

10.2478/nispa-2025-0019



Viral Communication Strategies: Facebook Posts and Citizen Engagement during the Covid-19 Pandemic

Bohdan Trembovelskyi¹, Vincent Mabillard²

Abstract:

Government communication is central for raising awareness about policy decisions and influencing citizen behaviour. Social media allows public authorities to involve the population in policy actions via interactive exchanges. This article investigates the link between vaccination-related posts published by government bodies in five Central and Eastern European states on Facebook and citizen engagement during the COVID-19 pandemic. It uses innovative topic modelling and clustering techniques and tests the association between content and engagement. Our study reveals significant differences in social-media engagement across various vaccination communication strategies on Facebook. We found that rational types of content—relying on facts and data—led to the highest levels of citizen engagement.

Keywords:

Central and Eastern Europe, COVID-19, machine learning, social media, vaccination

¹ University of Lausanne - IDHEAP, Lausanne, Switzerland.

² Solvay Brussels School of Economics and Management, Université Libre de Bruxelles, Brussels, Belgium.

1. Introduction

Communication is key to informing citizens about the government's decisions and actions. It also intends to improve the reputation of public organisations and convince people to change their behaviour. Social media offer opportunities to disclose information, reach out to specific groups, foster engagement, and leverage increased engagement to get feedback (DePaula et al., 2017). Such feedback may help governments improve their communication strategies, refine their policies, and collect citizen perceptions about these policies. Getting citizens engaged is therefore central, and regarded as a key objective for governments when using social media.

This observation also applies to crises, when governments need to react quickly to protect their population. While engagement neither guarantees nor acts as a proxy for behavioural change, it provides insights into citizens' feelings about a policy decision. These feelings may orient future communication and help governments refine their strategy as the crisis evolves. Numerous contributions have identified engagement drivers on social media (e.g., Wukich 2020), including post topics. In this regard, research has shown that citizen engagement may be significantly affected by variations in content published on social media (e.g., Dolan et al., 2019; Moran et al., 2019).

However, most contributions addressed the effect of content from a specific perspective (e.g., marketing) and in non-crisis situations. We aim to extend this field of research by addressing the communication strategies adopted by Ukraine, Poland, Slovakia, Moldova, and Romania in their COVID-19 vaccination campaigns. This cross-national perspective is compelling for three reasons. The first regards the dearth of research on this topic in Central and Eastern European (CEE) countries (Obregon et al., 2020; Popa et al., 2022). The content-engagement relationship is worth investigating in states where the vaccination rate is lower than in Western Europe. The second relates to methodology, as there have been few attempts to connect content with engagement using both advanced machine-learning techniques (to identify content) and statistical methods (to test the content-engagement relationship; see Bonsón et al., 2015; Paiva Dias, 2022). The third point concerns the literature's ambiguous and sometimes contradictory findings on the influence of rational and emotional content on engagement (Shahbaznezhad et al., 2021; Dolan et al., 2019).

Based on these considerations, we aim here to 1) identify the content raised by selected CEE countries in their vaccination campaigns; 2) assess whether various content influenced citizen engagement on social media; and 3) test whether rational content had more influence than emotional content. Therefore, our main research question is: during the COVID-19 pandemic, how did citizen engagement vary according to public authorities' communication strategies around vaccination?

The next part introduces the theoretical aspects of social-media communication, focusing on government strategies and citizen engagement, especially during crises. The subsequent part describes our methodological approach. Then, we present our results,

discuss our findings and their implications, and conclude with the limitations and paths for future research.

2. Theoretical background

2.1. Government communication on social media

Historically, government communication relied on traditional media, transmitting one-way messages via press releases, television, radio, and newspapers. Recently, online channels have raised expectations about two-way dialogue, interactivity, and more lively government communication. In this regard, social media—defined by Jin et al. (2011) as digital tools, platforms, and applications that facilitate content exchange among and between publics and organisations—provide opportunities to disseminate information widely, quickly, and more precisely than traditional communication, usually less suited to interactivity and global reach (Solis & Breakenridge, 2009).

Therefore, social media may foster engagement in policymaking, strengthen the state-citizen relationship, and enhance public services through collaboration (Lovari & Valentini, 2020). They provide governments with the possibility to improve citizen access to official information (Islm et al., 2021), to “steal the thunder” in emergencies by releasing information first, and to maintain their reputation by publishing reliable and relevant content (Lovari & Mazzei, 2015; Lee, 2020).

In most cases, social media is still, yet to a smaller extent nowadays, treated as an additional channel to simply release information (Neely & Collins, 2018; Wukich, 2016). When using social media, most government bodies still do not seize the opportunity to increase state-citizen interactions. This observation results from several shortcomings, as emphasised by Chen et al. (2020): vague organisational strategies, insufficient resources, and a lack of formal policies, among others.

The above is unfortunate, since authors such as Badu et al. (2023) have shown that dialogue with target audiences on social media can become proactive and trustful in crises. However, responsiveness can bring a positive reputation and trust, two core aspects for organisations during crises. Indeed, ensuring that crisis information and organisations themselves are perceived as credible and honest is key (Lee, 2016). Theoretical considerations about social-media communication in crises are further developed below.

2.2 Government crisis communication on social media

During crises, government communication is crucial, as citizens need to be informed about the latest developments, understand the actions and decisions made, and comply with these decisions. This joint “sense-making” is particularly important for building public trust and increasing citizens’ willingness to follow recommendations (vaccination in our study). Achieving this objective requires coordination, which should always

rely on a well-established communication strategy. Without a shared and agreed-upon point of view on the crisis and a clear strategy to communicate about it, messages will not reach their target audiences effectively, bringing discord in information flows (Boin & Renaud, 2013).

Regarding crisis communication, the public sector adhered to the use and gratification theory (Katz et al., 1973), meeting citizens' needs for reliable and up-to-date information. In challenging times, social media are regarded as a "driving force in the bleeding edge of crisis communication" (Coombs, 2014, p. 7). However, information, rumours or stories spreading online can be much more unpredictable than if emerging offline (Jin et al., 2011); yet it remains essential for governments to keep disinformation under control.

Recently, Wukich (2020) drew several recommendations for social-media communication during crises, especially on preparedness, resource allocation, and intelligence gathering. Regarding state-citizen relationships, he insisted on the importance of communicating about recovery efforts, encouraging dialogue, and soliciting feedback. Feedback can be collected on social media when measuring citizen engagement. Furthermore, social media can supplement traditional means of surveying public opinion by validating survey findings with social-media data and improving academic research quality, sustainability, and interpretability (Reveilhac et al., 2022).

One of the most recent and global crises was the COVID-19 pandemic. On the communication front, initial responses were disseminated by public health agencies via social media (Jandrić, 2020). Quickly, they emphasised the importance of vaccination to achieve "herd immunity" (Britton et al., 2020). Despite vaccine availability, willingness to follow recommendations remained crucial (Lazarus et al., 2021). Since effective crises require motivating and engaging the public to support government actions (Kim et al., 2021; Ngai et al., 2020), timely and continuous information was disseminated. In the case of the COVID-19 pandemic, it was also crucial for governments to communicate clearly about the evolution of the situation, convince people to follow the issued recommendations, and ensure compliance with the rules. The above calls for a better understanding of citizen engagement, which we will explore in the next section.

2.3 Engagement on social media

Because of its importance in social-media communication, engagement has witnessed significant development in scientific contributions on state-citizen relationships. According to Reddick et al. (2017), a "double-loop learning" approach to social media underlines the importance of interactions to increase participation and improve the quality of public services potentially. Measurement often relies on the metrics proposed by Bonsón and Ratkai (2013) and involves three dimensions:

- A. Popularity: average number of likes per post (per 1,000 followers);
- B. Virality: average number of shares per post (per 1,000 followers);
- C. Commitment: average number of comments per post (per 1,000 followers).

Using these metrics, numerous contributions have used engagement as a dependent variable and investigated the drivers of such engagement through independent variables. Among the determinants, the effect of content triggered much interest. In this regard, Shahbaznezhad et al. (2021) hypothesized that different types of content might have varying moderating effects on engagement, highlighting contrasting results from prior studies. As mentioned above, we aim to analyse here the distinctive effects of rational and emotional content on user engagement during the COVID-19 pandemic.

For the sake of clarity, we need to define these content types. Rational content refers to communication that conveys factual, functional, or educational information aimed at informing or assisting the audience in making decisions. Regarding vaccination, it includes product specification, brand-related updates, technical data, service details, current events and updates, etc. (Shahbaznezhad et al., 2021; Coelho et al., 2016; Cvijikj & Michahelles, 2013; Dolan et al., 2015; Tafesse, 2015). This type of content appeals to users' cognitive processing by offering clear, tangible value through informative and utilitarian messaging. In contrast, emotional content seeks to elicit affective responses and foster personal, political, or social connections. It involves storytelling using humor or empathy, visual or auditory stimulation (such as music or movement), relational cues, and calls for action or entertainment elements that engage the audience on an emotional level (Shahbaznezhad et al., 2021; Coelho et al., 2016; Cvijikj & Michahelles, 2013; Dolan et al., 2015, 2019; Tafesse, 2015). It appeals to users' emotional and psychological needs, and encourages interaction through enjoyment, empathy, or shared experiences. This distinction will allow us to effectively label topic clusters as either rational or emotional, enabling more straightforward interpretation of content strategies and audience engagement patterns.

Focusing on different areas, existing contributions have found a positive, significant relationship between engagement and rational content (e.g., Coelho et al., 2016) or reached the opposite conclusion (e.g. Cvijikj and Michahelles, 2013; Dolan et al., 2019). Most of them focused on one context and used Facebook exclusively. Regarding emotional content, Dolan et al. (2019) revealed that entertaining content tended to generate likes but had little influence on interactive behaviours. Tafesse (2015) showed that creative, humorous, and light-hearted posts were more likely to attract likes compared to factual posts. However, Shahbaznezhad et al. (2021) found that rational content triggers more likes than comments, while emotional content had a significant, adverse effect on getting people to like posts. Mixed evidence may be explained by the various contexts and publications previously analysed.

2.4 Engagement on social media during crises

Some authors also investigated social-media engagement during crises (e.g. Kankanamge et al., 2020). In emergencies specifically, Hofmann et al. (2013) stated that there was no well-defined communication strategy that would consistently generate engagement. Instead, citizens' information-seeking behaviour called organisations to fill "information holes" quickly and efficiently. In this regard, few contributions

investigated how diverse social-media content published by governments on Facebook may influence citizen engagement during crises. For example, Yavetz and Bronstein (2023) analysed government communication on Facebook during the “Guardian of Walls” military operation in Israel. They identified five content types: a) citizen collaboration, b) citizen services, c) empowerment and reassurance, d) guidelines, and e) news and announcements.

Regarding the COVID-19 pandemic, Fissi et al. (2022) showed that in Italy, in the first months of 2020, “there [was] a strict connection between the increasing trend in the number of posts from government and the rise of stakeholder engagement—measured by likes, shares and comments”(p. 287). In the US, Massey et al. (2021) employed natural-language processing (NLP) to sort through over 9 million social-media posts on forums like Reddit and Facebook. They discovered a stagnation in discussions around COVID-19 safety measures, indicating potential fatigue in engaging the public. Zhou et al. (2024) examined Facebook posts using the extended Moral Foundations Dictionary (eMFD). They found that moral framing—specifically appeals to care and fairness—boosted engagement, especially in politically-aligned regions, suggesting that alignment with local values may enhance message reception.

Based on the theoretical considerations presented above and the lack of studies in Central and Eastern Europe, we investigate the vaccination communication strategies of government social-media accounts in selected CEE countries. Building on prior contributions that showed an effect of communication strategies on engagement in crises (Yavetz & Bronstein, 2023), we test whether content published on Facebook had an effect on citizen engagement during the COVID-19 pandemic. Additionally, given the mixed evidence in the literature, we wish to assess the difference between the rational and emotional content of social-media posts related to COVID-19 published by governments.

3. Methodology

3.1. Data collection

Initially, we collected 12,911 posts from Facebook, Instagram, and Twitter (now X) in eight states (Ukraine, Poland, Czechia, Slovakia, Hungary, Moldova, Romania, and Bulgaria) between 1 November 2020 and 31 October 2021. Out of these 12,911 posts, 8,463 were Facebook posts, confirming the predominance of Facebook in the region (Zumofen et al., 2023).

To analyse the posts, we capitalised on the fusional nature of Slavic languages, especially the use of inflections, i.e., changes in the form of words (e.g. endings). As we intended to cover the broadest possible syntactic variations of keywords, we collected data using root words related to “vaccination”, without prefixes and suffixes, known as a stem: *вакц-* (Ukrainian); *szczep-* (Polish); *očkov-* (Slovak); *vaccin-* (Romanian).

Stemming is the process of removing inflectional endings to simplify search and retrieval of social-media posts. Content-wise, this allowed for mitigating potential data shortages and achieving analytical objectivity and solidity.

Seven thousand five hundred thirty-one posts related to COVID-19 vaccination were gathered and filtered through the Facebook active and indexable official accounts, including the Presidents' and Prime Ministers' offices, parliaments' chambers, and the central governing ministries dealing with the pandemic (Appendices B, C, D, E, F). The dataset covers the preselected period mentioned above. Due to high variations in the dataset, we excluded the countries with the lowest publications on vaccination (Czechia, Hungary, and Bulgaria).

3.2 Data processing

The first analytical step involved the qualitative examination of content to identify similarities and differences in vaccination-related Facebook posts. We used natural language processing, a topic modelling technique that helped discover latent communication patterns and themes (a set of semantically relevant words) within documents. To put it simply, "[a] topic is the theme, matter or subject of the text; it is the thing being discussed"; to give an example, one can assume from a topic containing the words "warming", "temperature", and "environment" that it is about global warming (Angelov, 2020, p. 1). To ensure the relevance and coherence of topic allocation, we reviewed all extracted keywords from the posts.

More precisely, we used Grootendorst's (2022) BERTopic modelling technique. This technique relies on the analysis of entire sentences and not on the simple statistical distribution of words. It allows for the creation of dense clusters, helping us interpret the topics that emerged from the analysis. The BERTopic syntax begins with the document-embedding technique, which involves converting social-media posts into high-dimensional numerical vectors that represent the overall meaning of the text in the dataset. Then, for effective clustering, embedded data should be reduced in dimensions. The Uniform Manifold Approximation and Projection (McInnes et al., 2018) algorithm reduces high-dimensional embedding into a lower, two-dimensional space while preserving their local and global structure, specifically for visualisation and clustering purposes. Hierarchical Density-Based Spatial Clustering of Applications with Noise (McInnes et al., 2017) was later used to group clusters based on their density and proximity to each other. The resulting clusters were labelled as topics. Finally, we used KeyBERT³ to create a coherent keyword representation, since it helped detect the most relevant words or phrases in a textual corpus. It also allowed for a better understanding of key themes and provides better interpretability for the next coding steps.

Since a decision was made to rely on a cluster analysis instead of BERTopic's automatic topic reduction, we extracted as many topics as possible using the

³ <https://maartengr.github.io/KeyBERT/api/keybert.html>.

“min_topic_size=2” model setting. A topic is considered if there are at least two semantically similar documents, allowing for more comprehensive topic coverage. Then, we used the elbow method based on the k-means clustering algorithm. Within-Cluster Sum of Squares (WCSS) gives a measure of how tightly the data points are clustered around their centroids. The “elbow” point is where the rate of decrease in WCSS slows significantly. Beyond this point, adding more clusters no longer reduces the WCSS notably, and thus does not provide further revealing insights into the data, visually resembling an elbow in the plot.

To deal with social media posts that were allocated to overgeneralized topics of -1 or 0 (often considered as very broad or noisy), we developed a reorganising algorithm to reassign those documents to their second-best topics, by checking topic distribution for each document and finding the highest probability topic that is neither -1 nor 0. The total number of extracted topics ranged between 104 and 62 according to the countries (Ukraine = 104, Poland = 91, Moldova = 78, Romania = 68, Slovakia = 62). To process various languages (Ukrainian, Polish, Slovak, Romanian), a multilingual model for the embedding step was used. The most extensive datasets in our collection (Poland, 1843 posts and Romania, 1970 posts) resulted in seven clusters of topics per country (Table 1). To keep the results homogeneous and comparable, and reduce size bias, we specified the cluster size of topics as 7 for all countries.

Table 1:
Accounts, posts, topics, and clusters per country

Country	Official social-media accounts	Posts	Topics modelled	Clusters
Romania	24	1970	68	7
Poland	18	1843	91	7
Ukraine	23	1583	104	7
Slovakia	17	1159	62	7
Moldova	16	976	78	7

3.3 Data analysis

To strengthen and complement our results, the topic modelling technique was combined with statistical inferential methods to establish an explanatory relationship between the topics and citizen engagement (Chen et al., 2021). Social media posts were not normally distributed over the topics and their clusters, making it impossible to use ANOVA to test differences across groups. We preferred the Kruskal-Wallis test, a non-parametric alternative to ANOVA, followed by post-hoc tests to identify which specific groups (clusters here) differed from others. The above explained which cluster may influence engagement more than others. We complemented this analysis with a Benjamini-Hochberg procedure, providing a balance between discovering true positives and

limiting false positives. Four calculation phases per dataset with 7 clusters each (0-6) were performed, testing hypotheses on whether clusters may influence: 1) reactions; 2) comments; 3) shares; 4) the sum of three (engagement).

4. Results

4.1. Overview of communication strategies

By categorising social-media posts into topics with a deep machine-learning technique, we extracted and clustered core messages to evaluate overall informational flows and how governments tried to persuade their population to vaccinate. Table 2 presents a country-by-country comparison of the topics, with the emotional topics highlighted in bold and underlined. Thus, we provide a structural review of the communication focus in each country, revealing nuances in how governments tailored their messages. Overall, governments largely favoured publishing a rational type of content on social media. However, among the five countries, Poland strongly emphasised emotional content, with three out of the seven clusters (2, 3, and 6), followed by Romania (3, 5) and Moldova (2, 5) with two clusters each. At the same time, for Slovakia (6) and Ukraine (5), we detected only one emotional cluster per country.

As a result, Ukraine focused on general vaccine promotion and information, logistical clarity for vaccination access, and protective health behaviors to complement vaccination efforts. While Cluster 5 included some rational aspects, focusing on vulnerable populations was often emotionally driven to elicit empathy, highlighting the need for support and care for those most at risk. In addition to more generic topics and its emphasis on its geopolitical role in Europe, Poland integrated military messaging that likely evokes emotions and national pride in Cluster 0. It also ensured empathetic coverage for high-risk and essential worker groups in Cluster 3, with Cluster 6 calling for communal support. Slovakia, on the other hand, prioritised patient care and healthcare-infrastructure information, also calling for communal support and aid in Cluster 6. Romania tried to foster public confidence by scientifically explaining the issue and using motivational slogans in Cluster 3, further evoking a sense of solidarity and a return to everyday life in Cluster 5. Moldova underscored its alignment with international initiatives, which are categorised as emotional here due to their appeal to national pride and political values. It also promotes vaccination as part of its national identity, placing it within Cluster 2.

Table 2:
Country-by-country comparison of government-communication strategies by topic clusters and Rational vs. Emotional Alignment

Cluster	Ukraine	Poland	Slovakia	Romania	Moldova
0	Broad promotion of vaccination and general awareness.	<u>Vaccinations in a military context leverage national defense to encourage vaccination.</u>	Care-focused: Regional healthcare coordination supporting patients.	Vaccine's role in immune response, focusing on antibodies and medical details to build trust through scientific explanations.	Vaccination efforts with COVAX's role in accessibility.
1	COVID-19-specific vaccination efforts emphasise the role of vaccines in combating the pandemic.	General COVID-19 information and vaccination registration guidance.	Warnings, testing, and vaccination registration are essential for safe behaviour.	Vaccination campaigns led by committees and organized teams.	Government and parliamentary participation in vaccination campaigns.
2	Logistical information facilitating public access to vaccination sites and resources.	Poland's role in European strategic discussions involves linking pandemic response to its geopolitical position.	Highlighting clinics and the Ministry of Health's accountability in pandemic management.	Preventive measures and public participation in safe events and responsible behaviour.	<u>Linking vaccination and immunisation with national identity.</u>
3	Protective measures and sanitation practices complement vaccination.	<u>Vaccination efforts for specific groups, such as essential workers and high-risk populations.</u>	The impact of disease and the challenges faced by healthcare facilities, hospital resources, and epidemiological control.	<u>Vaccination and protection campaigns, using motivational slogans.</u>	Moldova's engagement in international vaccination initiatives (e.g., COVAX, Gavi).
4	Highlighting government-led initiatives and policies advancing the rollout and preventive measures.	Broad COVID-19 information campaigns ensuring transparency and updates on pandemic developments.	National vaccination campaign: logistics details, registration, and testing requirements.	Pandemic updates and news.	Digital infrastructure supporting vaccination access (certification and registration systems).
5	<u>Focus on vulnerable populations, including adolescents and individuals with chronic conditions.</u>	Logistics of vaccination registration and healthcare access.	Slovakia's hospital network and response efforts, with a focus on Bratislava as a hub.	<u>Reopening and solidarity: Promoting resilience and returning to everyday life.</u>	<u>Vaccination as an alignment with European integration.</u>
6	Infection control and organisational support via partnerships and community-level responses.	<u>Hospitals and community support for vulnerable groups, particularly older adults.</u>	<u>Patient care in hospitals and community support for healthcare infrastructure.</u>	Post-vaccination issues, healthcare support, and the role of medical professionals.	Orchestrated government and parliamentary involvement in vaccination campaigns.

4.2. Clusters and engagement

The statistical analysis of social-media clusters provided insights into engagement metrics across various themes. Each cluster showed distinct engagement patterns, suggesting varying levels of public interest and response depending on the themes preferred in government communication. Below, we present the main findings for each country.

Detailed results can be found in Appendices B-F.

4.2.1. Ukraine

The Kruskal-Wallis H-test confirmed significant differences ($p < 0.01$ in all cases) in engagement across thematic clusters (likes: $H=164.86$; comments: $H=197.99$; shares: $H=161.10$; total interactions: $H=173.06$). Government-led vaccination efforts (Cluster 4) attracted the highest engagement, followed by general COVID-19 vaccination information (Cluster 1). Content focused on vaccination logistics and vulnerable groups vaccination received the lowest engagement, suggesting limited public interest in these topics.

4.2.2. Poland

A significant variation in engagement was observed across clusters, again at the 0.01 level (likes: $H=143.66$; comments: $H=189.30$; shares: $H=169.62$; total interactions: $H=167.02$). General COVID-19 information and registration guidance (Cluster 1) generated the highest engagement, followed by vaccination logistics and healthcare access (Cluster 5). Strategic discussions on vaccination policies and publications targeting specific groups again had minimal engagement, indicating a preference for practical, actionable content.

4.2.3. Slovakia

Engagement differences were also all statistically significant at the $p < 0.01$ level (likes: $H=87.56$; comments: $H=50.14$; shares: $H=24.81$; total interactions: $H=49.96$). Vaccination campaigns and registration information (Cluster 4) drove the highest engagement, followed by healthcare infrastructure-related content (Cluster 5). Government posts about hospitals (Cluster 2) received the least engagement, reinforcing the preference for direct, practical content over institutional narratives.

4.2.4. Romania

Significant differences in engagement were also identified in Romania (likes: $H=51.30$; comments: $H=48.20$; shares: $H=36.13$; total interactions: $H=41.86$). Content highlighting the vaccine's role in immunity reinforcement (Cluster 0) attracted the highest engagement, followed by publications related to the team-led vaccination campaigns (Cluster 1). Themes focusing on post-vaccination effects and public-event participation generated the lowest engagement, indicating less interest in these topics.

4.2.5. Moldova

The Kruskal-Wallis test confirmed significant engagement differences in Moldova at the 0.05 level as well (likes: $H=15.36$; comments: $H=19.25$; shares: $H=24.77$; total interactions: $H=16.27$). Vaccination campaigns (Cluster 1) generated the highest engagement, followed by content linking vaccination to national identity (Cluster 2). Discussions around international vaccination initiatives and European integration (Clusters 3

and 5) generated the lowest engagement, reinforcing the trend of limited interest in broader, strategic themes.

4.2.6. Summary of engagement by country

The findings confirm that rational content, which relies on facts, logic, and data, is the dominant driver of engagement across all countries. Government-led vaccination campaigns and practical, actionable content consistently led to more interaction, reflecting citizens’ preference for direct and locally relevant information. In contrast, abstract or niche topics, such as international initiatives, strategic discussions, and vaccination for specific groups, received limited engagement.

Different content types evoked varying levels of engagement among citizens in each country, revealing that public interest hinged on specific themes and messaging surrounding COVID-19 vaccination. Rational content focused on government-led vaccination campaigns and actions saw the highest engagement in Ukraine, Moldova, Slovakia, and Romania, indicating a strong response to official sources. Meanwhile, rational, practical information and registration guidance drew the most interest in Poland and Slovakia, further showcasing, again, a clear preference for actionable, straightforward information. Although rational content dominated across all countries, Moldova stood out with an exceptionally high response to emotional content related to vaccination, and especially national identity.

Table 3:

Most engaging (total of interactions / median) clusters per country – emotional clusters are highlighted in underlined bold

Country	Top Engagement	Total	Median	Second-Best Engagement	Total	Median
Ukraine	4 - Vaccination Efforts and Government-led activities	1.329.242	737.5	1 - COVID-19 vaccination	661.222	249
Poland	1 - General COVID-19 information and registration guidance	432.359	58	4 - COVID-19 campaigns	170.547	54
Slovakia	4 - Vaccination campaigns and registration information	1.136.886	622.5	5 - Healthcare infrastructure	114.443	1060
Romania	0 - COVID-19 vaccine role in immune response	910.261	99	1 - Team and committee-led vaccination campaigns	170.421	54
Moldova	1 - Government vaccination campaigns	86.544	121	<u>2 - Vaccination and national identity</u>	<u>71.278</u>	<u>127</u>

Conversely, there were some exceptions for rational content. Strategic discussions related to new vaccine supply or testing, international initiatives, and emotional niche topics like age-specific group vaccination consistently received low engagement in all countries, suggesting limited public interest in abstract or less immediate concerns (Appendix G). This pattern confirmed that citizens prioritised direct, practical, and locally relevant content over broader or strategic themes.

5. Discussion

5.1 Communication strategies

The study's first analytical phase delved into a comprehensive content analysis of social-media posts disseminated by governments. Despite variations in framing and the targeting of specific audience segments, a predominant trend emerged: most countries favoured an informational, pedagogical, and narrative-driven communication approach. This finding aligns with the literature on crisis communication, which emphasises the significance of tailoring messages to resonate with diverse audience groups (Canel & Luoma-aho, 2018) and making information from public authorities easy to reach and consume (Islm et al., 2021). The prevalence of a predominantly informative communication style suggests a concerted effort by governments to engage citizens in sense-making, foster trust, and promote compliance with vaccination recommendations (Kim et al., 2021; Ngai et al., 2020).

In our dataset, we found similarities and differences in communication approaches. Across Ukraine, Poland, Slovakia, Romania, and Moldova, social-media strategies shared core themes: promoting vaccination, offering logistical guidance, and status updates on the issue. All countries emphasised access to vaccination and the importance of institutional support, reflecting a unified approach to public health.

Regarding differences, Ukraine's strategy centred on comprehensive health messaging, encouraging vaccination uptake and promoting safe behaviours. Poland connected vaccination to national defence and European identity, while Slovakia emphasized healthcare resilience, regional support, and leadership visibility. Romania sought to build public trust through scientific explanations and motivational messaging, fostering a proactive public health culture. Moldova highlighted international solidarity and European partnerships in the context of vaccination. These nuanced strategies reflect the adaptability of social media in public-health communication, showing how different countries leveraged specific narratives to enhance vaccination acceptance.

Our main results from the second analytical step, which addresses rational-emotional types of content and engagement, show that while countries adopted similar targets to educate, inform, guide, and update their population to encourage vaccination, their varying focus on the presentation of this issue led to different engagement levels.

Rational social-media content that relies on facts and hard data to convey messages was generally dominant in terms of engagement. However, even some rational clusters related to new vaccine supply or its testing, international initiatives, alongside emotional topics like age-specific group vaccination, received low engagement across all countries. The above might indicate limited public interest in more abstract or less immediate concerns. The result was quite different in terms of emotional content (using feelings, values, and shared experiences). Among all countries, only Moldova received the second-best engagement from emotional content, which addressed vaccination and national identity in this case.

Our results complement prior findings from the crisis-communication literature in various ways. First, they show that effective communication entails more than high frequency of messaging. Although social media prove to be useful for government communication (Pang et al., 2021; Falco & Kleinhans, 2018; Haro-De-Rosario et al., 2016), our findings emphasise the need to move beyond sheer volume and consider other influential factors, such as message quality, content relevance, and emotional resonance withing specific cultural and/or political settings (Limaye et al., 2020).

The above indicates that successful crisis communication requires a multifaceted approach that goes beyond mere message dissemination (Boin & Renaud, 2013) and involves developing communication strategies in advance (Cernicova-Buca & Palea, 2021). Nevertheless, social media must be consistently filled with credible information from governments, reducing the spread of infodemia and disinformation (Lovari, 2020), which might otherwise hinder trust-building (Limaye et al., 2020).

5.2 Theoretical and practical implications

Using BERTopic, our refined approach to identifying social-media content provides a more sophisticated, scalable means of understanding the posts that drive engagement on social media. Focusing on CEE countries, we fill a gap in the literature on crisis communication, offering insights into how governmental strategies vary across different, under-commented contexts. Our findings lay the foundations for future qualitative research, suggesting that beyond content frequency, the nuances of message framing and emotional resonance play a critical role in effective crisis communication.

Our results encourage communication managers to focus on practical communication (vaccination information, registration guidance, and healthcare infrastructure), actionable communication (vaccination updates, thereof statistics, and regular updates), and, in some cases, emotionally resonant messaging (national identity). Emphasising clear guidance for accessing services and leveraging official, trustworthy voices enhances credibility and fosters engagement. In addition, topics involving abstract or strategic discussions (such as vaccine supplies, their testing and international initiatives) and emotional niche concerns (age-specific group vaccination) should be avoided, as they do not enhance two-way dialogue with the public.

6. Conclusion

Social media presents clear advantages, due to user-generated content and interactivity. By including them in their communication toolkit, public organisations can develop a positive reputation with their audience, built on proactive and trustworthy dialogue. This approach aligns with earlier research highlighting the significance of user engagement in shaping public behaviour during crises (Reyes-Menendez et al., 2019; Pang & Liu, 2020). Therefore, during global health crises, government communication should both motivate for action and promote engagement. Governments communicated the initial responses to the COVID-19 pandemic through social media and specialised agencies. By keeping people updated with clear, verified, and relevant content, official sources aimed to position themselves as a credible source of information and foster trust among the population.

Our study highlights the value of maintaining an informative and transparent online presence to establish a sense of reliability and credibility among citizens. Following a detailed content analysis of posts issued by Eastern European public bodies on COVID-19 vaccination, several common themes emerged, including a predominant focus on informational updates, storytelling, and government-led initiatives.

Our research showed strong statistical significance between clusters of content and various elements of social media engagement: a) reactions, b) comments, c) shares, d) sum of three – i.e. engagement. It also showed a strong statistical correlation between specific content clusters and distinct levels of social media engagement metrics: reactions, comments, shares, and overall engagement. We were also able to bring some clarity to the controversial findings on the impact of informational and relational types on engagement.

Our findings indicate that rational-content clusters focused on vaccination efforts, government-led campaigns, and actionable information consistently generated higher levels of engagement. Moreover, moderate engagement resulted from the publication of rational content, covering clusters that related to general vaccination information and healthcare infrastructure across most countries. Only in the case of Moldova did emotional content bring up high engagement, with a moderate level observed in Romania—less actionable topics, such as international and strategic discussions, generated less engagement. The above indicates that audiences were more responsive to rational content that was relevant locally, action-oriented, and directly related to the immediate health concerns of the public.

Our article faces limitations. First, while the vast majority of Facebook posts were retrieved, information might be missing because the data was collected based on keywords, which were reduced to their basic form (stem). Second, because we were looking for meaningful themes within a single theme of COVID-19 (using the elbow method's clusterisation algorithm to group similar topics based on semantic cosine similarity), it is possible that we lost some of the nuanced interpretation stored under fewer or greater

numbers of clusters. Third, while we contribute to the literature with data on under-commented CEE countries, we also acknowledge that communication strategies and public responses may vary considerably in other cultural and political settings (e.g., Western Europe). Fourth, our study focuses on statistical and pairwise significance, which serves a different purpose compared to techniques such as linear regression. While pairwise significance does not account for the influence of additional variables, it aligns with our bivariate scope and provides a clear basis for identifying individual relationships. While comparing broad categories across clusters provides insights, it may overlook finer distinctions within clusters that could offer a deeper understanding of engagement patterns. Moreover, fifth, the software that we used to retrieve social-media data did not differentiate between the various reaction types available on the platform, such as love, haha, sad, wow, or angry. While this is a limitation, we believe that distinguishing between these reactions will lead to a compelling follow-up study on the association between social-media content published by government accounts and citizen engagement, which may imply a manual, post-by-post analysis on a smaller sample.

In addition, our study offers three other compelling paths for future research. The first relates to statistical significance found among content clusters, which highlights an opportunity for complementary, qualitative research. Such a qualitative approach could explore why certain content performs differently by examining posts, topics, and clusters in greater depth. Second, although we cannot establish a direct link between user engagement and willingness to comply with the communication objectives (encouraging people to vaccinate), we identified that some content elicited more citizen responsiveness. A survey distributed among CEE countries may inform on people's willingness to get vaccinated. It would involve testing many socio-political and demographic variables, enabling future research to determine whether government communication on social media plays a role in convincing people to comply with policy objectives such as vaccination. Future studies may thus build on our findings, testing, for instance, the effects of such content through a lab or survey (vignette) experiment. Finally, the trust issue may also be investigated further, as prior research has suggested that culturally sensitive messaging could improve public-health campaigns (in the Romanian case, see Gherheș et al., 2023). In this sense, our article may serve as a foundation for future studies to explore more complex, multivariate relationships between content and emotions expressed through specific reactions, and the engagement-trust relationship in times of crisis.

References

- Angelov, D. (2020). Top2VEC: Distributed Representations of Topics. *arXiv (Cornell University)*. <https://doi.org/10.48550/arxiv.2008.09470>

- Badu, J., Kruke, B. I., & Saetren, G. B. (2023). Crisis Communication and Trustworthiness among Crisis Actors: towards a Typology of Crisis Management Difficulties. *Safety in Extreme Environments*, 5(2), 119–130. <https://doi.org/10.1007/s42797-023-00074-8>
- Boin, A., & Renaud, C. (2013). Orchestrating Joint Sensemaking across Government Levels: Challenges and Requirements for Crisis Leadership. *Journal of Leadership Studies*, 7(3), 41–46. <https://doi.org/10.1002/jls.21296>
- Bonsón, E., Royo, S., & Ratkai, M. (2015). Citizens' Engagement on Local Governments' Facebook Sites. An Empirical Analysis: The Impact of Different Media and Content Types in Western Europe. *Government Information Quarterly*, 32, 52-62. <https://doi.org/10.1016/j.giq.2014.11.001>
- Britton, T., Ball, F., & Trapman, P. (2020). A Mathematical Model Reveals the Influence of Population Heterogeneity on Herd Immunity to SARS-CoV-2. *Science*, 369(6505), 846–849. <https://doi.org/10.1126/science.abc6810>
- Canel, M. J., & Luoma-Aho, V. (2018). *Public Sector Communication: Closing Gaps Between Citizens and Public Organizations*. John Wiley & Sons.
- Cernicova-Buca, M., & Palea, A. (2021). An Appraisal of Communication Practices Demonstrated by Romanian District Public Health Authorities at the Outbreak of the COVID-19 Pandemic. *Sustainability*, 13(5), 2500. <https://doi.org/10.3390/su13052500>
- Chen, Q., Min, C., Zhang, W., Ma, X., & Evans, R. (2021). Factors Driving Citizen Engagement with Government TikTok Accounts During the COVID-19 Pandemic: Model development and analysis. *Journal of Medical Internet Research*, 23(2), e21463. <https://doi.org/10.2196/21463>
- Chen, Q., Min, C., Zhang, W., Wang, G., Ma, X., & Evans, R. (2020). Unpacking the Black Box: How to Promote Citizen Engagement through Government Social Media during the COVID-19 Crisis. *Computers in Human Behavior*, 110, 106380. <https://doi.org/10.1016/j.chb.2020.106380>
- Coelho, R. L. F., De Oliveira, D. S., & De Almeida, M. I. S. (2016). Does Social Media Matter for Post Typology? Impact of Post Content on Facebook and Instagram Metrics. *Online Information Review*, 40(4), 458–471. <https://doi.org/10.1108/oir-06-2015-0176>
- Coombs, W. T. (2014). State of Crisis Communication: Evidence and the Bleeding Edge. *Research Journal of the Institute for Public Relations*, 1(1), 1–12. <https://instituteforpr.org/wp-content/uploads/CoombsFinalWES.pdf>

- Cvijikj, I. P., & Michahelles, F. (2013). Online Engagement Factors on Facebook Brand Pages. *Social Network Analysis and Mining*, 3(4), 843–861. <https://doi.org/10.1007/s13278-013-0098-8>
- DePaula, N., Dincelli, E., & Harrison, T. M. (2017). Toward a Typology of Government Social Media Communication: Democratic Goals, Symbolic Acts and Self-presentation. *Government Information Quarterly*, 35(1), 98–108. <https://doi.org/10.1016/j.giq.2017.10.003>
- Dolan, R., Conduit, J., & Fahy, J. (2015). Social media engagement: a construct of positively and negatively valenced engagement behaviours. In R. J. Brodie, L. D. Hollebeek, & J. Conduit (Eds.), *Customer engagement: Contemporary issues and challenges* (1st ed., pp. 102–123). Routledge. <https://doi.org/10.4324/9781315725185>
- Dolan, R., Conduit, J., Frethey-Bentham, C., Fahy, J., & Goodman, S. (2019). Social Media Engagement Behavior: A framework for Engaging Customers through Social Media Content. *European Journal of Marketing*, 53(10), 2213–2243. <https://doi.org/10.1108/ejm-03-2017-0182>
- Falco, E., & Kleinhans, R. (2018). Beyond Technology: Identifying Local Government Challenges for Using Digital Platforms for Citizen Engagement. *International Journal of Information Management*, 40, 17–20. <https://doi.org/10.1016/j.ijinfomgt.2018.01.007>
- Fissi, S., Gori, E., & Romolini, A. (2022). Social Media Government Communication and Stakeholder Engagement in the Era of Covid-19: Evidence from Italy. *International Journal of Public Sector Management*, 35(3), 276–293. <https://doi.org/10.1108/ijpsm-06-2021-0145>
- Gherheș, V., Cernicova-Buca, M., & Fărcașiu, M. A. (2023). Public Engagement with Romanian Government Social Media Accounts during the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, 20(3), 2372. <https://doi.org/10.3390/ijerph20032372>
- Grootendorst, M. (2022). BERTopic: Neural Topic Modeling with a Class-based TF-IDF Procedure. *arXiv (Cornell University)*. <https://doi.org/10.48550/arxiv.2203.05794>
- Haro-De-Rosario, A., Sáez-Martín, A., & Del Carmen Caba-Pérez, M. (2016). Using Social Media to Enhance Citizen Engagement with Local Government: Twitter or Facebook? *New Media & Society*, 20(1), 29–49. <https://doi.org/10.1177/1461444816645652>
- Hofmann, S., Beverungen, D., Räckers, M., & Becker, J. (2013). What makes local governments' online communications successful? Insights from a multi-method

- analysis of Facebook. *Government Information Quarterly*, 30(4), 387–396. <https://doi.org/10.1016/j.giq.2013.04.002>
- Islm, T., Meng, H., Pitafi, A. H., Zafar, A. U., Sheikh, Z., Mubarik, M. S., & Liang, X. (2021). Why DO Citizens Engage in Government Social Media Accounts during COVID-19 Pandemic? A Comparative Study. *Telematics and Informatics*, 62, 101619. <https://doi.org/10.1016/j.tele.2021.101619>
- Jandrić, P. (2020). Postdigital Research in the Time of COVID-19. *Postdigital Science and Education*, 2(2), 233–238. <https://doi.org/10.1007/s42438-020-00113-8>
- Jin, Y., Liu, B. F., & Austin, L. L. (2011). Examining the Role of Social Media in Effective Crisis Management: The Effects of Crisis Origin, Information Form, and Source on Publics' Crisis Responses. *Communication Research*, 41(1), 74–94. <https://doi.org/10.1177/0093650211423918>
- Kankanamge, N., Yigitcanlar, T., & Goonetilleke, A. (2020). How engaging are disaster management related social media channels? The case of Australian state emergency organisations. *International Journal of Disaster Risk Reduction*, 48, 101571. <https://doi.org/10.1016/j.ijdrr.2020.101571>
- Katz, E., Blumler, J. G., & Gurevitch, M. (1973). Uses and Gratifications Research. *Public Opinion Quarterly*, 37(4), 509. <https://doi.org/10.1086/268109>
- Kim, H. M., Saffer, A. J., Liu, W., Sun, J., Li, Y., Zhen, L., & Yang, A. (2021). How Public Health Agencies Break through COVID-19 Conversations: A Strategic Network Approach to Public Engagement. *Health Communication*, 37(10), 1276–1284. <https://doi.org/10.1080/10410236.2021.1886393>
- Lazarus, J. V., Ratzan, S. C., Palayew, A., Gostin, L. O., Larson, H. J., Rabin, K., Kimball, S., & El-Mohandes, A. (2021). A global Survey of Potential Acceptance of a COVID-19 Vaccine. *Nature Medicine*, 27(2), 225–228. <https://doi.org/10.1038/s41591-020-1124-9>
- Lee, S. Y. (2016). Weathering the Crisis: Effects of Stealing Thunder in Crisis Communication. *Public Relations Review*, 42(2), 336–344. <https://doi.org/10.1016/j.pubrev.2016.02.005>
- Lee, S. Y. (2020). Stealing Thunder as a Crisis Communication Strategy in the Digital Age. *Business Horizons*, 63(6), 801–810. <https://doi.org/10.1016/j.bushor.2020.07.006>
- Limaye, R. J., Sauer, M., Ali, J., Bernstein, J., Wahl, B., Barnhill, A., & Labrique, A. (2020). Building Trust While Influencing Online COVID-19 Content in the Social Media World. *The Lancet Digital Health*, 2(6), e277–e278. [https://doi.org/10.1016/s2589-7500\(20\)30084-4](https://doi.org/10.1016/s2589-7500(20)30084-4)

- Lovari, A. (2020). Spreading (Dis)Trust: COVID-19 Misinformation and Government Intervention in Italy. *Media and Communication*, 8(2), 458–461. <https://doi.org/10.17645/mac.v8i2.3219>
- Lovari, A., & Mazzei, A. (2015). When the press Office goes social. The role of Social Media Policies for Media Relations Strategies in PSOS. *22nd International Public Relations Research Symposium BledCom. Ljubljana, Slovenia*. <https://apeiron.iulm.it/handle/10808/20907>
- Lovari, A., & Valentini, C. (2020). PSOs in an Era of Social Media. In *The Role of Social Media in Today's Global Communications*.
- Massey, D., Huang, C., Lu, Y., Cohen, A., Oren, Y., Moed, T., Matzner, P., Mahajan, S., Caraballo, C., Kumar, N., Xue, Y., Ding, Q., Dreyer, R., Roy, B., & Krumholz, H. (2021). Engagement With COVID-19 Public Health Measures in the United States: A Cross-sectional Social Media Analysis from June to November 2020. *Journal of Medical Internet Research*, 23(6), e26655. <https://doi.org/10.2196/26655>
- McInnes, L., Healy, J., & Astels, S. (2017). hdbscan: Hierarchical Density Based Clustering. *The Journal of Open Source Software*, 2(11), 205. <https://doi.org/10.21105/joss.00205>
- McInnes, L., Healy, J., & Melville, J. (2018). UMAP: Uniform Manifold Approximation and Projection for Dimension Reduction. *arXiv (Cornell University)*. <https://doi.org/10.48550/arxiv.1802.03426>
- Moran, G., Muzellec, L., & Johnson, D. (2019). Message Content Features and Social Media Engagement: Evidence from the Media Industry. *Journal of Product & Brand Management*, 29(5), 533–545. <https://doi.org/10.1108/jpbm-09-2018-2014>
- Neely, S. R., & Collins, M. (2018). Social Media and Crisis Communications: A Survey of Local Governments in Florida. *Journal of Homeland Security and Emergency Management*, 15(1). <https://doi.org/10.1515/jhsem-2016-0067>
- Ngai, C. S. B., Singh, R. G., Lu, W., & Koon, A. C. (2020). Grappling with the COVID-19 Health Crisis: Content Analysis of Communication Strategies and their Effects on Public Engagement on Social Media. *Journal of Medical Internet Research*, 22(8), e21360. <https://doi.org/10.2196/21360>
- Obregon, R., Mosquera, M., Tomsa, S., & Chitnis, K. (2020). Vaccine Hesitancy and Demand for Immunization in Eastern Europe and Central Asia: Implications for the Region and Beyond. *Journal of Health Communication*, 25(10), 808–815. <https://doi.org/10.1080/10810730.2021.1879366>

- Pang, P. C., & Liu, L. (2020). Why do Consumers Review Doctors Online? Topic Modeling Analysis of Positive and Negative Reviews on an Online Health Community in China. *Proceedings of the Annual Hawaii International Conference on System Sciences*. <https://doi.org/10.24251/hicss.2020.087>
- Pang, P. C., Cai, Q., Jiang, W., & Chan, K. S. (2021). Engagement of Government Social Media on Facebook during the COVID-19 Pandemic in Macao. *International Journal of Environmental Research and Public Health*, 18(7), 3508. <https://doi.org/10.3390/ijerph18073508>
- Paiva Dias, G. (2022). Local governments on Facebook: What content encourages citizen participation and what type of municipalities post it the most? In L. Amaral, D. Soares, L. Zheng, M. Peixoto, & C. Braga (Eds.), *Proceedings of the 15th International Conference on Theory and Practice of Electronic Governance (ICEGOV '22)* (pp. 242–247). ACM. <https://doi.org/10.1145/3560107.3560147>
- 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. <https://doi.org/10.3390/vaccines10050672>
- Reddick, C. G., Takeoka Chatfield, A., & Ojo, A. (2017). A social media text analytics framework for double-loop learning for citizen-centric public services: A case study of a local government Facebook use. *Government Information Quarterly*, 34(1), 110–125. <https://doi.org/10.1016/j.giq.2016.11.001>
- Reveilhac, M., Steinmetz, S., & Morselli, D. (2022). A systematic literature review of how and whether social media data can complement traditional survey data to study public opinion. *Multimedia Tools and Applications*, 81, 10107–10142. <https://doi.org/10.1007/s11042-022-12101-0>
- Reyes-Menendez, A., Saura, J. R., & Filipe, F. (2019). The Importance of Behavioral Data to Identify Online Fake Reviews for Tourism Businesses: A Systematic Review. *PeerJ Computer Science*, 5, e219. <https://doi.org/10.7717/peerj-cs.219>
- Shahbaznezhad, H., Dolan, R., & Rashidirad, M. (2021). The Role of Social Media Content Format and Platform in Users' Engagement Behavior. *Journal of Interactive Marketing*, 53(1), 47–65. <https://doi.org/10.1016/j.intmar.2020.05.001>
- Solis, B., & Breakenridge, D. (2009). *Putting the Public back in Public Relations: How Social Media is Reinventing the Aging Business of PR* (1st ed.). FT Press.
- Tafesse, W. (2015). Content Strategies and Audience Response on Facebook Brand Pages. *Marketing Intelligence & Planning*, 33(6), 927–943. <https://doi.org/10.1108/mip-07-2014-0135>

- Wukich, C. (2016). Government Social Media Messages across Disaster Phases. *Journal of Contingencies and Crisis Management*, 24(4), 230–243. <https://doi.org/10.1111/1468-5973.12119>
- Wukich, C. (2020). Government Social Media Engagement Strategies and Public Roles. *Public Performance & Management Review*, 44(1), 187–215. <https://doi.org/10.1080/15309576.2020.1851266>
- Yavetz, G., & Bronstein, J. (2023). Cities under fire: Crisis communication on home front versus frontline cities' Facebook pages during operation 'guardian of the walls'. *Journal of Contingencies and Crisis Management*, 31(3), 421–430. <https://doi.org/10.1111/1468-5973.12448>
- Zhou, A., Liu, W., Kim, H. M., Lee, E., Shin, J., Zhang, Y., Huang-Isherwood, K. M., Dong, C., & Yang, A. (2024). Moral Foundations, Ideological Divide, and Public Engagement with U.S. Government Agencies' COVID-19 Vaccine Communication on Social Media. *Mass Communication & Society*, 27(4), 739–764. <https://doi.org/10.1080/15205436.2022.2151919>
- Zumofen, R., Mabillard, V., & Pasquier, M. (2023). Social media use in Central and Eastern European cities: Defining local government-citizen relationships through phases. *NISPACEE Journal of Public Administration and Policy*, 16(1), 232–253.

Appendix

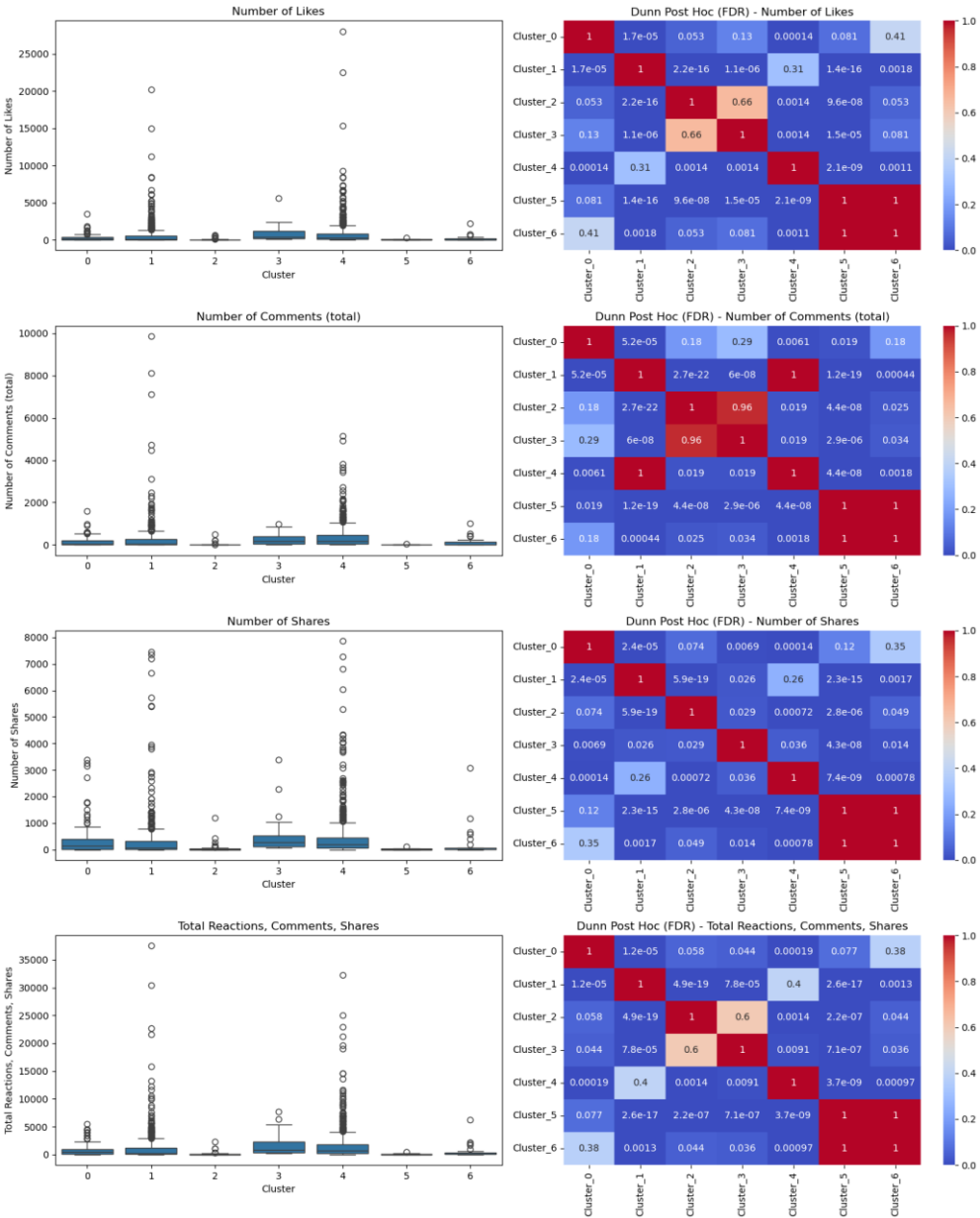
Appendix A: Preliminary distribution of social media posts

# of Vaccination publications	Facebook	Twitter	Instagram	Sum of posts	Vaccinated %
Ukraine	1.583	379	48	2.010	18
Poland	1.843	2.914	196	4.953	53
Czechia	230	154	62	446	57
Slovakia	1.159	1	84	1.244	45
Hungary	639	0	225	864	59
Moldova	976	17	54	1.047	33
Romania	1.970	45	269	2.284	33
Bulgaria	63	0	0	63	22

Appendix B: Ukrainian Post Distribution and Statistical Data

UKRAINE	Facebook, posts
Office of the President	62
Verkhovna Rada	59
Cabinet of Ministers	65
Ministry of Economy	8
Ministry of Internal Affairs	61
Ministry of Energy	1
Ministry of Foreign Affairs	43
Ministry of Ecology and Natural Resources	0
Ministry of Infrastructure	7
Ministry of Culture and Information Policy	11
Ministry of Youth and Sports	11
Ministry of Defence	25
Ministry of Health	1,036
Ministry of Education and Science	72
Ministry of Reintegration of Temporarily Occupied Territories	11
Ministry of Social Policy	2
Ministry of Veterans Affairs	8
Ministry of Finance	34
Ministry of Digital Transformation	44
Ministry of Justice	11
Ministry of Strategic Industries	2
Ministry of Agrarian Policy and Food	2
Ministry of Communities and Territories Development	8
TOTAL POSTS:	1,583

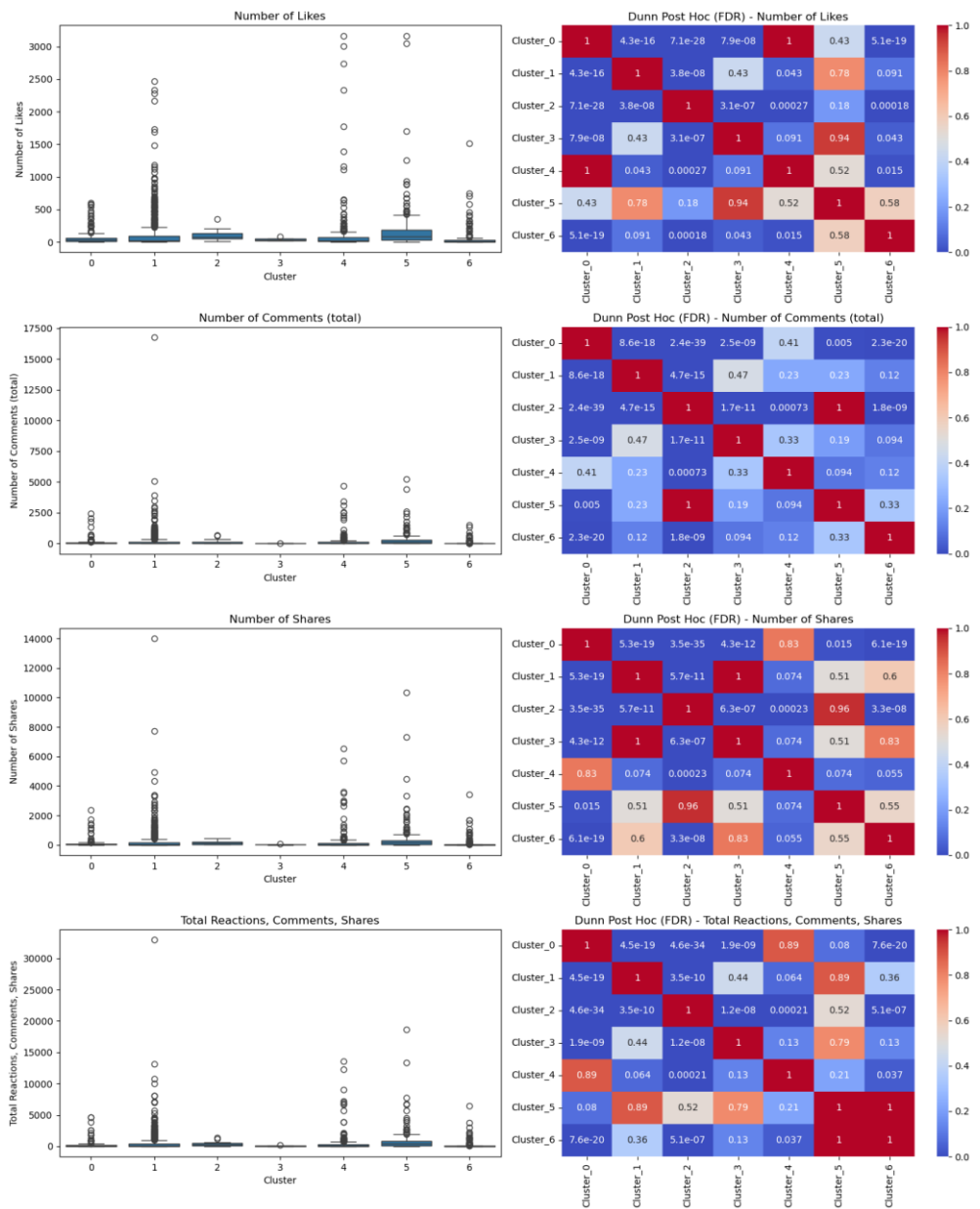
Cluster	Total Likes	Total Comments	Total Shares	Engagement
0	33,664	16,686	41,588	91,938
1	337059	141,176	182,987	661,222
2	3,349	1,078	2,790	7,217
3	22,434	6,298	13,029	41,761
4	677,557	296,070	355,615	1,329,242
5	473	70	183	726
6	5,955	3,215	6,496	15,666
K-W	H-statistic: 164.86 p-value: 5.53e-33	H-statistic: 197.99 p-value: 5.09e-40	H-statistic: 161.10 p-value: 3.47e-32	H-statistic: 173.06 p-value: 1.01e-34
	Median Likes	Median Comments	Median Shares	Median Engagement
0	180	52	141	424
1	136	42	63	249
2	31	1	6	41
3	335	171	262	852
4	322.5	179	189	737.5
5	25	0.5	9.5	34
6	59.5	11.5	16	83



Appendix C: Polish Post Distribution and Statistical Data

REPUBLIC OF POLAND	Facebook, posts
Chancellery of the President	36
Chancellery of the Prime Minister	409
The Sejm	28
The Senate	43
Ministry of State Assets	121
Ministry of Education and Science	185
Ministry of Funds and Regional Policy	44
Ministry of Infrastructure	7
Ministry of Climate and Environment	32
Ministry of Culture and National Heritage	51
Ministry of National Defense	143
Ministry of Family and Social Policy	440
Ministry of Agriculture and Rural Development	18
Ministry of Development and Technology	32
Ministry of Sport and Tourism	0
Ministry of Justice	3
Ministry of Internal Affairs and Administration	42
Ministry of Health	209
TOTAL POSTS:	1,843

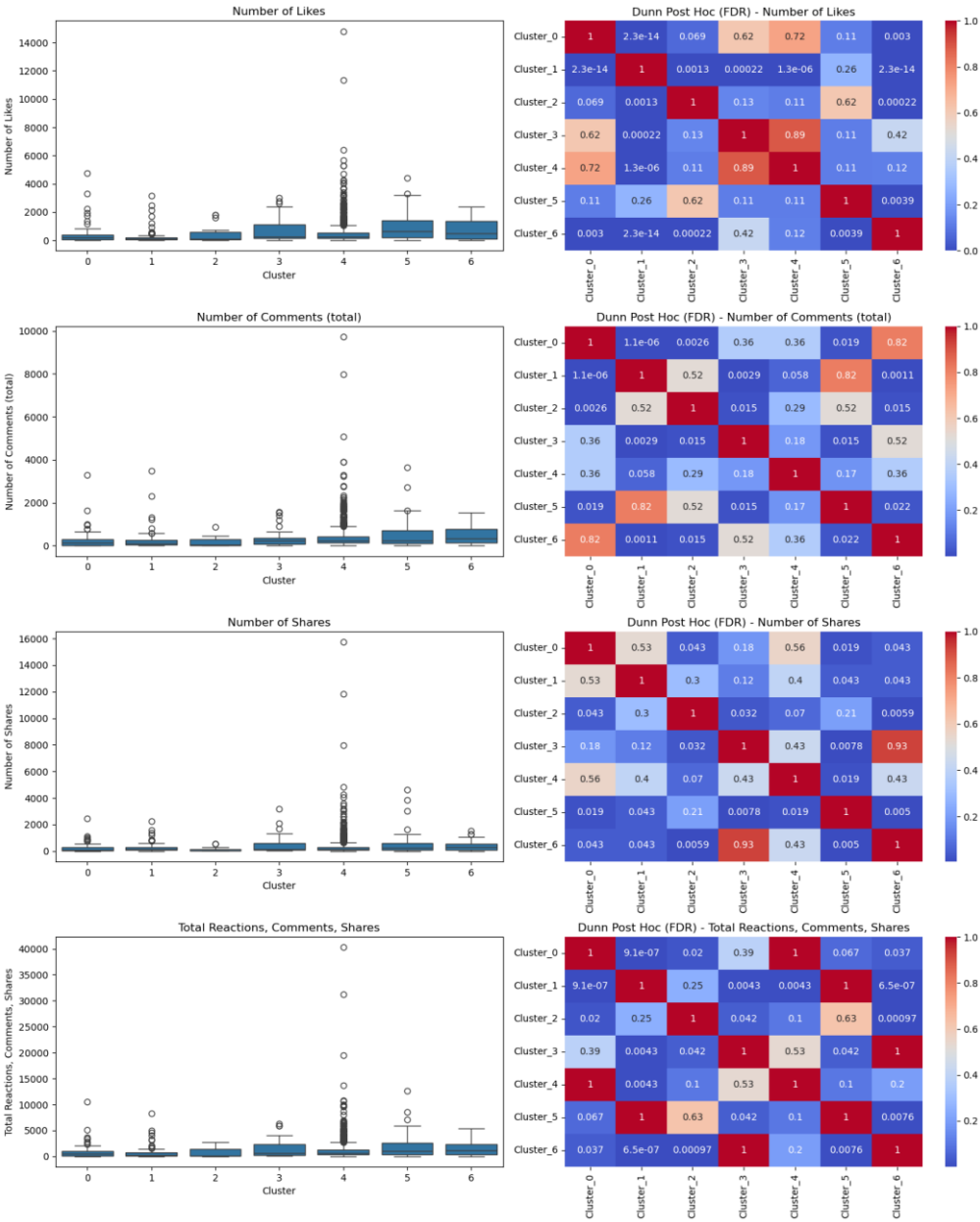
Cluster	Total Likes	Total Comments	Total Shares	Engagement
0	13,023	16,979	18,763	48,765
1	92,237	152,466	187,656	432,359
2	1,333	2,139	1,887	5,359
3	248	25	102	375
4	40,794	56,363	73,390	170,547
5	36,774	61,558	81,849	180,181
6	11,012	9,931	19,414	40,357
K-W	H-statistic: 143.66 p-value: 1.69e-28	H-statistic: 189.30 p-value: 3.59e-38	H-statistic: 169.62 p-value: 5.42e-34	H-statistic: 167.02 p-value: 1.92e-33
	Median Likes	Median Comments	Median Shares	Median Engagement
0	28	13	22	70
1	26	8	22	58
2	72	38	121	337
3	35.5	1	10.5	47
4	21.5	7.5	21	54
5	86	117	156	389
6	14	1	7	23



Appendix D: Slovak Post Distribution and Statistical Data

SLOVAK REPUBLIC	Facebook, posts
Presidential Office	1
Government of the Slovak Republic	29
The National Council	0
Ministry of Economy	5
Ministry for Investments and Informalization	5
Ministry of Finance	44
Ministry of Transport and Construction	3
Ministry of Agriculture and Rural Development	4
Ministry of Interior	65
Ministry of Defense	11
Ministry of Justice	3
Ministry of Foreign and European Affairs	10
Ministry of Labour, Social Affairs and Family	4
Ministry of Environment	2
Ministry of Education, Science, Research and Sport	44
Ministry of Culture	5
Ministry of Health	924
TOTAL POSTS:	1,159

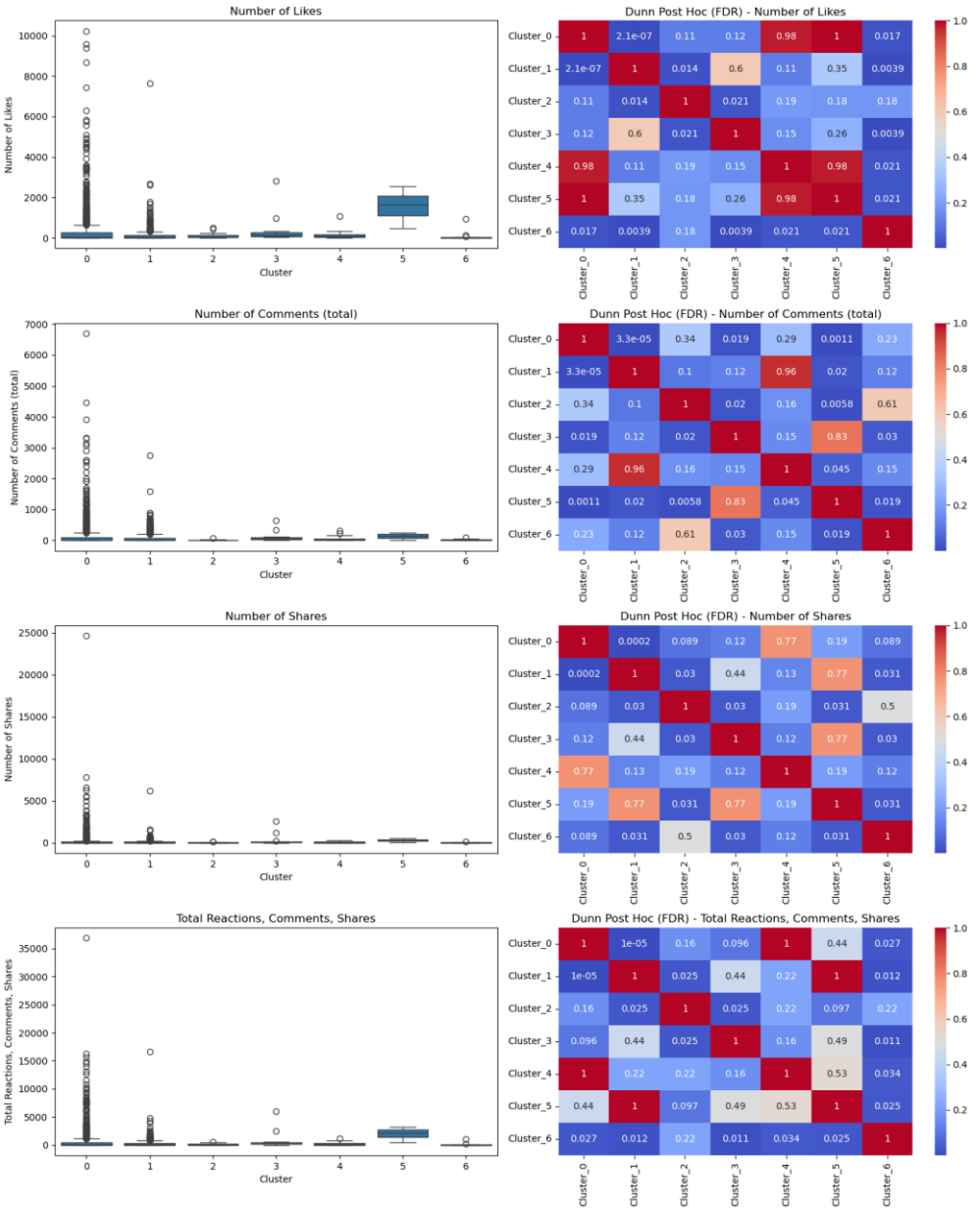
Cluster	Total Likes	Total Comments	Total Shares	Engagement
0	28,677	17,557	15,210	61,444
1	21,774	21,312	22,511	65,597
2	6,869	2,542	1,842	11,253
3	29,781	13,918	18,086	61,785
4	475,866	351,042	309,978	1,136,886
5	53,663	30,153	30,627	114,443
6	13,026	9,451	8,294	30,771
K-W	H-statistic: 87.56 p-value: 9.73e-17	H-statistic: 50.14 p-value: 4.40e-09	H-statistic: 24.81 p-value: 3.70e-4	H-statistic: 49.96 p-value: 4.80e-9
	Median Likes	Median Comments	Median Shares	Median Engagement
0	214	146	99	478
1	87	98	119	290
2	101.5	38.5	25.5	177.5
3	246	225	144.5	631.5
4	251	225.5	139.5	622.5
5	618	225	254	1060
6	485.5	338.5	314	1151.5



Appendix E: Romanian Post Distribution and Statistical Data

ROMANIA	Facebook, posts
Government of Romania	565
Chamber of Deputies	4
The Senate	10
Presidential Administration	0
Ministry of Transport and Infrastructure	55
Ministry of Finance	47
Ministry of Internal Affairs	125
Ministry of Foreign Affairs	74
Ministry of Justice	44
Ministry of National Defence	173
Ministry of Economy	31
Ministry of Energy	49
Ministry of Agriculture and Rural Development	66
Ministry of Environment, Water and Forests	46
Ministry for Development, Public Works and Administration	55
Ministry of Investments and European Projects	48
Ministry of Labour and Social Solidarity	47
Ministry of Health	301
Ministry of Education	55
Ministry of Entrepreneurship and Tourism	0
Ministry of Research, Innovation and Digitalization	22
Ministry of Culture	76
Ministry of Sports	77
TOTAL POSTS:	1,970

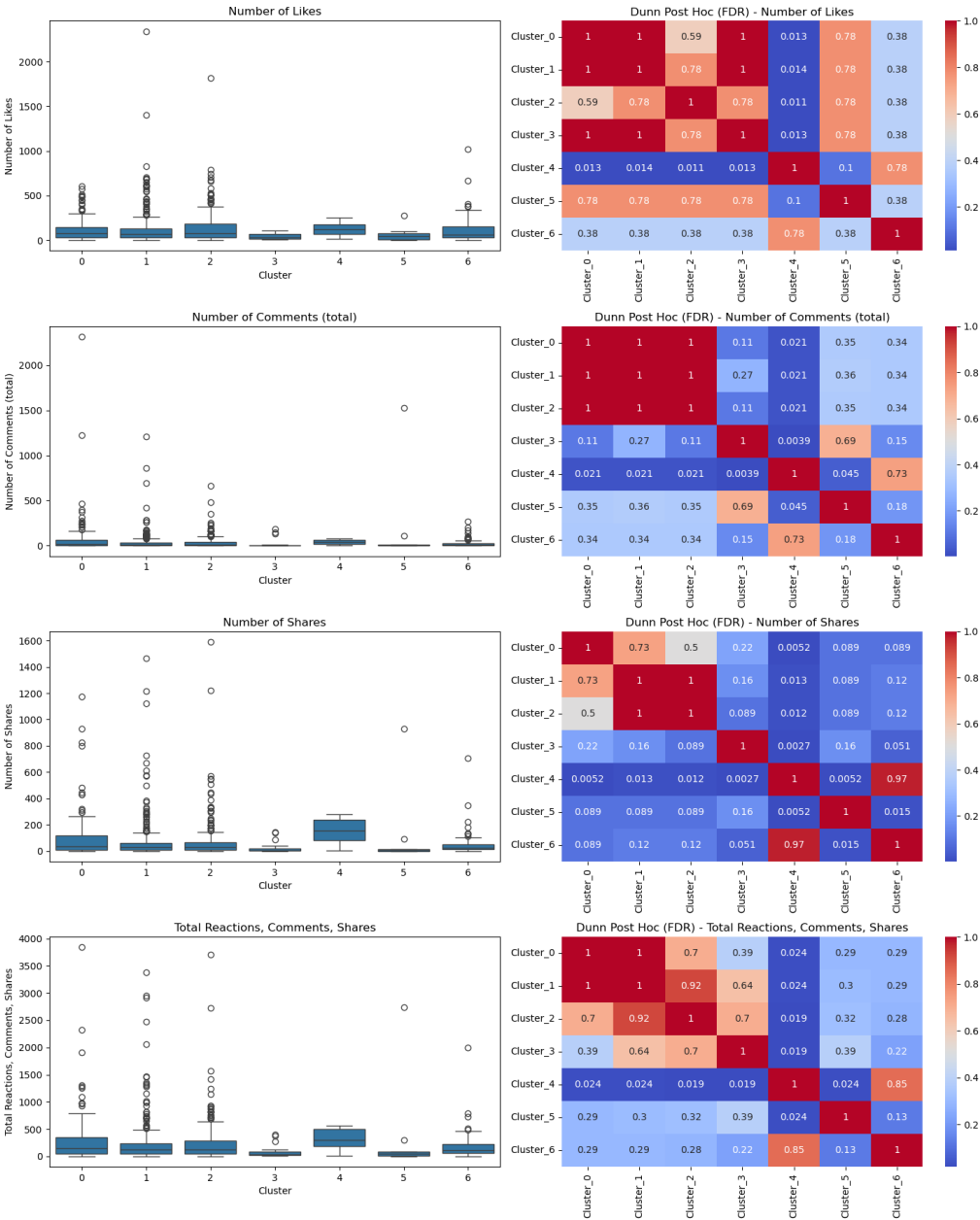
Cluster	Total Likes	Total Comments	Total Shares	Engagement
0	452,343	198,895	259,023	910,261
1	76,108	47,082	47,231	170,421
2	2,287	183	639	3,109
3	5,452	1,495	4,674	11,621
4	4,780	1,790	2,724	9,294
5	6,282	547	1,188	8,017
6	1,356	261	386	2,003
K-W	H-statistic: 51.30 p-value: 2.57e-9	H-statistic: 48.20 p-value: 1.07e-8	H-statistic: 36.13 p-value: 2.60e-6	H-statistic: 41.86 p-value: 1.96e-7
	Median Likes	Median Comments	Median Shares	Median Engagement
0	49	19	21	99
1	29	9	12.5	54
2	43	3	15	49
3	127	42.5	67	260
4	96	22.5	58	170
5	1631	142	322	2121.5
6	16	2.5	11.5	28



Appendix F: Moldovan Post Distribution and Statistical Data

REPUBLIC OF MOLDOVA	Facebook, posts
The Parliament	19
Government of the Republic of Moldova	75
Presidential Administration	54
Ministry of Infrastructure and Regional Development	0
Ministry of Foreign Affairs and European Integration	51
Ministry of Justice	2
Ministry of Health	723
Ministry of Defense	19
Ministry of Internal Affairs	9
Ministry of Education and Research	9
Ministry of Economy	3
Ministry of Finance	5
Ministry of Environment	1
Ministry of Culture	1
Ministry of Labour and Social Protection	3
Ministry of Agriculture and Food Industry	2
TOTAL POSTS:	976

Cluster	Total Likes	Total Comments	Total Shares	Engagement
0	16,555	10,803	13,607	40,965
1	46,894	13,408	26,242	86,544
2	40,678	10,177	20,423	71,278
3	768	483	494	1,745
4	765	236	913	1,914
5	610	1,648	1,061	3,319
6	13,529	2,869	5,297	21,695
K-W	H-statistic: 15.36 p-value: 0.018	H-statistic: 19.25 p-value: 0.004	H-statistic: 24.77 p-value: 0.0004	H-statistic: 16.27 p-value: 0.012
	Median Likes	Median Comments	Median Shares	Median Engagement
0	74,5	20	35,5	145,5
1	68	12	30	121
2	75	10	27	127
3	32	1	4	39
4	122,5	39	156,5	304,5
5	50	1	8	54
6	64,5	11	25	108



Appendix G: The least engaging (total of interactions / median per post) clusters – emotional clusters are highlighted in underlined bold

Country	Moderate Engagement	Total	Median	Low Engagement	Total	Median
Ukraine	0 - General vaccination content	91.938	424	3 - Protective measures and sanitation	41.761	852
				6 - Infection control and organisational support	15.666	83
				2 - Logistics and contact information	7.217	41
				<u>5 - Vaccination for specific groups and vulnerable populations</u>	<u>726</u>	<u>34</u>
Poland	5 - Registration logistics and healthcare access	180.181	389	2 - European strategies for vaccination	5.359	337
	<u>0 -Vaccination promotion</u>	<u>48.765</u>	<u>70</u>			
	<u>6 - Hospitals and community support</u>	<u>40.357</u>	<u>23</u>	<u>3 - Vaccination for specific groups and vulnerable populations</u>	<u>375</u>	<u>47</u>
Slovakia	1 - Warnings and vaccine testing	65.597	290	<u>6 - Patient care in hospitals</u>	<u>30.771</u>	<u>1151.5</u>
	3 - Disease impact and hospital resources	61.785	631.5			
	0 - Health and patient care	61.444	478	2 - Clinics and government officials	11.253	177.5
Romania	<u>3 - Vaccination and promotion campaigns</u>	<u>11.621</u>	<u>260</u>	2 - Prevention on participation in public events	3.109	49
	4 - Pandemic updates and news	9.294	170			
	<u>5 - Returning to normal life and resilience</u>	<u>8.017</u>	<u>2121.5</u>	6 - Post-vaccination issues and medical professionals	2.003	28
Moldova	0 - Vaccination accessibility	40.965	145.5	<u>5 - Vaccination efforts and European Integration</u>	<u>3.319</u>	<u>54</u>
	6 - Government involvement in vaccination	21.695	108	4 - Digital vaccination infrastructure	1.914	304.5
				3 - International vaccination initiatives	1.745	39