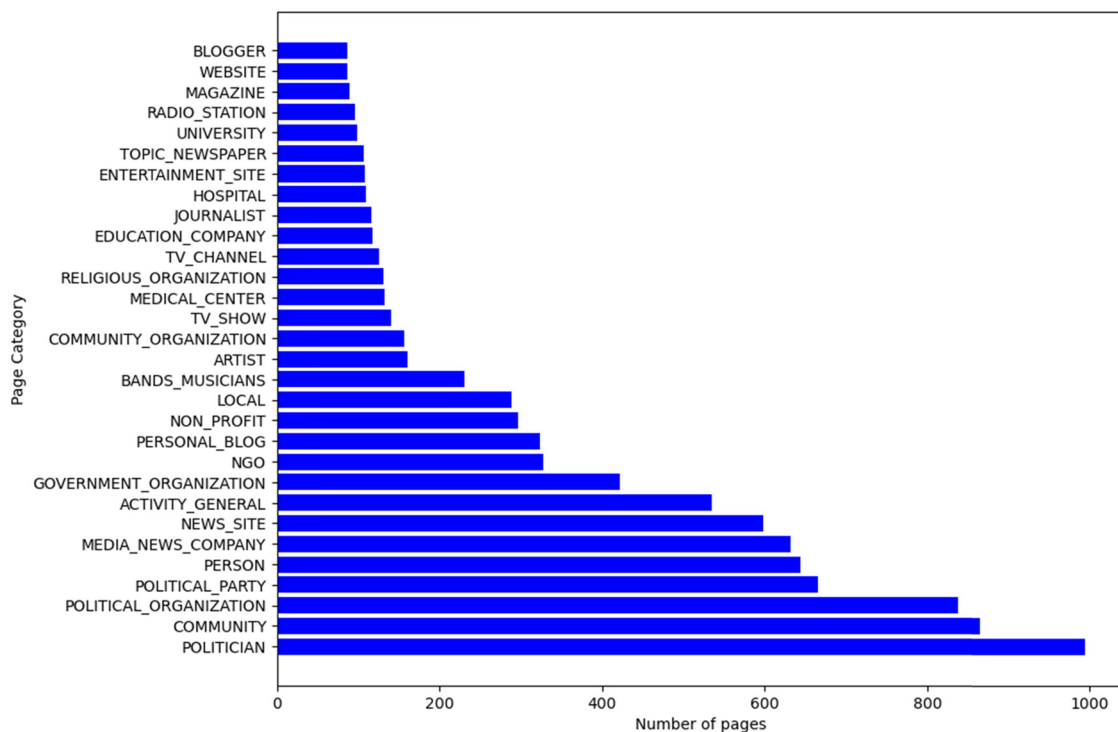


Figure 1. Pages grouped by their level of activity in the top 30 categories.

Source: Author's contribution, <https://github.com/QuantLet/Covid-RO/tree/main/EDA>.

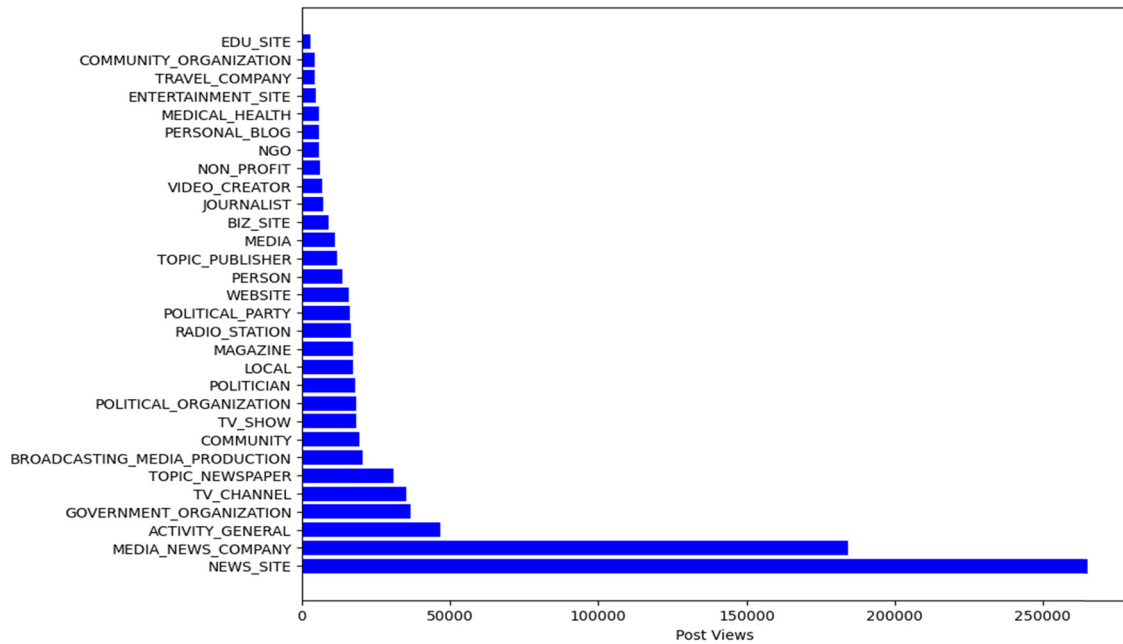


Figure 2. The number of views received by posts from different categories of Facebook pages related to COVID-19 in Romania.
Source: Author's contribution, <https://github.com/QuantLet/Covid-RO/tree/main/EDA>.

strong reliance on official and journalistic sources for pandemic updates, consistent with expectations regarding public health communication.

Notably, government organizations garnered significant engagement, suggesting that official communications played a crucial role in public awareness and response strategies. The presence of categories such as newspapers and broadcasting media further underscores the pivotal role of

traditional media in shaping public discourse. Conversely, categories such as educational sites, community organizations, and travel companies had comparatively lower viewership, suggesting that these sectors contributed less to the information ecosystem surrounding COVID-19 on Facebook.

Figure 3 provides insights into the Romanian public's emotional engagement with COVID-19-related Facebook posts over time. The fluctuating patterns of reactions

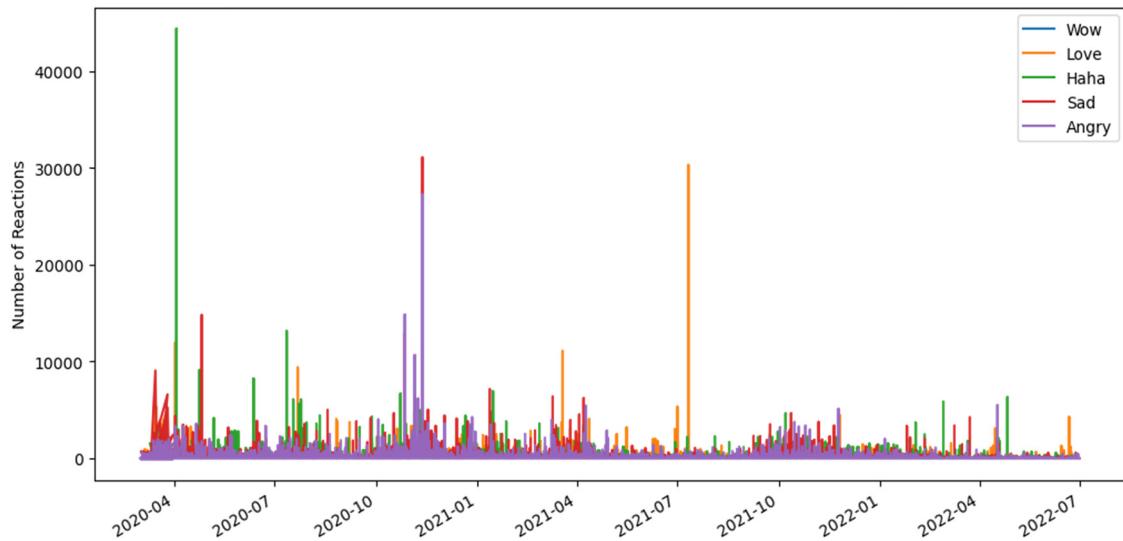


Figure 3. Public's reaction to Facebook posts over time.
Source: Author's contribution, <https://github.com/QuantLet/Covid-RO/tree/main/EDA>.

suggest distinct phases of sentiment throughout the pandemic.

The early peak in “Haha” reactions indicates that humor played a role in coping with initial uncertainty. Later, periodic spikes suggest that satire and irony remained a common response to policy changes and public discourse. The “Love” reaction peaking in mid-2021 aligns with potential moments of collective optimism, such as vaccine rollouts or community-driven support initiatives.

In contrast, the “Sad” reaction correlates with distressing events, such as high mortality rates or economic hardships, while “Angry” reactions rise during periods of public discontent, possibly reflecting backlash against government policies, lockdown measures, or vaccine mandates (Radu, 2021). The co-occurrence of sadness and anger suggests that frustration often accompanied moments of grief, reinforcing public dissatisfaction with crisis management.

Ultimately, the figure highlights the emotional volatility of the public's response to the pandemic.

4.2 Sentiment analysis of Facebook posts

After processing the text and isolating tokens, we generated a WordCloud (Figure 4) to visualize the 100 most frequently used words in Facebook posts related to COVID-19. The predominance of terms such as “Covid,” “people,” “cases,” and “Romania” suggests that the discussion was primarily centered on the pandemic’s impact at both the national and regional levels. The presence of county names, references to vaccines, and medical terminology indicates a strong focus on public health concerns

and the incidence of cases across different areas. Many of these geographical terms appear in conjunction with COVID-19, reinforcing the importance of location-specific discussions, as noted in previous studies (Papapicco, 2020).

The prominence of terms such as “persoane” (people), “cazuri” (cases), “coronavirus,” and “urgentă” (emergency) suggests that discussions were primarily centered on infection rates, mortality, and the severity of the crisis. The frequent appearance of words like “deces” (deaths) and “spital” (hospital) indicates that hospital capacity and fatalities were major public concerns, reflecting anxieties about Romania’s healthcare system.

The presence of geographical terms such as “București,” “Cluj,” and “Constanța” highlights that pandemic discussions were not only national, but also regional, likely in response to local outbreaks and policy measures. This reinforces the idea that the public closely followed how different areas were affected by COVID-19 and how authorities responded at a regional level. Additionally, the recurring mention of “vaccinare” (vaccination) and “împotriva” (against) points to significant engagement with vaccine-related discussions, reflecting both advocacy for immunization and the presence of vaccine hesitancy or opposition.

Another key observation is the focus on governmental measures, as indicated by the frequent use of words such as “măsuri” (measures) and “protecție” (protection). This suggests that public discourse was heavily influenced by discussions about pandemic-related policies, restrictions, and health guidelines, which aligns with global trends where government interventions became a focal point of debate.

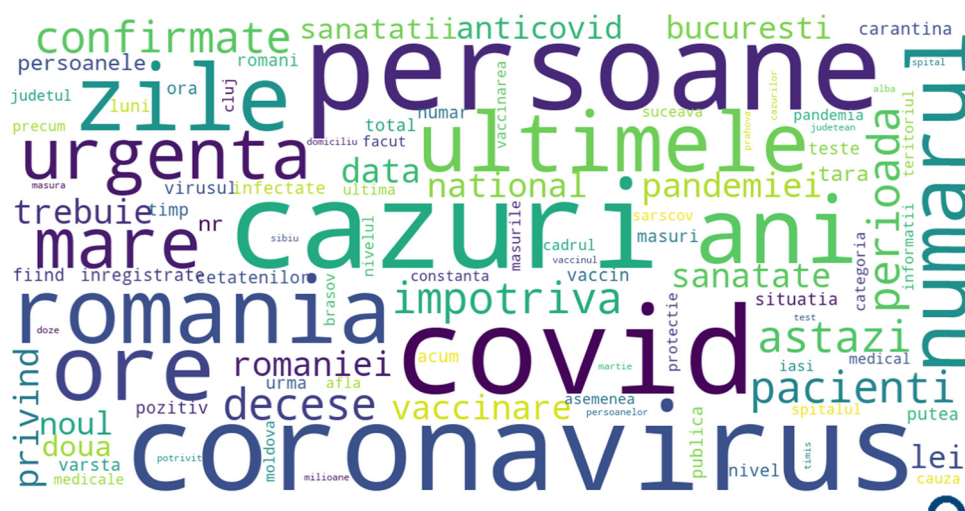


Figure 4. WorldCloud of top 100 most used words extracted from Facebook posts.

Source: Author's contribution, <https://github.com/QuantLet/Covid-RO/blob/main/LDA/WorldCloud.ipynb>.

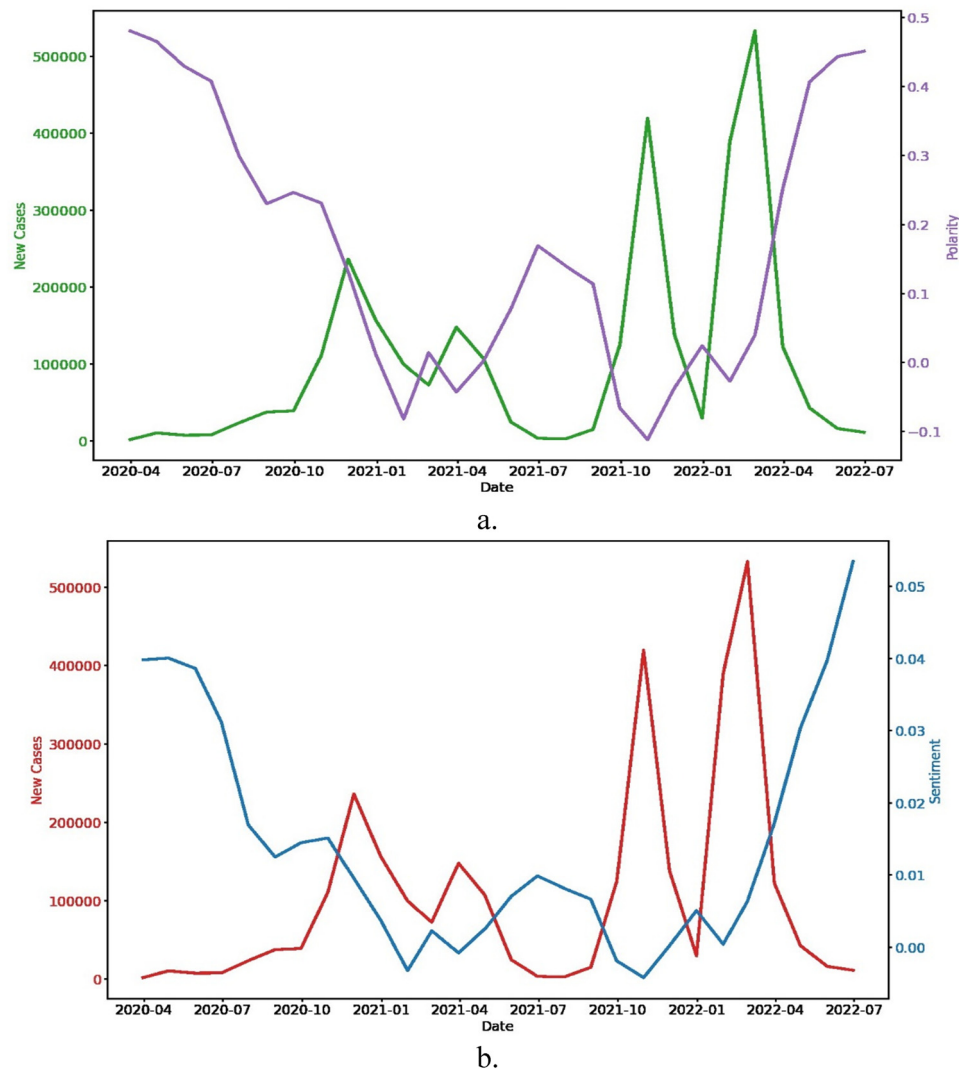


Figure 5. COVID-19 cases vs (a) Polarity and (b) Sentiment extracted from Facebook posts.

Source: Author's contribution, [https://github.com/QuantLet/Covid-RO/blob/main/LDA/Sentiment Analysis.ipynb](https://github.com/QuantLet/Covid-RO/blob/main/LDA/Sentiment%20Analysis.ipynb).

To analyze sentiment trends, we used the SpaCy library, which applies a predefined Romanian-language dictionary to classify words as positive, negative, or neutral. Sentiment scores range from -1 (strongly negative) to 1 (strongly positive), while 0 represents neutrality. This classification allows for an assessment of the emotional tone within Facebook posts discussing COVID-19. Figure 5 provides a comparative analysis of newly reported COVID-19 infections and the public sentiment expressed in social media discourse over time.

In Figure 5a, the purple line represents the number of new COVID-19 cases, while the green line illustrates the polarity of Facebook posts, which measures the strength and nature of sentiment, ranging from negative to positive.

The observed fluctuations in polarity align with key moments in the pandemic, potentially reflecting collective emotional responses to major events.

Figure 5b compares the new COVID-19 cases (blue line) with the sentiment extracted from Facebook posts (red line) over the same period. A sharp decline in sentiment at the beginning of 2020 is consistent with studies that indicate an initial wave of optimism or resilience at the onset of the pandemic, followed by increasing negativity as the crisis deepened (Fernandez et al., 2022).

Notably, there appears to be an inverse relationship between the sentiment extracted from social media and the number of COVID-19 cases. In periods where case numbers surged, public sentiment tended to become more

Topic	Words and probabilities
Number of cases	0.056*“covid” + 0.040*“cases” + 0.030*“people” + 0.025*“hours” + 0.025*“recent” + 0.014*“deaths” + 0.013*“patients” + 0.011*“coronavirus” + 0.010*“number” + 0.010*“county”
Financial aspects	0.027*“lei” + 0.026*“days” + 0.013*“person” + 0.012*“covid” + 0.010*“room” + 0.009*“euro” + 0.008*“rate” + 0.007*“hotel” + 0.007*“test” + 0.006*“period”
Health measures	0.021*“covid” + 0.005*“Romania” + 0.004*“anticovid” + 0.004*“years” + 0.004*“against” + 0.003*“now” + 0.003*“vaccine” + 0.003*“done” + 0.003*“must” + 0.003*“health”

Topics in Romanian: **Topic 1** “0.056*“covid” + 0.040*“cazuri” + 0.030*“persoane” + 0.025*“ore” + 0.025*“ultimele” + 0.014*“decese” + 0.013*“pacienti” + 0.011*“coronavirus” + 0.010*“numarul” + 0.010*“judetul””; **Topic 2** “0.027*“lei” + 0.026*“zile” + 0.013*“persoana” + 0.012*“covid” + 0.010*“camera” + 0.009*“euro” + 0.008*“tariful” + 0.007*“hotel” + 0.007*“test” + 0.006*“perioada””; **Topic 3** “0.021*“covid” + 0.005*“romania” + 0.004*“anticovid” + 0.004*“ani” + 0.004*“impotriva” + 0.003*“acum” + 0.003*“vaccin” + 0.003*“facut” + 0.003*“trebuie” + 0.003*“sanatatii”.”

Table 2. Topics identified through LDA.

Source: Author’s contribution, <https://github.com/QuantLet/Covid-RO/tree/main/LDA>.

negative, likely due to concerns over rising infections, hospitalizations, and restrictive measures. Conversely, sentiment improved during phases where case numbers declined, reflecting moments of relief or optimism.

These findings suggest that public sentiment on social media closely mirrored the real-world progression of the pandemic, emphasizing the role of online discourse as a real-time reflection of collective mood and crisis perception.

4.3 LDA

Table 2 shows the distinct topics with associated words and their respective probabilities within that topic.¹

The analysis of COVID-19-related Facebook discussions in Romania using LDA reveals distinct thematic clusters that structure the pandemic discourse.

The first topic centers on COVID-19 case reporting, emphasizing the number of cases, affected individuals, and fatalities. Key terms such as “covid,” “cazuri” (cases), “persoane” (people), “decese” (deaths), “pacienti” (patients), and “judetul” (the county) highlight a strong focus on official statistics and media updates tracking the pandemic’s progression. These findings align with broader research on crisis communication, where case metrics play a central role in shaping public perception (Papapicco, 2020). However, the dataset does not explicitly reflect discussions on trust in institutions providing these statistics, despite research suggesting that perceptions of data transparency influence compliance with health measures (Asif et al., 2021).

The second topic addresses the financial implications of the pandemic, including costs associated with testing, medical services, and quarantine accommodations. The presence of terms like “lei” (Romanian currency), “euro,” “tariful” (the rate), and “hotel” suggests that economic concerns were a significant part of pandemic-related discussions. This is consistent with global trends where financial anxieties became a major driver of online engagement, as highlighted in prior studies on COVID-19’s economic impact (Asif et al., 2021). The findings indicate that economic discourse may have been more emotionally charged than case reporting, particularly during lockdown periods and economic downturns. Additionally, the framing of financial burdens could have implications for vaccine hesitancy, as individuals weighed the perceived costs and benefits of immunization.

The third topic focuses on Romania’s public health response, including vaccination and containment measures. Key terms such as “vaccin” (vaccine), “impotriva” (against), “sanatatii” (of health), and “trebuie” (must) suggest a discourse centered on vaccine administration and compliance with health directives. Unlike studies that emphasize strong vaccine skepticism in Eastern Europe (Golos et al., 2023), the dataset does not prominently feature misinformation-related terms, indicating that the discussions were framed around practical implementation rather than ideological resistance. However, the lack of a dedicated family well-being topic, as seen in other pandemic-related analyses, suggests that these posts primarily focused on tracking pandemic developments rather than personal experiences. This distinction may stem from differences in data characteristics; while our dataset comprises posts focused on pandemic progress, other studies have examined how individuals sought to mitigate the pandemic’s effects on daily life.

¹ Detailed LDA results can be found here: <https://github.com/danpele/Covid-RO/blob/main/LDA/Lda.html>.

The diversity of these thematic clusters highlights the multifaceted nature of online pandemic discourse, where public attention was divided between tracking infection data, navigating economic challenges, and discussing health interventions. However, merely identifying topics does not fully explain why certain themes dominated or how they evolved over time. The patterns observed in these discussions suggest that narrative structures played a key role in shaping public perceptions, reinforcing the idea that economic survival, government control, and scientific trust were central narratives influencing engagement with pandemic-related content (Shiller, 2017).

While the LDA model successfully delineates thematic boundaries, its results should be interpreted in the context of narrative economics, which argues that public behavior is influenced not only by raw data but also by the stories people construct around those data. The absence of explicit engagement with trust and misinformation narratives, despite their known impact on crisis responses, suggests that further research should investigate how sentiment, institutional credibility, and political discourse interact with these thematic categories. Additionally, expanding the comparative scope to include other Eastern European countries could provide insights into how Romania's COVID-19 discourse differed from or aligned with broader regional trends, particularly concerning vaccine acceptance, economic anxieties, and political trust.

These findings also highlight the need for more targeted public health messaging strategies, as different aspects of the pandemic resonated with different segments of the population. Government agencies and health authorities could benefit from real-time monitoring of online discourse to identify emerging narratives and adjust their communication strategies accordingly. In particular, misinformation monitoring, artificial intelligence (AI)-driven content moderation, and community-based fact-checking could help counteract misleading narratives while reinforcing trust in official sources. Addressing economic concerns through transparent policy communication may also help mitigate resistance to health interventions, especially among those most affected by financial instability.

4.4 SNA

SNA is a methodological approach that applies statistical and mathematical tools to examine patterns of connections within social structures. It is used to identify key actors, understand communication dynamics, and analyze the overall structure of networks consisting of individuals or entities. A core focus of SNA is the study of network

characteristics such as centrality, connectivity, and community structures, as well as the diffusion of information or behaviors through the network. This method helps determine how information propagates and through whom it spreads, offering valuable insights into the role of influential nodes in the network. Visualizing these structures through graphs further clarifies relationships, highlights communication patterns, and identifies weak ties relevant to research and intervention strategies.

To conduct this analysis, we employed Python's NetworkX library, which facilitates the modeling of complex social networks and the identification of critical relationships and influencers. This is particularly relevant in the context of a pandemic, where understanding the spread of information, misinformation, and public discourse is crucial. SNA considers both the fundamental components of a network – nodes (representing entities such as Facebook pages or users) and edges (representing interactions between them, such as mentions, comments, or shares) – and the nature of these relationships, whether directed, undirected, or weighted. Applying this method requires several steps, including data processing and natural language processing (NLP) techniques to extract meaningful insights from large volumes of social media data.

4.4.1 Entity extraction from posts

To identify page names mentioned in other posts, it was necessary to filter key entities from the dataset. Given the large volume of data, we used Named Entity Recognition, a technique that automatically detects and classifies entities into predefined categories. We implemented this using SpaCy, a library optimized for fast and efficient entity recognition through advanced statistical models. The extracted entities included person names (e.g., *Andreea Esca*), organizations (e.g., *Ministry of Business*), and locations (e.g., *Cluj*). From these results, only the names corresponding to pages in the database were retained for network analysis.

4.4.2 Database processing

To construct the network, we refined the extracted entity lists by removing duplicate values within each post, as repeated mentions of the same entity in a single post do not add meaningful connections for analysis. Posts containing only one identified entity were also excluded, as they could not form relationships within the network.

For each post, all entities were paired into source and target columns, creating relationships between the

mentioned individuals or institutions. These connections were prepared for visualization as nodes linked by edges. Any instances where a node was self-referential (i.e., an entity mentioned itself) were removed, as a node cannot form a connection with itself. Additionally, cases where the order of source and target entities was reversed in duplicate rows were consolidated to ensure consistency. The strength of each relationship (or edge weight) was determined by the frequency of co-occurrence within posts – this means that thicker links in the network graph indicate stronger connections between entities.

4.4.3 Network graph construction

Once the dataset was refined, the NetworkX library was used to transform these relationships into a structured network graph. The weights assigned to the edges were incorporated as attributes, visually representing the strength of connections between nodes. This approach enabled the identification of the most influential actors in the Romanian COVID-19 discourse on Facebook, offering insights into information flow, community formation, and potential misinformation dynamics.

Figure 6 presents a graphical representation of the network, where nodes represent individuals or entities, and the edges between them indicate relationships or

interactions. The clustering of nodes reflects communities or subgroups, while highly connected nodes serve as key influencers or central hubs of activity.

To analyze the network, we examine various metrics that offer insights into its structure and dynamics, helping to understand how information flows, which nodes play a critical role, and how resilient the network is to disruptions. One such measure is degree centrality, which identifies the most connected nodes. These highly connected individuals or entities are likely to be influential in spreading information, well-informed, or capable of rapidly reaching a broader audience within the network.

Figure 7 provides insights into the most influential entities in the COVID-19 discourse on Facebook, ranking the top 30 nodes by their degree of connectivity. The data reveal a hierarchical structure of information dissemination, where political figures and media entities serve as central actors in shaping public narratives about the pandemic.

Klaus Iohannis, the President of Romania, emerges as the most frequently mentioned individual, indicating his centrality in discussions surrounding pandemic response and policy decisions. He is followed by Ludovic Orban, Romania's Prime Minister from November 2019 to December 2020, and Vlad Voiculescu, the Minister of Health during the pandemic. Their similar levels of centrality suggest a

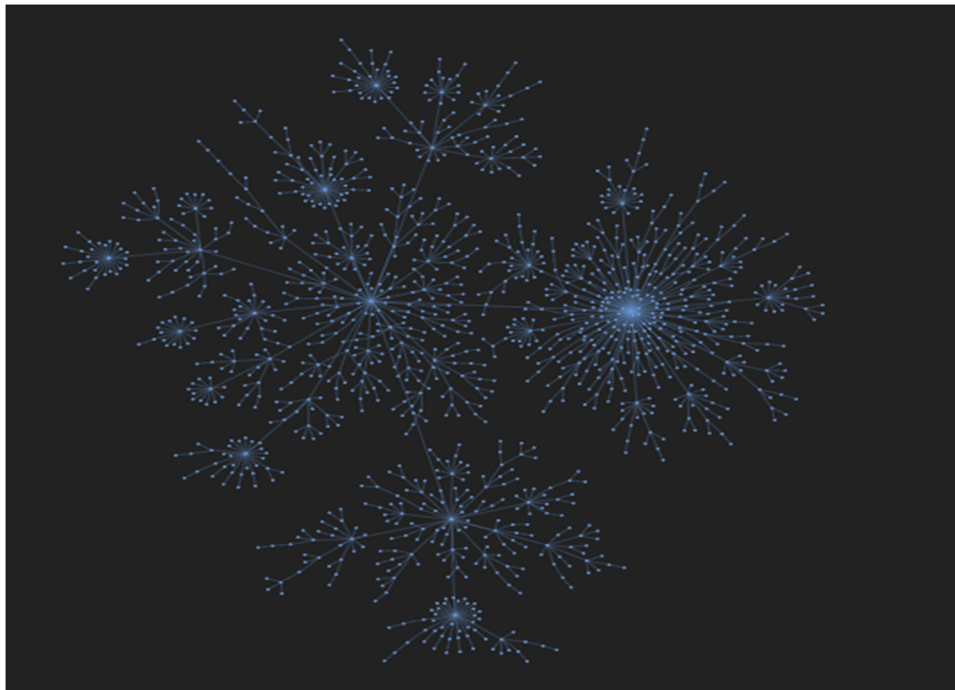


Figure 6. Social Network graph.

Source: Author's contribution, [https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social Network Analysis.ipynb](https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social%20Network%20Analysis.ipynb).

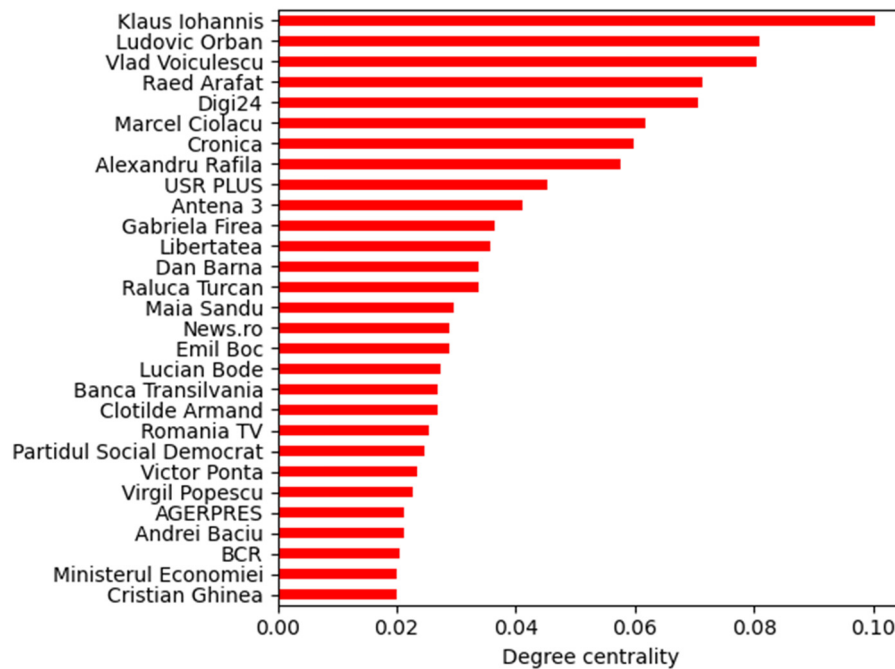


Figure 7. Degree of centrality, top 30 nodes in the network.

Source: Author's contribution, [https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social Network Analysis.ipynb](https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social%20Network%20Analysis.ipynb).

comparable degree of influence in shaping public discourse, particularly as figures associated with government crisis management efforts.

A key institutional figure, Raed Arafat, the Secretary of State and Head of the Department for Emergency Situations, holds a prominent position within the network. As the primary government communicator on restriction measures and emergency protocols, Arafat's high connectivity reflects the public's reliance on authoritative sources for pandemic updates. The visibility of emergency response officials aligns with studies on crisis communication, where official health authorities play a pivotal role in structuring online discussions and public sentiment (Yang et al., 2021).

Among media entities, Digi 24 emerges as the most central television network, reflecting the dominant role of mainstream news outlets in pandemic-related discourse. This finding supports previous research showing that traditional media, despite competition from social media platforms, remained a key conduit for COVID-19 information dissemination (Papapicco, 2020). Cronica.ro follows as another highly cited news source, suggesting a strong engagement with digital media platforms. The presence of USR Plus as the most central political party in discussions highlights its salience in public debates, likely due to its policy stance during the pandemic and active involvement in governance during the 2019–2020 period.

The results underscore the concept of “superspreaders,” where a small number of highly connected nodes exert disproportionate influence over information flows (Yang et al., 2021). In the Romanian context, political leaders and major news organizations function as key amplifiers, shaping the dominant narratives that structured public understanding of the pandemic. However, these findings also raise important questions about the dynamics of information control, the potential for misinformation diffusion through authoritative channels, and the role of social media in reinforcing or challenging official narratives.

The analysis of network centrality measures highlights the key actors in Romania's COVID-19 discourse, revealing how information circulated and which entities played the most significant roles in shaping public narratives. By examining Betweenness Centrality, Closeness Centrality, and Eigenvector Centrality, we can distinguish between those who acted as bridges, rapid disseminators, and structurally influential figures within the network.

Betweenness Centrality, as shown in Figure 8, identifies nodes that serve as intermediaries between different parts of the network, meaning they control the flow of information between otherwise disconnected groups. Klaus Iohannis, Romania's President, stands out as the most central figure, reinforcing his role as a key point of reference in

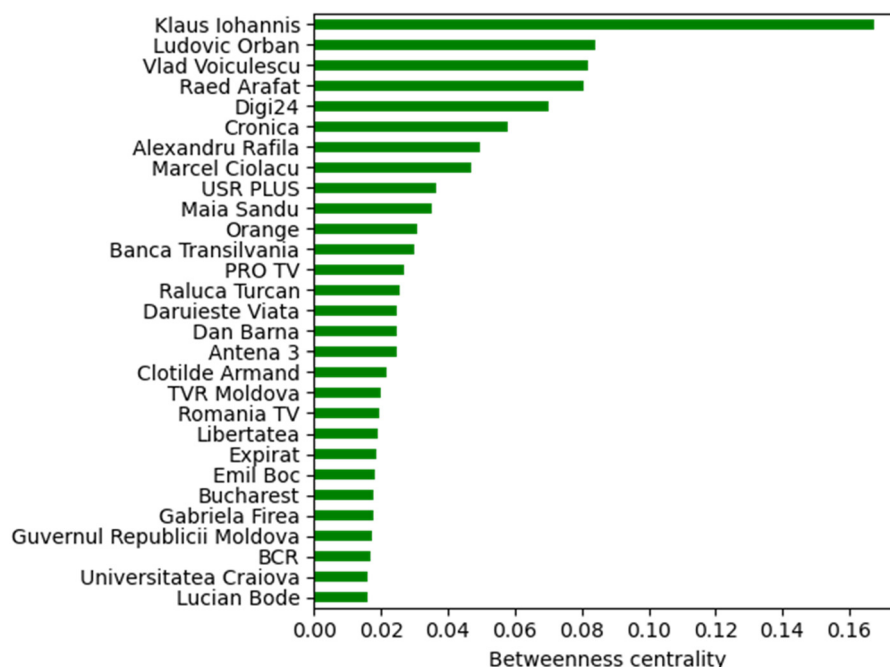


Figure 8. Betweenness centrality, top 30 nodes.

Source: Author's contribution, [https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social Network Analysis.ipynb](https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social%20Network%20Analysis.ipynb).

pandemic-related discussions. His high betweenness centrality suggests that information on COVID-19 was frequently channeled through him, amplifying his role as a dominant voice in the digital conversation. Alexandru Rafila, Romania's representative in the WHO Steering Committee until 2021, and Cronica.ro, a major digital news source, also rank highly, indicating their strategic position in information diffusion. Compared to Marcel Ciolacu,² these entities appear to have played a more pivotal role in connecting different segments of the discourse.

Closeness Centrality, presented in Figure 9, measures how quickly a node can reach all others in the network. The top-ranking entities remain relatively stable, reflecting the high density of interactions within the dataset. However, one notable shift is that Gabriela Firea (former mayor of Bucharest) replaces USR PLUS in the top 10, suggesting that while she may not be the most frequently mentioned figure, she is well-positioned to spread information effi-

ciently across the network. This distinction highlights the importance of both direct visibility and structural positioning in information flow.

Eigenvector Centrality, illustrated in Figure 10, measures a node's influence based on the centrality of its connections, meaning that being linked to other highly influential figures increases a node's overall importance. Klaus Iohannis leads once again (0.2666), followed closely by Ludovic Orban (0.2468) and Vlad Voiculescu (0.2447). Their consistently high rankings across different centrality measures confirm their dominant role in structuring pandemic discourse. Digi24 and Raed Arafat, scoring 0.2249 and 0.2248 respectively, reinforce the strong presence of media organizations and emergency management authorities in shaping public communication. Gabriela Firea and Antena 3 rank lower but remain prominent, reflecting their sustained relevance in COVID-19 discussions.

These findings illustrate the hierarchical nature of information dissemination in the Romanian social media landscape, where political leaders, health officials, and major news outlets played crucial roles in shaping narratives and public perception. The persistence of certain figures across all three centrality metrics suggests that they were not only highly visible but also structurally embedded within the network, influencing the trajectory of information exchange.

² In 2020, Marcel Ciolacu served as the leader of Romania's Social Democratic Party (PSD). He officially assumed this role in August 2020, following an interim leadership period that began in November 2019. As of February 2025, Ciolacu serves as Prime Minister of Romania.

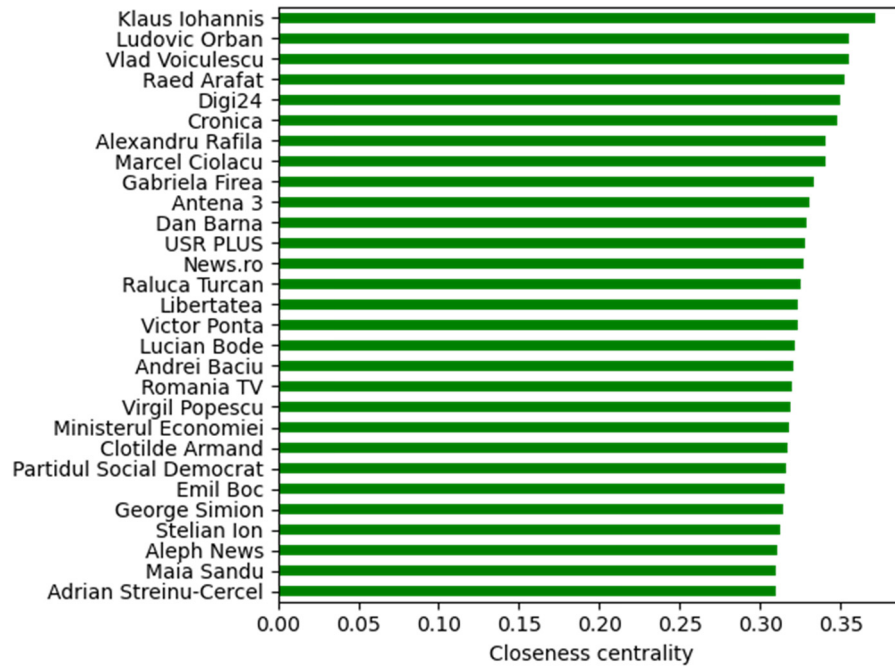


Figure 9. Closeness centrality, top 30 nodes.

Source: Author's contribution, [https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social Network Analysis.ipynb](https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social%20Network%20Analysis.ipynb).

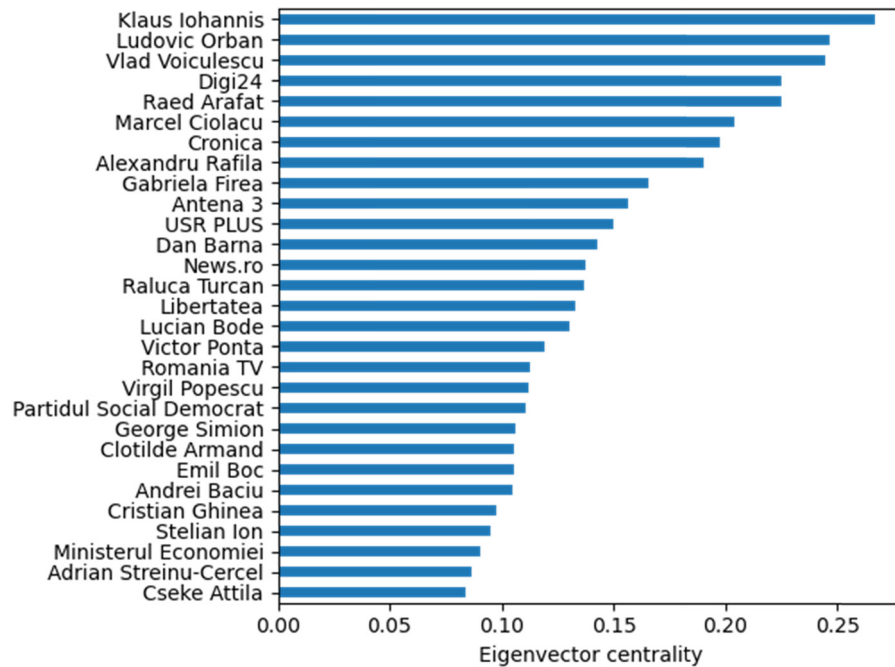


Figure 10. Top 30 eigenvector centrality scores.

Source: Author's contribution, [https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social Network Analysis.ipynb](https://github.com/QuantLet/Covid-RO/blob/main/SNA/Social%20Network%20Analysis.ipynb).

While centrality measures help map the architecture of pandemic discussions, they also raise important questions about the implications of centralized information flows. The

dominance of political figures and institutional actors suggests that the framing of COVID-19 policies and public health measures was largely controlled by a small set of influential entities.

5. Conclusions, limitations, and policy implications

This study models the dynamics of the COVID-19 infodemic by analyzing public Facebook posts in Romania, focusing on the dissemination of news and emergency measures. Although the dataset primarily draws from official news outlets, it reflects a diverse range of users and discussion topics. Sentiment analysis indicates a predominantly neutral tone, with notable shifts aligned with key moments of the pandemic and fluctuations in COVID-19 case numbers. Network analysis identifies key influencers and major information conduits, including political figures and media outlets, underscoring the role of political discourse in shaping public perceptions.

A key insight from this research is the impact of narrative structures on public sentiment and the spread of misinformation, aligning with the concept of narrative economics (Shiller, 2017), which posits that dominant narratives influence public behavior. Future research could formalize hypotheses on how political discourse and key events influenced sentiment trends and misinformation propagation, offering a clearer understanding of the relationship between public discourse and the evolution of the infodemic.

Despite its contributions, this study has several limitations. The analysis focuses exclusively on public Facebook posts, excluding private discussions and other platforms such as WhatsApp and Telegram, which limits the scope of observed interactions. Additionally, reliance on COVID-19-related keywords may have overlooked broader discussions indirectly tied to the pandemic. Automated sentiment classification also presents challenges in detecting sarcasm, implicit emotions, and nuanced contextual shifts, potentially affecting accuracy.

One limitation of this study is that we did not implement a dedicated bot detection mechanism to filter out potential automated accounts or coordinated disinformation campaigns. While CrowdTangle allows for extensive data collection on public Facebook posts, it does not inherently distinguish between human users and bots. As a result, some engagement metrics (e.g., likes, shares, and comments) may include activity generated by automated or inauthentic accounts, potentially influencing the analysis of interaction trends. Future research could address this limitation by incorporating bot detection techniques, such as analyzing posting frequency anomalies and repetitive content patterns, or leveraging external AI-based bot identification tools. Despite this limitation, our dataset provides valuable insights into the broader COVID-19

infodemic, capturing real-time public discourse and information dissemination patterns on Facebook.

Future research should also expand on these findings by employing enhanced methodologies, including advanced network analysis to investigate misinformation flow using weighted edges and temporal network modeling, improved sentiment analysis leveraging state-of-the-art NLP models such as RoBERTa for higher accuracy in classifying emotions in Romanian-language posts, and comparative studies benchmarking Romania's infodemic dynamics against other countries to identify regional and global patterns.

The findings suggest that authorities should adopt a multifaceted approach to managing future infodemics effectively. Systematic misinformation monitoring through AI-driven tools for real-time detection and classification of misinformation trends would enhance response efficiency. Strengthening fact-checking partnerships by improving collaboration between social media platforms, fact-checking organizations, and public health institutions would ensure more effective debunking of false narratives. Designing targeted public communication strategies based on sentiment analysis insights would allow authorities to address concerns proactively across different demographic groups.

Engaging trusted influencers could help amplify accurate health information and counteract misinformation within their communities. Implementing educational campaigns focused on digital literacy would equip users with the skills to critically evaluate sources and recognize misinformation patterns. Establishing community-based interventions through localized information hubs would provide direct engagement with communities to address specific concerns and misinformation themes.

If implemented, these measures could strengthen Romania's resilience against future infodemics, ensuring that accurate information prevails in public discourse. By fostering collaboration between government agencies, social media companies, fact-checkers, and civil society, policymakers can mitigate the harmful effects of misinformation and enhance crisis communication strategies for future public health emergencies.

Acknowledgements

This article was supported through the European Cooperation in Science & Technology COST Action grant CA19130 – Fintech and Artificial Intelligence in Finance – Towards a transparent financial industry; the project “IDA Institute of Digital Assets,” CF166/15.11.2022, contract number

CN760046/23.05.2023; the project “AI for Energy Finance (AI4EFin),” CF162/15.11.2022, contract number CN760048/23.05.2023; the project “Accountable Governance and Responsible Innovation in Artificial Intelligence,” CF158/15.11.2022, contract number CN760047/23.05.2023, financed under Romania's National Recovery and Resilience Plan, Apel nr. PNRR-III-C9-2022-I8; and the Marie Skłodowska-Curie Actions under the European Union's Horizon Europe research and innovation program for the Industrial Doctoral Network on Digital Finance, acronym: DIGITAL, Project No. 101119635.

Author contributions

Andrei Răzvan Săvescu contributed to conceptualization, data curation, software, visualization, and writing the original draft; Daniel Traian Pele supervised the project and contributed to methodology, formal analysis, and writing – review and editing; Miruna Mazurencu-Marinescu-Pele contributed to the theoretical framework, literature review, validation, and writing – review and editing; Alexandra Conda and Vlad Bolovăneanu contributed to formal analysis and writing – review and editing.

Conflict of interest statement

Authors state no conflict of interest.

Data availability statement

The raw data used in this study were obtained through Meta's CrowdTangle platform and cannot be publicly shared due to Meta's data usage and privacy policy. However, the code and processed data supporting the findings of this study are available on the Quantlet platform: <https://github.com/QuantLet/Covid-RO/tree/main>.

References

- Abdeen, M., Hamed, A., & Wu, X. (2021). Fighting the covid-19 infodemic in news articles and false publications: The neonet text classifier, a supervised machine learning algorithm. *Applied Sciences*, 11(16), 7265. doi: 10.20944/preprints202106.0482.v3.
- Adekoya, C., & Fasae, J. (2021). Social media and the spread of covid-19 infodemic. *Global Knowledge Memory and Communication*, 71(3), 105–120. doi: 10.1108/gkmc-11-2020-0165.
- Altıparmak, A., Bojar, A., Brouard, S., Foucault, M., Kriesi, H., & Nadeau, R. (2021). Pandemic politics: Policy evaluations of government responses to COVID-19. *West European Politics*, 44(5–6), 1159–1179. doi: 10.1080/01402382.2021.1930754.
- Andrei, D. M. (2022). Excess mortality associated with the COVID-19 pandemic in Romania. *Ovidius University Annals, Economic Sciences Series*, 22(1), 2–11.
- Asif, M., Zhiyong, D., Iram, A., & Nisar, M. (2021). Linguistic analysis of neologism related to coronavirus (COVID-19). *Social Sciences & Humanities Open*, 4(1), 100201. doi: 10.1016/j.ssaho.2021.100201.
- Chen, X., Lee, W., & Lin, F. (2022). Infodemic, institutional trust, and COVID-19 vaccine hesitancy: A cross-national survey. *International Journal of Environmental Research and Public Health*, 19(13), 8033. doi: 10.3390/ijerph19138033.
- Choi, Y., & Fox, A. M. (2022). Mistrust in public health institutions is a stronger predictor of vaccine hesitancy and uptake than Trust in Trump. *Social Science & Medicine* (1982), 314, 115440. doi: 10.1016/j.socscimed.2022.115440.
- Cinelli, M., Quattrocioni, W., Galeazzi, A., Valensise, C. M., Brugnoli, E., Schmidt, A. L., & Scala, A. (2020). The COVID-19 social media infodemic. *Scientific Reports*, 10(1), 16598. doi: 10.1038/s41598-020-73510-5.
- CrowdTangle Team. (2023). *CrowdTangle*. Facebook, Menlo Park, California, United States. [1714093].
- Dascalu, S., Geambasu, O., Raiu, C. V., Azoicai, D., Popovici, E. D., & Apetrei, C. (2021). COVID-19 in Romania: What went wrong? *Frontiers in Public Health*, 9, 813941. doi: 10.3389/fpubh.2021.813941.
- Fernandez, G., Maione, C., Yang, H., Zaballa, K., Bonnici, N., Carter, J., Spitzberg, B. H., Jin, C., & Tsou, M. H. (2022). Social network analysis of COVID-19 sentiments: 10 Metropolitan Cities in Italy. *International Journal of Environmental Research and Public Health*, 19(13), 7720. doi: 10.3390/ijerph19137720.
- Freire, N. (2023). Impacts of the infodemic on COVID-19 for Brazilian health professionals. *Ciência & Saúde Coletiva*, 28(10), 3045–3056. doi: 10.1590/1413-812320232810.13902022en.
- Gavagni, Z. V. (2020). Infodemic in the global coronavirus crisis. *Depiction of Health*, 11(1), 1–5. doi: 10.34172/DOH.2020.01.
- Ghoushchi, S., Bonab, S., & Ghiaci, A. (2023). A decision-making framework for COVID-19 infodemic management strategies evaluation in spherical fuzzy environment. *Stochastic Environmental Research and Risk*

- Assessment, 37(4), 1635–1648. doi: 10.1007/s00477-022-02355-3.
- Gisondi, M., Chambers, D., La, T., Ryan, A., Shankar, A., Xue, A., & Barber, R. (2022). A stanford conference on social media, ethics, and COVID-19 misinformation (INFODEMIC): Qualitative thematic analysis. *Journal of Medical Internet Research*, 24(2), e35707. doi: 10.2196/35707.
- Golos, A., Guntuku, S., Piltch-Loeb, R., Leininger, L., Simanek, A., Kumar, A. & Bittenheim, A. (2023). Dear Pandemic: A topic modeling analysis of COVID-19 information needs among readers of an online science communication campaign. *Plos One*, 18(3), e0281773. doi: 10.1371/journal.pone.0281773.
- Guarino, S, Pierri, F, Di Giovanni, M, & Celestini, A. (2021). Information disorders during the COVID-19 infodemic: The case of Italian Facebook. *Online Social Networks and Media*, 22, 100124. doi: 10.1016/j.osnem.2021.100124.
- Gupta, G., Ashish, H. L., Farnoush, A., & Jiang, W. (2021). Understanding patterns of COVID infodemic: A systematic and pragmatic approach to curb fake news. *Journal of Business Research*, 140, 670–683. doi: 10.1016/j.jbusres.2021.11.032.
- Hu, Z., Yang, Z., Li, Q., & Zhang, A. (2020). The COVID-19 infodemic: Infodemiology study analyzing stigmatizing search terms. *Journal of Medical Internet Research*, 22(11), e22639. doi: 10.2196/22639.
- Hua, J., & Shaw, R. (2020). Corona virus (COVID-19) “infodemic” and emerging issues through a data lens: The case of China. *International Journal of Environment Research and Public Health*, 17(7), 2309. doi: 10.3390/ijerph17072309.
- Kaul, A., & Guaba, R. (2022). *Communication through Social Media: Fake or Reality*. IntechOpen. doi: 10.5772/intechopen.99719.
- Koltay, T. (2022). The width and depth of literacies for tackling the COVID-19 infodemic. *Journal of Documentation*, 79(2), 269–280. doi: 10.1108/jd-01-2022-0007.
- Kontis, V., Bennett, J. E., Parks, R. M., Rashid, T., Pearson-Stuttard, J., Asaria, P., Zhou, B., Guillot, M., Mathers, C. D., Khang, Y. H., McKee, M., & Ezzati, M. (2022). Lessons learned and lessons missed: Impact of the coronavirus disease 2019 (COVID-19) pandemic on all-cause mortality in 40 industrialized countries and US states prior to mass vaccination. *Wellcome Open Research*, 6, 279. doi: 10.12688/wellcomeopenres.17253.2.
- Kundhalini, A. (2023). Infodemic threat as an obstacle in the covid-19 pandemic handling in Indonesia. *International Journal of Humanities Education and Social Sciences*, 3(2), 1004–1010. doi: 10.55227/ijhess.v3i2.609.
- Lee, A., Kakoschke, N., Higgins, L., Reeson, A., & Brindal, E. (2023). The invisible burden of managing covid-19 for Australian women: Cognitive labor and public health information. *Frontiers in Public Health*, 11, 1041944. doi: 10.3389/fpubh.2023.1041944.
- Lohiniva, A., Nurzhynska, A., Al-hassan, H., Anim, B., & Aboagye, D. (2022). Infodemic management using digital information and knowledge cocreation to address COVID-19 vaccine hesitancy: Case study from Ghana. *JMIR Infodemiology*, 2(2), e37134. doi: 10.2196/37134.
- Luo, J., Peng, D., Shi, L., El Baz, D., & Liu, X. (2023). A comparative analysis of the COVID-19 Infodemic in English and Chinese: Insights from social media textual data. *Frontiers in Public Health*, 11, 1281259. doi: 10.3389/fpubh.2023.1281259.
- Luo, J., Xue, R., Hu, J., & Baz, D. (2021). Combating the infodemic: A Chinese infodemic dataset for misinformation identification. *Healthcare*, 9(9), 1094. doi: 10.3390/healthcare9091094.
- Mărcău, F. C., Purec, S., & Niculescu, G. (2022). Study on the refusal of vaccination against COVID-19 in Romania. *Vaccines (Basel)*, 10(2), 261. doi: 10.3390/vaccines10020261. PMID: 35214719; PMCID: PMC8879492.
- Media Ownership Monitor Romania. (2024). *Media ownership in Romania*. <https://media-ownership.eu/findings/countries/romania/>.
- Mourad, A., Srour, A., Harmanani, H., Jenainati, C., & Arafeh, M. (2024). Critical impact of social networks infodemic on defeating coronavirus COVID-19 pandemic: Twitter-based study and research directions. *IEEE Transactions on Network and Service Management*, 17(4), 2145–2155. doi: 10.1109/TNSM.2020.3031034.
- Naeem, S., & Bhatti, R. (2020). The Covid-19 ‘infodemic’: A new front for information professionals. *Health Information & Libraries Journal*, 37(3), 233–239. doi: 10.1111/hir.12311.
- Papapicco, C. (2020). Informative contagion: The coronavirus (COVID-19) in Italian journalism. *Online Journal of Communication and Media Technologies*, 10(3), e202014. doi: 10.29333/ojcmr/7938.
- Popa, A. D., Enache, A. I., Popa, I. V., Antoniu, S. A., Dragomir, R. A., & Burlacu, A. (2022). Determinants of the hesitancy toward COVID-19 vaccination in Eastern European countries and the relationship with health and vaccine literacy: A literature review. *Vaccines*, 10(5), 672. doi: 10.3390/vaccines10050672.
- Priest, S., & Myrick, J. G. (2020). Communicating risk and uncertainty in the face of COVID-19. *Science Communication*, 42(5), 559–561. doi: 10.1177/1075547020962104.

- Radu, B. (2021). Trust in public institutions and compliance with measures against the COVID-19 pandemic. Case study on the Metropolitan Area of Cluj, Romania. *Transylvanian Review of Administrative Sciences*, 17(63), 128–150. doi: 10.24193/tras.63E.7.
- Roos, M., & Reccius, M. (2024). Narratives in economics. *Journal of Economic Surveys*, 38, 303–341. doi: 10.1111/joes.12576.
- Rovetta, A., & Bhagavathula, A. (2020). Global infodemiology of COVID-19: Analysis of Google web searches and Instagram Hashtags. *Journal of Medical Internet Research*, 22(8), e20673. doi: 10.1101/2020.05.21.20108910.
- Rovetta, A., & Castaldo, L. (2021). Influence of mass media on Italian web users during the COVID-19 pandemic: Infodemiological analysis. *JMIRx Med*, 2(4), e32233. doi: 10.2196/32233.
- Secosan, I., Virga, D., Crainiceanu, Z. P., Bratu, L. M., & Bratu, T. (2020). Infodemia: Another enemy for Romanian frontline healthcare workers to fight during the COVID-19 outbreak. *Medicina (Kaunas, Lithuania)*, 56(12), 679. doi: 10.3390/medicina56120679.
- Seytre, B. (2022). Public perceptions, more than misinformation, explain poor adherence to proven COVID-19 control measures. *American Journal of Tropical Medicine and Hygiene*, 106(4), 1000–1002. doi: 10.4269/ajtmh.21-1251.
- Shiller, R. J. (2017). Narrative economics. *American Economic Review*, 107(4), 967–1004. doi: 10.1257/aer.107.4.967.
- Statista. (2024). *Social media usage in Romania*. <https://www.statista.com/topics/7134/social-media-usage-in-romania/>.
- Su, Z., McDonnell, D., Wen, J., Kozak, M., Abbas, J., Šegalo, S., & Xiang, Y. (2021). Mental health consequences of covid-19 media coverage: The need for effective crisis communication practices. *Globalization and Health*, 17, 4. doi: 10.1186/s12992-020-00654-4.
- Susanti, R., Juniarti, N., & Nurhasanah, N. (2021). Culture versus technology: Bridging the gap to improve COVID-19 prevention and care based on the COVID-19 task force perspectives. *Open Access Macedonian Journal of Medical Sciences*, 9(T6), 92–100. doi: 10.3889/oamjms.2021.7586.
- Thakur, N. (2022). A Large-Scale Dataset of Twitter Chatter about Online Learning during the Current COVID-19 Omicron Wave. *Data*, 7(8), 109. doi: 10.3390/data7080109.
- White, B., Ishizumi, A., Yau, B., Wright, A., Lavery, L., Nguyen, T., & Purnat, T. (2023). Narrative trends over the COVID-19 pandemic: Digital social listening to inform WHO infodemic management. *Studies in Health Technology and Informatics*, 302, 893–894. doi: 10.3233/shti230297.
- White, B., Phuong, L., Roach, J., Teggelove, N., & Wallace, H. (2022). Pandemics, infodemics and health promotion. *Health Promotion Journal of Australia*, 34(1), 169–172. doi: 10.1002/hpja.644.
- Williams, N., Wassler, P., & Ferdinand, N. (2020). Tourism and the covid-(mis)infodemic. *Journal of Travel Research*, 61(1), 214–218. doi: 10.1177/0047287520981135.
- World Health Organization. (2020). *Munich Security Conference*. WHO.
- Yang, K. C., Pierri, F., Hui, P. M., Axelrod, D., Torres-Lugo, C., Bryden, J., & Menczer, F. (2021). The COVID-19 infodemic: Twitter versus facebook. *Big Data & Society*, 8(1), 20539517211013861. doi: 10.1177/20539517211013861.
- Yang, K. C., Torres-Lugo, C., & Menczer, F. (2020). Prevalence of low-credibility information on twitter during the COVID-19 outbreak. In *Proceedings of the Fourteenth International AAAI Conference on Web and Social Media (ICWSM 2020)*. doi: 10.48550/arXiv.2004.14484.
- Ying, W., & Cheng, C. (2021). Public emotional and coping responses to the COVID-19 infodemic: A review and recommendations. *Frontiers in Psychiatry*, 12, 755938. doi: 10.3389/fpsy.2021.755938.
- Zarocostas, J. (2020). How to fight an infodemic. *The Lancet*, 395(10225), 676. doi: 10.1016/S0140-6736(20)30461-X.
- Zielinski, C. (2021). Infodemics and infodemiology: A short history, a long future. *Revista Panamericana de Salud Pública*, 45, e40. doi: 10.26633/RPSP.2021.40.